



Australian students' Information and Communication Technology (ICT) use  
in middle school and at home

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for the degree of Doctor of Philosophy

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## **Statement of originality**

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

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## **Abstract**

Over the past three decades Australian governments, school systems and schools have made considerable investments in providing information and communication technology (ICT) to support teaching and student learning. These investments have been strongly endorsed by national and international organisations, as well as by businesses and schools themselves. Key rationales for providing ICT in schools have been to enhance the quality of teaching and students' learning; to prepare students for participation in the emerging knowledge economy; and for participation in life-long learning. Previous studies have provided accounts of the use of ICT in schools and classrooms, yet the literature and findings from the current study indicates that the use of ICT in Australian schools is not a daily occurrence; nor is it transformative. In particular the literature and the current study reinforces the need for a number of ICT inhibitors to be overcome before the potential of ICT to transform teaching and students' learning can be realised.

This study sought to understand how six Australian schools used and viewed their use of ICT for teaching and students' learning from the perspective of parents, students, teachers and the school principals. These issues were investigated using a case study survey methodology involving 84 parents (guardians), 120 students, 56 teachers and 6 school principals across two Australian states, Tasmania and Victoria. Data were analyzed using inferential and descriptive statistics and structural equation modeling procedures. There were five main findings: (a) parents who were involved in school decision-making were more supportive of school uses of ICT than the less involved parents; (b) students who used ICT at home more frequently tended to use the same technologies at school and were more confident users; (c) younger teachers, female teachers, and teachers who had worked in four or more schools or regional schools were more positively disposed towards the use of ICT in their teaching practices, than their colleagues, although teachers with good ICT skills felt that technology could be a distraction for students' learning, (d) principals were supportive towards the use of ICT in their schools and provided staff with equipment, ancillary support staff, and teacher professional development opportunities, and (e) there was an iterative interaction between ICT and home and

school use, particularly in terms of ICT that was used for producing an assessable assignment and an output that linked to the students' writing of text, use of visual media and multiliteracies, seeking new information, and using software to solve problems. Schools played a major role in enhancing students' confidence about ICT, while home provided opportunities to practice with that technology and to facilitate communication using ICT. An important finding was that both home and school enhance students' ICT skills and make the student a more independent learner and user of ICT.

Whilst the current study identified that teachers were not yet taking full advantage of technology's ability to offer students a greater variety of learning experiences and learning opportunities, the school principals reported that in the future their schools would offer students more access to online resources, more remote access to these resources, more opportunities for learning, and a change in the pace of learning. To improve teachers' use of ICT in their classroom this study recommends the adoption of a cyclic process for continuously adapting to ICT, based on review, application and innovations. This model for evaluation of the application of ICT into schools incorporates the elements of: the needs of the students; the planned use of the technology into the students' program, the social support and resource structures of the home and the community and their ICT expectations, and the inter-relationships between these elements.

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## Glossary of Terms

Term	Abbreviation	Explanation
Actor		A person, group, organisation, technology, or system that affects or can be affected by another actor's actions.
Digital divide		Differences in ICT access and capabilities in society.
Digital immigrant		Someone who has not grown up in the digital age, typically born before 1980.
Digital native		Someone who has grown up in the digital age, typically born after 1980.
Governance		Decision making within a school that shapes the provision, capabilities and functions within the school.
Information and communication technologies	ICT	The items of equipment (hardware) and computer programmes (software) that allow us to access, retrieve, store, organise, manipulate, share and present information electronically.
Interactive Whiteboard	IWB	A touch-sensitive projection screen that allows the user to control a computer directly by touching the screen.
Pedagogy		The strategies and approaches teachers can use to engage students in learning.
Personal Digital Assistant	PDA	Personal digital assistants are portable data-centric devices designed for on-the-move computing and communications.



<b>Term</b>	<b>Abbreviation</b>	<b>Explanation</b>
Professional development	PD	Post qualification training opportunities, also called professional learning.
Reliability		The extent to which ICT processes and equipment perform as and when expected
Teacher		Title of person working with pupils/students in school settings, used interchangeably with educator or practitioner.
Working knowledge		Knowledge required for selecting, operating and troubleshooting ICT.

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## **Chapter 1 Introduction**

### **Introduction**

National and international reports and inquiries record the need to improve opportunities for individuals to engage in ongoing learning throughout their lifetime. For many, this process begins in school and in the 21<sup>st</sup> Century, it is often associated with Information and Communications Technology (ICT). Technology in turn is being seen as a vital tool to facilitate learning and to foster commerce, industry and personal lifestyles. The beliefs in the empowering nature of technology have reached the point where it has been said that to operate effectively in the 21<sup>st</sup> Century individuals must be able to “utilise technology effectively” (UNESCO, 2008, p. 1) and ICT in the education sector is an essential skill and tool for students and teachers to use (Cepeda, 2006; Stier, 2010). The 21<sup>st</sup> Century, unlike previous centuries which were more reliant on agricultural and manufacturing production, is more reliant on information and processes to convert information into knowledge, giving rise to this century being referred to as the “knowledge economy” or “digital economy” (Cepeda, 2006; Davenport & Prusak, 2000; Dolence & Norris, 1995; OECD, 1997; Stier, 2010). As a result, the education sector is being asked by governments, businesses and the wider public to embrace ICT as a means of achieving economic growth and prosperity through information management and lifelong learning (CEO Forum, 2001; Hargreaves & Shirley, 2010; Kenelev, Kommers, & Kotsik, 2004).

The advent of the knowledge economy, globalization, the rapid advance of technology and the pressures that technological change exerts on labour markets is helping to transform work practices. This is resulting in increasingly technology savvy individual and ‘customers’ placing increased pressure on organisations and individuals to apply the latest technology (Hargreaves & Shirley, 2010; Liao, 2003; Lin & Pervan, 2003; Pearlson & Saunders, 2006; Peppard & Ward, 2004). This pressure is also an influence on schools to incorporate more ICT into their educational program (Australian Council of Deans, 2001; Downes, Khun, Scott, Leonard, &



Warhurst, 2003; King, 2000; Meredyth, Russell, Blackwood, Thomas, & Wise, 1999; Office of the National Education Commission, 2004). To handle these increasing pressures and expectations, organisations and in particular schools have had to optimize their understanding and use of ICT. This recognition that ICT is changing how work is performed and managed and, in teaching terms, how students can learn, is evidenced by the enthusiasm with which governments and schools have embraced ICT through hardware and software purchases. In understanding how to better optimize technology use within the education sector, requires an understanding of this sector together with a broader understanding of the educational context that encapsulate the school as an organisation (Orlikowski & Barley, 2001); technology users, such as teachers and students (Lamb & Kling, 2003) and the technology itself (Orlikowski & Iacono, 2001). This thesis therefore encompasses three distinct, but integrated, research domains:

1. education;
2. learning environments, and
3. information systems (IS)

For this study, linking these domains has involved an interpretative case study of six Australian schools that aimed to depict and analyse information obtained on the technology used by the teachers and students; and the expectations of the schools' principals during the data collection period 2006 to 2007. The majority of the literature and policies cited in this study were therefore taken from those that were readily available. This approach was taken in order to contextualise the study data and findings with the literature that was 'in play' at this time. From this analysis, factors were elicited that aimed to explain the teachers' usage (or non-use) of ICT and the role of school management in teachers' decision-making. The literature review (Chapter Two) will reveal a paucity of systematic research studies and a lack of clarity associated with the three areas, especially within an Australian context.

The claim is that the Australian education sector is confronted with a multitude of challenges ranging from curriculum changes, an ageing workforce, through to pressure from governments and industry to produce students who are more capable and 'job ready'. These pressures are further compounded by a greater public demand to educate and prepare students to meet future societal challenges and expectations (Chalmers, 2001; Hancock, 1993, Hattie, 2009). In order to meet these challenges society and the business sector have embraced ICT to help meet current and future requirements. This in turn places additional expectations on the education sector to use ICT and to prepare students who are technologically capable and well informed (Department of Education [DoE]-Tasmania, 2000, 2002a/b; Grabe & Grabe, 2001; Kumar, 2002; Milis & Mercken, 2004; Sherman, 2000).

Initial enthusiasm for ICT in the education sector included predictions about how it would make teachers' jobs easier, allowing more time for individualised one-to-one teaching. For students technology was meant to change how and when they learnt, making learning more personal and lifelong. Experience, however, would show that such predications were naïve (Hattie, 2009; O'Rourke, 2003), as technology, for all its benefits, can only ever be an enabler and a supporting element in the education of students (Lehaney, Clarke, Coakes, & Jack, 2004). Furthermore, technology usage is highly dependent on the teachers' pedagogy (Bigum, 2001) and the internal conditions of the school (Meredyth et al., 1999). This suggests that pedagogy and school organisational conditions need to be taken into account in any study of ICT use in schools. Furthermore, the technology itself needs to be considered in any investigation of ICT use so that similar technologies can be compared. ICT has many facets and encompasses various technologies, such as computers, mobile phones, and the Internet, together with the software that makes the hardware operate. Given this variety there are a number of definitions of what is, and what is not ICT. For the purpose of this study, UNESCO's version of ICT was applied as it provides a succinct, contemporary definition:

...the tools and the processes to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic and other automated means. These include hardware, software and telecommunications in the forms of personal computers, scanners, digital cameras, phones, faxes...and DVD players and recorders...and multimedia programmes (2003, p. 75).

UNESCO's definition acknowledges that ICT is evolving at a rapid rate and that newer technologies often converge with other technologies to create new products or functions, which communicate digitally. Consequently, the current study uses the terms ICT, digital technology and information technology (IT) interchangeably, unless specifically referring to a term in the literature.

This thesis investigated and addresses the problems of technology use within schools by considering not only its use but also the technology and the culture of the school. The current chapter presents an overview of the research problem, rationale and organisational context of the study. The research problems were investigated from the perspective of three inquiry foci:

1. the current embedding of ICT in Australian schools;
2. the decision-making process that affects the extent and degree of this ICT embedding,  
and
3. the influences that affect the processes of ICT decision-making in schools.

### Statement of the problem

Despite the significant time, financial outlay and goodwill spent on providing digital technologies for schools there is a claimed inconsistency between the rhetoric that ICT will transform teaching and students' learning, and hence schooling, and the actual experiences in schools. For indeed the consultancy firm Trinitas (2001) a decade ago recommended that it was time for schools to shift the focus from the technology to its use for supporting content. Further to this, McRae (2001) at the same time reported that IT infrastructure in schools was adequate to

support the move from teaching about technology to actually using the technology to support teaching and students' learning. Supporting Trinitas' and McRae's assumptions various Australian governments have initiated technology supported curriculum projects for well over a decade (Lambert, 2001), for instance the Practical and Interactive Science Materials [PRISM - [prism.education.vic.gov.au](http://prism.education.vic.gov.au)] and the Learning Federation's online curriculum content ([www.learningfederation.edu.au](http://www.learningfederation.edu.au)) were designed to assist teachers move from just teaching the technology, to utilising it to promote students' learning.

The incorporation of ICT, or one of its derivatives IT, into Australian society has been well-reported (Alexander & McKenzie, 1998; Australian Council of Deans of Education, 2001; Larking, 2012, Lin & Pervan, 2003; Trinitas, 2001; Yelland 2001). At a school level, the incorporation of digital technologies has affected how schools operate and function at multiple levels with intended and unintentional consequences. Schools may have had to reconfigure learning spaces and timetables to accommodate ICT specific learning opportunities. In addition, teachers have had to retrain or up skill themselves through professional development (PD) to use digital technologies within their teaching practice. At the same time schools, teachers, students, parents and communities have devoted a great deal of time and money in learning about and acquiring various forms of technologies for education, work, leisure and personal pursuits. Despite the investment by governments and schools in terms of funding and policies, technology is still seen by teachers and schools as an 'outsider' in the pedagogy of schools and that this 'outside' or 'top-down' approach may be a contributing factor for the relative failure of ICT to transform schooling (Selwyn, Potter & Cranmer, 2009; Watson, 2000).

In reviewing the use of ICT in schools the literature report concerns over the effectiveness of the high cost of ICT-based programs and increasing resistance by some parents, school administrators, and educational bureaucracies to its implementation. Selwyn, Potter, and Cranmer (2009) report on ICT use by students in British schools and note, "Whilst our data

depict a generation of young people for whom ICTs are part of their everyday lives, closer inspection shows many pupils' actual engagement with ICT to be often perfunctory and unspectacular - especially within the school setting" (p. 928). Notwithstanding the findings of Selwyn et al. and others noted above, the broad spectrum of literature reviewed indicates that technology has positive outcomes for students across a range of domains, and so it is more a question of not if technology will be used but how can we facilitate its use.

### Schools and technology

The outsider view of school technology has led several notable ICT researchers to conclude that technology will not improve education unless it becomes "integrated into schools" (Hay, 2001, p. 5). Furthermore, the approach of "pasting new technologies onto existing pedagogy" (Russell & Russell, 1997, p. 130) is considered ineffective and for lasting changes to occur teachers are the key to educational change (Hargreaves, 1994), and it is not just their capacity to change but also their desire to change that is important (Donovan, Hartley & Studler, 2007).

The implementation of new technology is becoming more important to schools in order for them to prepare students to operate in a digital economy and the success of such implementations is often due to the presence of supportive school leadership and 'willing' teachers (Baek, Jung, & Kim, 2008). Just how schools should use ICT and support staff in its use though is often a contentious issue in the literature.

Given the above findings, many researchers have investigated the reasons for school technology uptake as well as the factors which have restricted or hindered this (Bateman & Oakley, 2009; Berman & McLaughlin 1977; Cuban, 1999a; Fullan & Stiegelbauer, 1991; Hall & Hord, 1987; Kinsler & Gamble, 2002; Malouf & Schiller, 1995; McLaughlin, 1991; Tondeur, Cooper, & Newhouse, 2010; Venezky, 2001; Venezky & Davis, 2001). Specifically at the institutional or school level, a significant factor is the mismatch between the technology investment and a

similar investment in training (Alexander, 1998; Bateman & Oakley, 2009; Ehrmann, 1995; Larkin, 2012; Williams, 1997). Compounding the technology-training mismatch, it would appear that some schools and teachers are being driven by the technology and not basing technology investment decisions and planning with in a pedagogical rationale (Tondeur, Cooper & Newhouse, 2010; Brown, Burg, & Dominick, 1998; Gilbert, 1996).

Some reasons for the technology mismatch may be due to a lack of models for digital technology integration into the curriculum (Northrup, 1997; Schofield, 1995) and ineffective institutional planning and communication mechanisms (Ehrmann, 1995; Lan, 1997; Middlehurst, 1995; Tondeur et al., 2010). In a similar vein, some schools systems and decision-makers have believed that technology would increase school performance and productivity, reduce operating costs and may even replace traditional teaching practices (Candiotti & Clarke, 1998, Detienne & Jackson, 2001; Ehrmann, 1995; Gilbert & Green, 1995a; Selwyn et al., 2009). These attitudes further complicate the decision about how to use ICT for teaching and student-related learning practices.

Despite the wealth of studies on technology and schools, few refereed reports were identified during the literature review that indicated that technology implementation into schools had transformed how the school operated or changed the teaching and learning process (Hattie, 2009). Yet, many references were found for the health sector (Berg, Aarts, & Van der Lei, 2010; Dardelet & Darcy, 2003) and business sector (Cumps, Viaene, Dedene, & Vandenbulcke, 2006; Lee, 2001) which articulated how technology had changed work practices and services offered. This raises an important question of why transformation is not occurring to the same extent in the education sector when it is more apparent in other sectors. In answering this question, it needs to be recognised that the education sector, as is the health and businesses sectors, is influenced by many internal and external factors that impinge on the technology decision-making process. The educational research literature (Atkin, 1997; Riedel, Smith, Ware, Wark, & Yount, 1998; Slowinski, 2010) indicated that an essential aspect for digital technology

development within a school was that the school itself needed to control and make decisions that were commensurate with its own digital technology goals. This decision-making process is therefore a critical element in embedding ICT into a school's program (Bennett, 1991; Bigum, 2001; Booth, Bowser-Riley, & Maber, 1996; OECD 1997, 2001, 2002 & 2005; Russell, G., 1999; Selwyn et al., 2009; Stier, 2010). Thus, Silberman's questioning of the value and purpose of education nearly forty years ago, in relation to educational reform or transformation, is as pertinent today as it was over four decades ago:

What is education for? What kind of human beings and what kind of society do we want to produce? What methods of instruction and classroom organisation as well as subject matter do we need to produce these results? (Silberman, 1970, p. 182).

Similar questions arise when considering the significant time, effort and money that have been spent providing digital technologies for the education sector. Littig and Griessler (2005) maintained that much of this capital investment into digital technologies by the stakeholders in schooling has been fuelled by a belief that economic and social sustainability are directly linked to technology capacities. That is state, national and international organisations place great faith in the transformative capability of technology to improve the economy and promote a citizenship of lifelong learners (ISTE, 2008a; Slowinski, 2000). As such, it is possible that technology is being procured for pragmatic reasons in the conviction that aspects of the educative context might be enriched, controlled, or stabilized for better professional practice and student outcomes by the presence of the technology. This commitment to technology capacity development is considered to be driven by a multiplicity of motivations and often with little thought for unintended and unintentional consequences. For instance, beliefs regarding the empowering good of ICT, and the immediate solution of ICT is often in contrast to the lack of evaluation of these beliefs (Phillips & Merisotis, 1999; Russell, T., 1999).

Given all these facets, there is an increasing concern, perhaps even scepticism, regarding the benefits and value of pouring so much time, effort and money into providing digital technologies for the compulsory education sector. For this study the compulsory education sector is defined as students usually aged from five to sixteen (primary and lower secondary) and upper secondary education usually aged from 16 to 18. This period of education is also referred to as K-12 education, following US terminology. Issues of quality, effectiveness, efficiency, cost, equity, access and return-on-investment soon begin to overshadow the initial enthusiasm and novelty for the technology innovation (Anderson, Johnson, & Milligan, 1999; DEET, 2004; DEETYA, 1999a; Mouza, 2008; Donovan et al., 2007). This in turn has led some administrators and policy-makers across all education sectors to question the value of the technology investment in terms of return-on-investment by asking who is benefiting from the technology innovation:

- the students?
- the institution?
- or the technology creators and sellers? (McKenzie, Alexander, Harper, & Anderson, 2005; Alexander & McKenzie, 1998; Schofield & Olsen, 2000)
- and does the use of technology make any significant difference to students' learning? (Russell, T., 1999).

Thus, when it comes to the development, integration, embedding and subsequent management of digital technology in the education sector, questions persist around the underlying rationale that is driving the educational technology transformation (McKenzie et al., 2005). More specifically, questions concerning:

- How teachers and students use digital technologies in their schools?



- What are the promoters and inhibitors for this to occur? and
- How are stakeholders in the education process (specifically school administrators, teachers, students and parents) involved in the ICT decision-making process?

Answers to such questions will provide teachers and school administrators with a better understanding of what ‘teachers are actually doing with ICT in the classroom’. This information can then be used to help support teachers in becoming more confident, competent and productive users of classroom-based technologies.

Such, the current study recognises that there are many factors outside and within the school, which influence technology use and decision-making (Atkin, 1997; Mitnik, Nussbaum, & Soto, 2008; Slowinski, 2000). However, as the literature review will indicate, the majority of the technology ‘push’ is for technical use rather than a ‘tool’ based approach. A ‘push’ is often driven by others rather than “the pedagogic staff that learn and say how they want it [the technology] to work” (Selander, 2003, p. 9). So perhaps Riffel and Levin (1997) were right when they noted that the problem of ICT integration is that the technology has been seen as an answer, rather than a question about the role of technology in supporting education.

The successful implementation of technology is important for schools. This is often dependent on effective leadership, the presence of teaching staff who actively and enthusiastically promote the new technology and an understanding of technology promoters and inhibitors. User competence in the requisite domain, such as teaching or learning with ICT, is an important factor influencing intention to champion an innovation. In this respect many researchers have suggested a number of theoretical models or frameworks to help categorise technology users.

This categorising of users as ‘leader’, ‘follower’ or ‘technophobe’ whilst useful in designing future professional learning activities fails to fully appreciate or consider the numerous conditions that need to be met before the technology innovations can be introduced, adopted and diffused through an institution. The literature review chapter examines several of the dominant theoretical frameworks that are used to categorise ICT users but this is not the intent of the current study which is more concerned with understanding what is currently being done with ICT and what hinders ICT uptake in schools. So for someone to be confident enough to champion technology in an organisation, such as a school, they need to have a certain level of ICT competence and be able to overcome personal and institutional barriers to ICT adoption. Many of these issues are looked at in the current study in order to further progress our understanding of ICT in schools.

### Research objectives

The overall objective of this research is to better understand how digital technologies are being used in schools. This objective is important because Shakeshaft (1994) reported that “just because ICT is present doesn’t mean that it is being used” (p. 4). Therefore, an improved understanding of how ICT is being used will help facilitate the maximization of the potential for technology use, and provide an effective guide or model for successfully utilising the available technologies. In light of these objectives the literature review (Chapter Two) assists in the framing of the research questions, and by association the research objectives.

### Research questions

Organisations, and in particular schools, have to re-examine their existing structures and practices to realign themselves to the knowledge economy which is heavily reliant on digital technologies. This realignment requires a transformation of how decisions are made and implemented. For some organisations, this may be a major transformation in itself (Dolence & Norris, 1995). With this in mind, the main question for this research was:

*RQ1 How can schools successfully embed digital technologies for teaching and students' learning?*

This overall research question was then broken into two subsidiary questions, which focused on: (a) the current use of technology and (b) influences on the use of that technology.

A better understanding of the nature of technology usage and how decisions are made to use that technology can form a strong basis for understanding, not only current practice, but how to improve that practice. Following this line of thought, the subsidiary research questions became:

*RQ2 How are schools utilising digital technologies for teaching and students' learning?*

*RQ3 What are the inter-relationships between teachers' and students' background, access to technology, and attitude towards technology?*

The problems and supporting literature associated with each of these questions are addressed throughout the thesis and discussed in detail in the final chapter of the thesis (Chapter Five).

## Contribution to research and practice

The study adopts a broad view of knowledge, extends existing knowledge about digital technology use, and facilitates a better understanding of the role of ICT in schools. Therefore, the study seeks to contribute to scholarly and practitioner understanding of digital technology use in schools. It will do this by examining the relationships in school ICT decision-making process, and investigating the inter-relationships between a number of factors (variables) which the literature suggest have an effect on ICT use in schools.

The findings of this study may offer insights and guidelines for improving current practice and planning for future developments. As such, this study will contribute to research (literature and theory) and practice (literature and guidelines). These contributions are summarized in the final

chapter of this thesis (Chapter Five).

## Overview of the thesis

The thesis is organized into five chapters. Chapters One to Three provide the background, framework and context for the study, while Chapters Four and Five present the analysis, interpretations, and study findings. The outline of the thesis is:

Chapter One has reviewed the background to the study and provided an outline of the research questions and research approaches. This introductory chapter also outlined the structure of the thesis. Throughout this first chapter, a number of issues associated with digital technology decision-making and subsequent educational use were highlighted. In particular, how the technology was being used in schools, what were the benefits of using that technology, and who were included in the technology decision-making process. Each of these areas is examined in the proceeding chapter.

Chapter Two examines the literature to identify the current and historical aspects of technology, especially as it relates to education and how these changes are affecting the education sector. The issues of innovation and change are discussed with particular reference to how they are conceptualized and decisions made with regard to the use and embedding of digital technologies for teaching and students' learning in the compulsory education sector.

Chapter Three describes the research methodology adopted by this study and outlines the design, describing each of the key research stages. This is followed by a description of the data gathering methods and instruments as well as the processes involved in managing, analysing and storing the data. The ethical issues and the problems encountered in the study are presented at the end of the chapter.

Chapter Four presents the results of the study, which are shown according to the research

instruments used. In particular, it provides various background information on the study data sets and all research instruments, and how they were combined to provide a comprehensive picture of how each case study site utilised digital technologies in their teaching and students' learning practices.

The interpretation and analysis of the results, are discussed in the final chapter (Chapter Five), and provide for a number of assertions that have been derived from the research questions. The Chapter also presents the conclusions drawn from the research findings, implications, limitations and strengths of the study, and suggestions for future research.

### Chapter summary

This Introductory Chapter to the thesis began with the background to the study and provided an outline of the research questions and research objectives. Following this, the research and practical contributions of the study were identified. The Chapter also briefly introduced the thesis outline. In the next chapter (Literature Review), the contextual and conceptual factors that have had a bearing on the study are introduced and described.

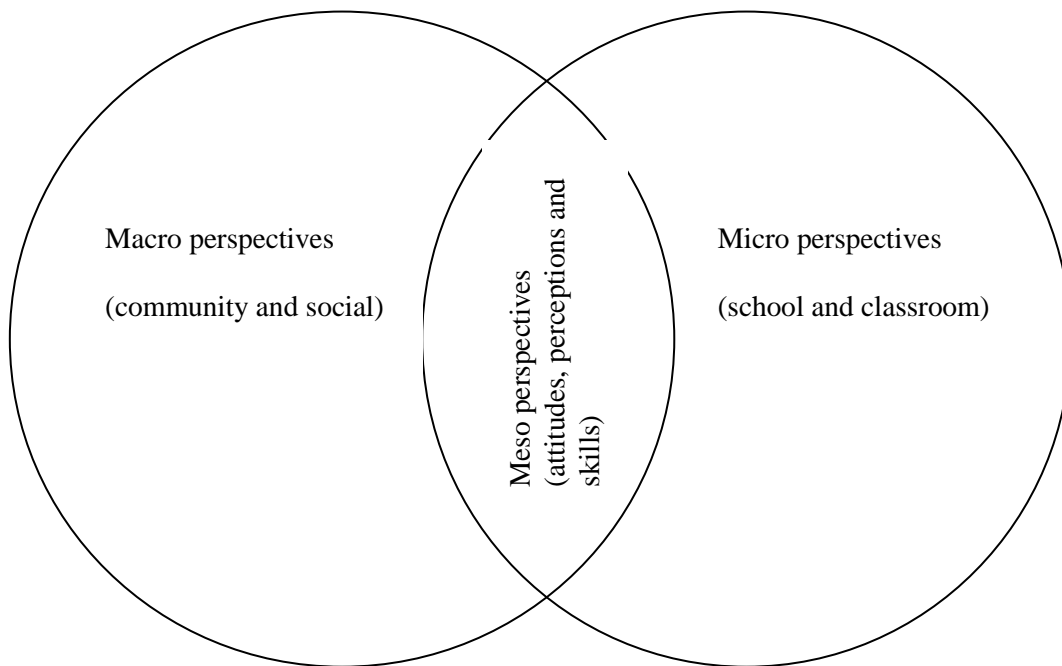
## **Chapter 2 Literature review**

### **Introduction**

Renowned journalist and education critic Charles Silberman in the 1970's asked what is education for and what kind of society do we want to produce (1970, p. 2). In questioning the value and purpose of schooling Silberman was asking how schools can prepare students for their future roles in society.

In attempting to understand this question in the digital age this chapter contains a review of the literature that considered the purposes of education; the role of ICT in 21<sup>st</sup> Century schooling; how schools cope or adapt to changes, and what hinders school change (particularly ICT based changes), with a particular focus on the literature and policies that were readily available during the time the data for the current study was collected in 2006 to 2007. More contemporary literature has subsequently been reviewed to reframe, support or discredit the earlier studies.. In doing this literature review the initial attempt was to categorize this literature around 'neat' and discrete organisational boundaries. What eventuated, however was a better understanding that 'packaging' the ICT and school literature into discrete and standalone sections was doing the literature and the research aims an injustice. The term injustice implies that no good would come out of such an approach. Instead the literature review started to come together as a series of interrelated elements and elements that were considered internal to the school and external to the school and a combination of the two (Figure 2.1).

That is these factors would be considered as external factors (macro) to each school, internal factors (micro) that include the school and its community. The intersection of each of these factors termed "meso" is how external and internal factors interact to affect the use of ICT by teachers and students.



*Figure 2.1 Literature review elements*

This “triumvirate” interactive model suggests that each element, whilst important in its own right, is interdependent on the other elements, and by considering each in isolation then in unison, a fuller understanding of how each influences ICT use in schools can be achieved. For instance, the macro perspectives represent the broader picture of education and change, in effect societal issues. The micro perspectives represent individual site, or school level (organisational) characteristics which have an impact on teachers’ use and understanding of how to incorporate ICT into their teaching. The interconnection of the two elements, meso, refers to how individuals react to societal and organisational influences to incorporate ICT into their teaching practices.

Each of the elements, or discourses, came together to help shape the philosophical and methodological design or structure of this research study, and in so doing guided the formulation of the study’s research questions. In order to understand how these questions were derived from the literature review, this chapter presents each element separately (as illustrated in Figure 2.1) but aims to bring these elements together to frame the research questions.

For instance, the first section (macro perspectives) describes change and educational re-culturing as a result of the introduction of ICT into the compulsory educator sector, and as such examines the rise of the knowledge economy; ICT diffusion, and ‘winds of change’ affecting ICT and schooling. The second section (micro perspectives) examines the literature related to the use of ICT within schools, and the associated infrastructure that goes into supporting the technology. The third section (meso perspectives) reviews the literature describing the up-skilling of teachers as a result of the introduction of ICT into schools, and the factors which inhibit or promote teachers’ use of the available technology. At the conclusion of the chapter a summary of the main issues identified in the literature review is provided and discussed.

The review of the literature will reveal that the use of digital technologies for teaching and students’ learning purposes is shaped by broader processes of globalization, development, transfer of ICT innovation, and micro-processes of change within organisations and individuals. These aspects in turn influenced the design of the research questions, research design and methods utilised for data gathering, analysis and reporting.

### Macro perspectives: Change and educational re-culturing

Throughout time the introduction of any new technology, whether a weaving loom, a horseless carriage (motor vehicle), or a computer, results in a change in societal attitudes and roles. In terms of schooling, technological changes have occurred due to the introduction of the printing press (hence books), slate boards, the biro and now ICT, specifically computers and the internet. At the same time there have been protagonists espousing the introduction of technology and the benefits that it brings to the teaching and students’ learning process. Simultaneously, antagonists have been advocating that the technology will be a hindrance, or the ruin of schooling. In this regard research on using technology in schools for teaching and students’ learning has grown in importance since the first computer was introduced into Australian



classrooms in the 1980's. Since then the relative importance of technology has grown to the point that the absence of technology, specifically computers, in schools would be the exception. Within Australia the importance of ICT in the education sector has recently culminated in the Federal Government's \$2 billion *Digital Education Revolution* which seeks to improve the access and usage of digital technologies in schools with the purpose being to "prepare students for further education and training, jobs of the future and to live and work in a digital world" (Australian Government, 2008, par.1).

This *Digital Revolution* commences the first section of the macro level perspective; that is the rise of the knowledge economy which is followed by ICT diffusion and political pressure. The next macro level perspective relates to ICT as a catalyst for change.

### The fall of the industrial society and the rise of the knowledge society

Probably for as long as society has been educating its citizens, humans have relied on some form of technology to assist in the process of teaching. Books, pens and writing paper were to revolutionize the 19<sup>th</sup> Century education system, in much the same way as radio, television and films were to transfigure the 20<sup>th</sup> Century (Cuban, 1986). Similarly ICT, specifically computers and the internet, are meant to transform schools in the 21<sup>st</sup> Century (Australian Labor Party, 2007; Kerry & Isakson, 2000). Such beliefs give rise to assumptions that with the growth of ICT the image of the classroom will change (Kook, 1997). Transformative change, however, has not always occurred as widely in schools as it has in other sectors. For instance, in the business (Brynjolfsson & Hitt, 2000) and health sectors (Silber, 2004) the introduction of ICT has changed work practices, employee duties and altered the type of services being offered or produced. However in schools, despite the educational advances that computers or peripheral devices such as data projectors may have, not every teacher uses them. This being said, there are a number of factors affecting the 'inner life' or operation of schools which find their origins in the *knowledge economy* (Gibbons, Limoges, Nowothy, Schwartzman, Scott, & Trow, 1994).

The key characteristic of the knowledge economy lies in the belief that wealth (or productivity) is increasingly dependent on the development and application of new knowledge by specialist knowledge workers and that a nation's capability to apply this new knowledge is essential to its economic growth and development. To this end, economies in the 21<sup>st</sup> Century (or the digital age) are increasingly being built on a foundation of information, learning and adaptation. As a result the quantity of knowledge and the production of knowledge is accelerating, which is due to advances in the use of technology (de Weert, 1999; Scott, 1997), giving rise to the concept of the knowledge or digital economy.

In relation to the rise of the knowledge economy, globalization (the intensification of international competition in business and industry) is seen as the driving force behind a significantly increased trade in 'marketable knowledge' (Gibbons et al., 1994). To the extent that businesses wishing to compete in the global economy will have to possess the organisational abilities (knowledge) to enable them to maintain or increase their competitive advantage in an ever increasing global environment (Gibbons et al., 1994). Workers in this global marketplace in turn need education and training to help them obtain the necessary skills and knowledge to operate in a digital economy.

For schools to help prepare students for life and work in the new knowledge economy, they will have to take on-board teaching and students' learning practices that incorporate the use of ICT. In other words, school practices will need to use ICT in ways that students and society (especially business and commerce) use those technologies for communication and knowledge production. For schools to strengthen their role in the knowledge economy they will have to re-examine how they operate and use ICT. These aspects have been recognized by school systems. For instance, in Australia the Australian Council of Deans of Education (2001, pp. 85-86) pointed out that knowledge is highly situated, changes rapidly and requires doing things in different ways and contexts, aspects that Australian State and Territory education systems are

taking on-board with recent curriculum reforms (Brennan, 2000). Central to Australian curriculum reforms is the notion that learning not only occurs within formal classrooms, but also in environments outside of school, for instance, in the family home, at work or with friends. As such, students' learning is a lifelong process and schooling in the 21<sup>st</sup> Century needs to recognize this phenomenon and build on the capacity for students' learning to occur in multiple ways; in numerous environments, aspects which encapsulate the notion of lifelong learning.

### Lifelong learning

Lifelong learning is the recognition that learning may occur in any setting and that learning is a lifelong process. As such, schools need to recognize that students come to school with a variety of experiences with technology and ways of learning (Field, 2000). The development of lifelong learning is not the only challenge that schools are encountering in the 21<sup>st</sup> Century. Other changes relate to when and how students may participate in their education. In a traditional context, compulsory education (grades K-12, 5 year olds through to 18 year olds) provided students with the learning needed for future careers and lives (Hancock, 1993; Middlehurst, 2003). Even so the claim is that schools are changing resulting from:

- students with more diverse backgrounds;
- changing roles of teachers/instructors;
- more flexible curricula, new delivery methods;
- new contacts between schools and other partners, and
- the globalization of education (Guri-Rosenblit, 1998).

As a result of the above changes the role of the teacher is shifting from being the *sage on the stage* to *guide on the side* as teachers move from traditional roles of information giver to facilitator, guide, co-learner, mentor and information resource manager (Dyril & Kinnaman, 1994; Perkins, 1991; See, 1994). In order for teachers to change they must be supported in an

organisation that is also willing to change and embrace innovation (Hall & Hord, 1984), and one of these innovations is using ICT.

ICT is therefore seen as transforming the way individuals live and learn (New Zealand's E-Learning Advisory Group, 2002). In the education sector the use of technology has been widely promoted since the 1980's as a tool that will improve access to knowledge, as a medium to improve collaboration and interactions through the ability of technology to transmit content through a variety of formats (Jenkins, 1999). At the forefront of the educational technology revolution is the belief that teaching with ICT is "an important catalyst and tool for introducing educational reforms that change ...students into productive knowledge workers" (Pelgrum, 2001, p. 163). This kind of revolutionary change indicates, for many, that the introduction of ICT will transform teaching and students' learning (Dawes, 2001; Massy & Zemsky, 1995).

The axiom that technology will change the way teachers and students' learn has been widely espoused for many decades. Indeed, in the 1920's Thomas Edison predicted that the motion picture would transform the education system and that within a few short years it would "supplant largely, if not entirely, the use of textbooks" (Oppenheimer, 1997, p. 45). The motion picture, like radio, television, computers and now the internet and multimedia capable computers, have all been seen as a possible panacea for improving teaching and students' learning. To date though, the rhetoric of technology transforming the education sector has not been fully realised (Cuban, 2001, Cuban, Kirkpatrick, & Peck, 2001). Despite this, technology can provide a tool for lifelong learning which the United Kingdom's ICT agency, (British Educational Communications and Technology Agency [BECTA], 2001) believed can be fostered through linking school use of technology with outside school use. In this regard ICT is being seen to provide opportunities for not only strengthening home-school links but it is also perceived as a "rapprochement between formal education and the learning that takes place outside the school" (BECTA, 2001, p. 101), facilitating lifelong learning.

Despite the benefits that ICT offers for lifelong learning and for preparing students for their future lives in the knowledge economy, schools appear to have remained relatively stable or unchanged in spite of the significant societal changes that technology has brought elsewhere (i.e. business, health and personal lives). This perceived ‘lack’ of change or transformation gives rise to the notion of the *immovable object* status which reflects schools being slow or reluctant to change.

### The immovable object - schools in a changing environment

An organisation, such as a school, is not an entity on its own; it has to interact with its environment, locally and globally. Indeed, an early educational reformist Malcolm Skilbeck (1979) succinctly referred to schools as organisations devised by society to achieve broad purposes for the education of its members. In the context of the current study, this was taken to mean that the purpose of schooling is to prepare students for their future work and personal lives in an ever increasing digital world.

Given that schools must operate in a broader society, the influences of that society impact on the teachers and students of the school. Schools have to react to these changes. Sometimes they may want to anticipate changes and adapt in advance of crises.

In considering schools and ICT, governments play a vital external stakeholder role in influencing schools’ adoption of technology. The influences of government on education in the United Kingdom have been well described by Wallace (1997) whilst Chapman, Gaff, Toomey, and Aspin (2005) have described how the Australian Commonwealth and State governments are implementing policies to capture the notion of lifelong learning. What these studies reveal is that governments, through policy and funding, play a key role in determining how schools operate. For instance in Australia, the Hobart (1994) and Adelaide Declarations (1999) (MCETTYA, 2008) agreed to by all Australian State and Territory Governments in conjunction

with the Commonwealth Government, set out a national policy plan to cater for the diverse learning needs of students and how students' learning would be measured and reported. Both meetings also agreed to continue the status-quo of State Governments controlling the financial and policy directions of schools. From such meetings individual state education departments set out their own individual technology plans. For instance, Tasmania's *ICT in education strategic policy 2002-2005* indicated the Department's commitment to using ICT in Tasmanian schools, and in particular for using 'proven' technologies:

Goal 5: Practice which is informed by evaluation and research

c) Strategic research and development programs will be undertaken, particularly in relation to identifying how to maximize student outcomes through ICT use (Department of Education, Tasmania, 2002a, p. 9).

No explanation was given on determining "proven technologies" leaving this up to individuals and schools. More recently, Australian State, Territory and Commonwealth Education Ministers met and reaffirmed the public (government) education sector's commitment to learning with technology as a means of ensuring its citizens will be capable workers in the new knowledge economy (Melbourne Declaration, 2008). This meeting also affirmed the need for school technology to be reflective of those types of technologies that students would encounter in their future working and personal lives.

The Melbourne Declaration (2008), as previous Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) declarations, is the Australian education sector's attempt to align government education policy to economic imperatives. In this instance MCEETYA supported the desire for all Australian students to become lifelong learners and capable users of technology. The Education Ministers' belief was that this would help produce individuals who would be more productive workers in the new information dependent economy.

At the centre of creating a competitive advantage is the conviction that ICT has the “potential to contribute to more rapid growth and productivity” (OECD, 2001, p. 21). Within an education context Australian government education policy espouses that students should leave school as “confident, creative, and productive users of...technology” (Toomey, 2001, p. 2). This policy commitment has also been associated with financial injections of funds to schools to provide increased student access to technology, specifically computers. Government commitment via policy and funding reflects belief in the correlation between technology and economic prosperity (Dawkins, 1988; Twigg, 2005) something which has also been identified in the business sector as a way to improve efficiency (Robertson, Grady, Fluck, & Webb, 2006).

Associated with the empowering belief for the transformative capacity of ICT on education, governments worldwide have been committing large sums of money and resources towards providing more ICT resources to schools. For instance, former United States President Bill Clinton doubled spending on providing ICT resources for schools to USD \$425 billion (Sartore, 1997). At the same time, Australian States also increased their commitment to improving the ICT resources available in schools. For example, Tasmania and Victoria commenced the ‘roll-out’ of laptops to teachers (Department of Education, Tasmania, 2002a; School Education Initiatives, 2000). Similarly, the United Kingdom had expanded their laptop computer for teachers program (BBC News, 2002, p. 1).

More recently, former Australian Prime Minister Kevin Rudd initiated a \$2.4 billion education revolution, of which \$2 billion has been set aside towards providing computer access to every student from grade 9 through to grade 12 (Archer, 2007; Australian Labor Party, 2007; Coorey, 2007).

This significant investment in providing ICT in the education sector is occurring at the same time, or perhaps is occurring because of it, as the western world is transitioning from the Industrial Age to the Information Age, with much of the transition being ameliorated by

technology (Capra, 2002; Tong & Trinidad, 2005). An example of this is what Gibbons (1995) called 'social accountability', which is the growing awareness about the variety of ways in which advances in science and particularly technology can affect the public interest. This awareness leads to the conviction that education, especially in the secondary years, should be relevant to the labour market and to economic growth (Meek & Wood, 1998; Middlehurst, 2003). Accordingly, Goedegebuure and De Boer (1996) noted that there was also a trend towards increased accountability in terms of value for money. Adding to these pressures is that technologies are not neutral objects, as each form of technology brings with it values and practices which "either support or subvert...and that the failures of technology to alter the look-and-feel of schools...result from a mismatch between the values of [the] school...and those...embedded within the...technology itself" (Hodas, 1998, p. 3).

Supporting the assertion that the education sector is coming under increasing market pressures Williams (1995) acknowledged that almost all member countries of the Organisation for Economic Co-operation and Development (OECD) had experienced an increased exposure to global market forces. These challenges are multifaceted and include catering for a more transient population; a population that is becoming increasingly technologically capable, and a population that is increasingly having more leisure time and disposable income. What this indicates is that in a global economy the compulsory education sector has to deal with the fact that the characteristics of its students are changing. For instance, primary aged students are coming to the classroom with a broader understanding of the world around them and their particular place within the world, which has mainly come about by the increased use of technology and mass communication, such as television and the internet (Cole & Pullen, 2010; Coorey, 2007). This in turn implies that students are coming to school with a broader understanding of how to use technology. This immediately implies that these learners need a higher level of flexibility of time, space, content, types of study materials and assignments so that schooling reflects students' use of technology outside of school and the needs of a global economy.



Given the impetus from governments, the business sector, and social commentators for digital technologies, IT has become ubiquitous in most western developed societies and its absence in schools and workplaces in developed countries would be an exception (New Zealand Ministry of Education, 2003). This on-going pervasiveness of technology represents both a major on-going challenge and an exciting opportunity for the education system.

The challenges and opportunities afforded by ICT are often related to how governments believe the technology can transform the students' learning process. For example, similar to Australia (MCEETYA, 2008) in New Zealand (NZ) the Ministry of Education outlined a vision for the use of ICT in government schools. New Zealand's ICT education vision states that all students, irrespective of their backgrounds, with the assistance of ICT should be able:

- to develop their knowledge, understandings, skills, and attitudes;
- to participate fully in society;
- to achieve in a global economy, and
- to have a strong sense of identity and culture ( NZ MOE, 2001).

During the same time period the United States' Department of Education outlined its national ICT plan:

- Goal 1: All students and teachers will have access to information technology in their classrooms, schools, communities and homes.
- Goal 2: All teachers will use technology effectively to help students achieve high academic standards.
- Goal 3: All students will have technology and information literacy skills.
- Goal 4: Research and evaluation will improve the next generation of technology

applications for teaching and learning.

- Goal 5: Digital content and networked applications will transform teaching and learning (USA-DoE, 2000).

Similarly, in 2000 the Australian Commonwealth Department of Education, Training, and Youth Affairs (DETYA) produced the publication *Learning for the Knowledge Society: An Education and Training Action Plan for the Information Economy*. This plan established a framework for stakeholders to:

. . . ensure that all citizens possess broad literacy, numeracy, and technological literacy skills for life, work, and lifelong learning and that there are adequate numbers of people with the specialist skills needed by the information and communications technology (ICT) industries . . . (DETYA, 2000).

The Australian ICT plan designated five key areas or priorities which need to be identified and addressed in implementing ICT in schools:

- people;
- infrastructure;
- online content, applications, and services;
- policy and organisational framework, and
- regulatory framework.

In examining these three national ICT plans it becomes evident that New Zealand's national ICT policy seeks to have its students fully participate in their society and work by having the necessary digital literacy skills (the ability to use technology to communicate, for a more in-depth explanation of digital literacy or technoliteracy see Cole & Pullen, 2010; Pullen & Cole, 2010; Pullen, Gitaski, & Baguley, 2010; Zehr, 1997). In developing their technoliteracy skills New Zealand students are also assisted to use technology as a way of expressing their own

individual and cultural identity- trying to minimize technologies depersonalization effect. The New Zealand policy, unlike the American and Australian national policies, does not indicate how this will be achieved in terms of providing infrastructure and training to teaching staff. Furthermore, the Australian and American policies stipulated that to achieve their respective national ICT goals a strong regulatory and organisational framework would be required. In iterating the regulatory framework the American national policy goes further than the other two policies in stating that ICT will transform how teaching and students' learning would occur (Goal 5). In effect, Goal 5 is at the centre of the MCEETYA declaration on education in Australia and perhaps intended, though unspoken (written) in New Zealand's and Australia's national educational ICT policies. As such the American policy adopts a much more transformative approach to viewing and talking about ICT use in the education sector than does the Australian or New Zealand national ICT policies.

What each of these national technology plans have at their heart is the desire for students to become knowledgeable, capable and ethically responsible users of technology. The American and Australian technology plans also have an expectation that technology will transform how teaching and students' learning occur. At the national level there is the expectation that schools will educate students to become productive users of technology. For example, in the Australian context the *Learning for the knowledge society* (DETYA, 2000, p. 10) report reiterated international perspectives (OECD, 2001) on ICT as a means of creating wealth and prosperity. In response the Australian government through the *Learning for the Knowledge Society: An Education and Training Action Plan for the Information Economy* demonstrated a strong commitment for all its citizens, not just students, to reap the rewards and benefits that ICT can offer. In conjunction with international (OECD) and national ICT policy frameworks all Australian States have parallel initiatives (DEET, 2004; DETYA, 2000). Even so, despite the proliferation and support for ICT in schools, cynics could ask "why hasn't ICT transformed the education sector like it has other sectors?"

Two decades ago technology commentator Larry Cuban (1986) partially answered the above question by asserting that educational innovations are rarely completed due to a lack of planning or political support. Indeed, as has been described, governments through policy and funding have given schools the opportunity to take advantage of the digital revolution that has transformed other sectors. Yet very little ICT transformation, or progress, has been made in schools (Kim, 2000; Mathews, 2000; Matthews, 2000; Mulkeen, 2003; Oppenheimer, 1997). It needs to be argued that ICT is appropriate in schools, but to date its implementation has been somewhat a failure. This is not to say that all ICT usage in schools is a failure, rather to date little change in teaching and students' learning has resulted from the introduction of ICT into schools. Given this approach, several researchers believe that with the increased access to ICT in schools, the education sector is reaching a point that improvement is more likely than it has been in the past (Downes, Khun, Scott, Leonard, & Warhurst, 2003). This being said, there has been some signs of ICT-based improvement in schools (Newhouse, Trinidad, & Clarkson, 2002; Sandholtz, Ringstaff, & Dwyer, 1997; Wenglinsky, 1998) and that it could be said that whilst there has been little effect to date, ICT still holds the potential to significantly impact on how teaching and students' learning can occur (Clarke, 2003).

This anticipation may in part explain why, many individuals, such as politicians, educational policy makers, as well as parents, employers and the general public give great credit to the transformative capacity of technology. For instance, Barbara Means (interviewed in Koenig, 1997) related that the general public expects educational use of ICT to have transformative aspects because they "have a strong belief in technology's power to transform education either because of technology's 'mystique' or because they have experienced technology's power in other settings" (p. 12). This 'mystique' or 'experience' in other areas of our lives, in turn is influenced by technology's ability to be used for purposes other than what it was originally designed (Taylor, 1997). For example, the alpha-numeric keypad on mobile phones quickly gave rise to smart messaging (text) and the internet has given rise to virtual reality worlds and online gambling. Both uses not intended when the technology was designed and originally

marketed. Technology's ability to change is not only a benefit it also raises additional challenges in trying to research technology which further adds to its 'mystique'. Despite the 'mystique' and 'unintended' uses, ICT roll-out into the education sector continues to receive widespread financial and political support, however one question still remains unanswered which is "why hasn't the education sector experienced the same degree and depth of technological transformation that has occurred elsewhere?" These inconsistencies between the rhetoric for technological transformation of the education sector and actual practice give rise to the study's first research question of: *How can schools successfully embed digital technologies for teaching and students' learning?*

### Summary of Macro elements

In providing support to RQ1 this section examined the literature concerning changes in society that are occurring at the same time as ICT is becoming more widespread in our personal and working lives. This '*technologizing*' (to modify or affect by technology; make technological, see <http://www.thefreedictionary.com/technologizing>) is transforming society from being dependent on the production of goods, the industrial society, to one that is becoming much more reliant on the production and reinterpretation of information into knowledge. Hence the 21<sup>st</sup> Century has been termed the knowledge economy, and in this new economy ICT is transforming work and leisure activities. With work and leisure transformations occurring because of ICT the following section explores what is happening in schools as a result of the introduction of ICT; in effect the following section examines micro level perspectives.

### Micro perspectives: ICT and education

The previous macro level perspectives of ICT and education indicated that technology is being promoted in schools by the belief in the transformative capacity of the technology to cause fundamental changes in students' learning; promoting lifelong learning and enabling citizens to participate in the knowledge economy. Although, there is a claimed mismatch and disparity in

the continued expansion of technology into schools and the continued underuse of those technologies, this mismatch may be associated with raising expectations (Clarke, 2003).

So whilst the previous section showed external actors, essentially governments and the transition from an industrial society to a knowledge economy, have an impact on ICT in schools, the literature reviewed also indicated that the school's internal characteristics play a significant role in determining how they will react to change. Indeed, a significant number of researchers have identified that the internal characteristics of the school, its culture, to be the biggest single factor for determining if and how an innovation will proceed in schools (Hargreaves, 1992; Hargreaves & Fullan, 1992; Newmann & Wehlage, 1995).

This following section's discourse therefore addresses teaching and students' learning; in particular with or through the use of ICT, and the factors which influence the use of ICT within a school. In discussing the aforementioned aspects of ICT use in schools it will be acknowledged that many of the barriers to the adoption of ICT in schools are specific barriers to change in general. This implies that any study investigating the implementation of ICT in teaching and students' learning must also, if briefly, look at general factors affecting change in education (Cox, 2005).

An early example of the significance of internal school factors and change was noted by Schiller (1992) who observed that the introduction of computers and computer policies into schools in the early 1980's resulted in increased pressures being placed upon school leaders to make technology-based decisions for which they were not equipped to do. To a large part this increased technology-based pressure stemmed from fundamental beliefs in technology's ability to improve the education system. For instance, in a report to the President and the Congress of the United States of America, Kerrey and Iskason (2000) noted that the internet had the power to improve schooling by making learning more student-centred, whilst also enabling the teaching to cater for individual students' learning requirements. In addition, to the belief that the

internet will transform teaching and students' learning, is the assumption that ICT will provide students with the capacity to become lifelong learners (BECTA, 2001; Forsyth, 1996; Guri-Rosenblit, 1998; Reil, 2000; Robertson & Williams, 2004). Therefore, given the changes to teaching and students' learning that may be made possible by ICT, up-skilling teachers to apply technology in their teaching is seen by many to be imperative (Watson, 2001; Wheeler, 2001; Yelland & Swaminathan, 2003) to achieving the digital transformation.

Schrum (1995) has stated that "introducing information technologies to practicing teachers is a non-trivial task" (p. 221). Equally, educating those teachers together with the education system about the purpose of using ICT and staying abreast of technological change is similarly as important. Therefore, the subsequent sections examine the educational rationale for using ICT; schools' adoption of technology; teachers' use of technology; how technology-based decisions are made in schools, and the role of professional development (PD) in improving teachers' usage of ICT. Such a holistic approach to understanding ICT use in schools goes some way towards understanding how ICT use can be supported and its use improved upon in schools.

### ICT and an improved education system "teacher proofing schools"

It could be said that one reason for providing technology in schools is to teacher proof the education sector. In much the same way as machines, such as the weaving mill improved productivity (hence profits) in the 18<sup>th</sup> Century and automobiles made transport more efficient than the horse-and-cart in the 19<sup>th</sup> Century, so too is ICT seen as a way of improving the education process in the 21<sup>st</sup> Century. For instance, an important effect of introducing ICT into the education sector is technology's potential to reshape teaching and teachers' pedagogies (Grabe & Grabe, 2001; Green, Eckel, & Andris, 2002). Indeed, some have referred to technology as the "great siren song of education" (Kearsley, 1998, p. 47) which implies that technology can become a distraction to good teaching practices. It is therefore important that the pedagogical models used in teaching are not technology driven (*technocentric*), although

technology can provide options for stretching the mould. This opinion was supported by O'Rourke (2003) in her study of Victorian teachers' ICT pedagogy. O'Rourke's study concluded that technology alone cannot transform teaching and students' learning practices, and for lasting changes to occur a teacher needs to alter their pedagogy. Further to this, O'Rourke's study identified that teachers' pedagogy comprised their attitudes and behaviours, and perceptions, which determined their decision to apply or not to apply the technology in their classroom.

Compounding the pedagogy issue is the desire by governments and industry bodies for the application of ICT in schools. Indeed, some believe that the use of ICT and in particular the internet to be essential for the progression of education (Kenelev, Kommers, & Kotsik, 2004), a view well supported by others (Bracewell, Breuleux, Laferriere, Beniot, & Abdous, 1998; Grabe & Grabe, 2001; Kling & Iacona, 1995). However, what is it that ICT brings to the education context that is so important?

Whilst the previous sections have given some justification for why ICT is perceived to be an important tool for the education sector to take advantage of, perhaps what is also required is the recognition that ICT is a "double-edged sword". This analogy succinctly describes the dual role of ICT. First, technology can be a tool for classroom teaching and students' learning, and second, technology can act as a reform or change instrument.

Given the demand for ICT to be considered as a tool for teaching and students' learning since the early 1980's much research work has been carried out investigating how it improves the education process. For example, during the mid-1990's research carried out in the United States of America by the National Council for Educational Technology (NCET) concluded that the benefits of using ICT in the teaching and students' learning process were:



- stimulates learning;
- difficult ideas are made more visible with IT;
- IT gives students the power to try new things;
- computer simulations stimulate analytical and divergent thinking;
- IT makes teachers re-examine how students learn, and in turn how they teach, and
- students make more effective use of the technology if teachers know when and how to intervene (Capel, Leask, & Turner, 2001, p. 41).

Technology, especially computers, has been viewed as a way of improving the way students learn (Barak, 2004; BECTA, 2001; Cox, Abbott, Webb, Blakely, Beauchamp, & Rhodes, 2004a; Olson, 1988; Robertson & Williams, 2004), whilst at the same time ICT had many benefits on the process or practice of teaching. For instance, Alessi and Trollip (2001) concluded that instruction application of ICT meant that:

- learning with computers took less time;
- lesson materials were easier to prepare, and cheaper, as compared to non-ICT materials preparation;
- students could work at their own pace, and
- students were offered the opportunity for extensive practice which in turn made them more motivated.

At the same time as these positive studies of the benefits for incorporating ICT into the education system, other studies concluded that ICT had detrimental effects on students' learning (Alliance for Children, 2000; Dunn & Ridgway, 1991; Healy, 1998) or ICT made no significant difference (Russell, T., 1999). Regardless of whether or not researchers support that ICT encourages or diminishes students' learning, one thing that holds true in both antagonist and protagonist camps, is that the introduction of ICT into schools has resulted in debate about how

this is achieved. Therefore, since ICT has been introduced into the education system an understanding of how schools utilise the technology is required.

### Schools' adoption of ICT

In response to the social and economic benefits being purported by school technology use, Australia like other western countries, has adopted the widespread introduction of ICT into the education sector as a means of addressing economic, social and educational reform agendas in order to progress from the industrial age to the new knowledge economy or information age. To achieve this transition governments and schools have adopted technology policies and allocated technology specific funds to achieve their desired outcomes. To date, several ways have been used to report on this technology transition. First, there is the resource or mechanistic approach which measures success in terms of measuring the physical deployment of technologies (Cuban, 2001). This measure is often reported in terms of student to computer ratio, computer type (i.e. Pentium 4 or Macintosh), and the number of peripheral devices such as data projectors and interactive white boards (IWB's) that the school has (Newhouse, Trinidad, & Clarkson, 2002). The resulting measurements are then used by some (i.e. governments and schools) to indicate technological progress and/or success (Bligh, 2002).

For instance, a just over a decade ago in the United Kingdom (UK) a report to the British House of Parliament recommended that all schools should have access to internet connected computers and that all school students should have their own laptops by the end of the year 2004 (Dearing, 1997). To date this objective has not been met with the most recent UK reports indicating that on average there was one computer for every 7.5 primary students and one for every 4.9 secondary students by the end of 2004. Though, one benchmark which was achieved was that in 2004 all UK schools had access to the internet (DCSF, 2004), though no mention was made of bandwidth which could have an impact on subsequent usage. Within the Australian context Federal Government reports mirrored the same aspirations (DETYA, 2000), although, like the

UK sector one computer per student ratio has yet to be realized.

In Australia, more recently, former Prime Minister Kevin Rudd proposed the institution of a two billion dollar “education revolution”, in a policy paper during his term as Opposition Leader in 2007. This proposal, which is currently in the process of being instituted, aims to provide access to a computer for every secondary school student from year’s nine to twelve (Archer, 2007; Australian Labor Party, 2007; Coorey, 2007). Minister Rudd based this decision on data from the Organisation for Economic Co-operation and Development (OECD) which indicated that Australia spends well below the OECD average on early childhood education and has one of the lowest retention records for secondary school students. Former Prime Minister Rudd contended that Australia’s prosperity would decline unless the quality and funding of education from early childhood through to adulthood was raised substantially. He stated that “there is now incontrovertible evidence that education should be understood as an economic investment” (Coorey, 2007). The “education revolution” appears to support his understanding that technological literacy is essential to enable students to function effectively in a digital society.

Through the “digital revolution” Australia is attempting, at least in the senior secondary school level, to ensure that all students have access to ICT in schools. This may be a vital first step to overcome the widely acknowledged digital divide (Warschauer, 1999, 2003) in which the diffusion of ICT in individuals’ home environments is different. That is some individuals have more access to technology than others, who in some cases have little or no access. The deployment of digital technologies across the Australian compulsory education system has been uneven. For example, the average computer to student ratio for the six schools reported on in this study was 1:4 compared to 1:15 a decade ago (Meredyth et al., 1999).

Related to school access to technology, specifically computers and the internet, is student and teacher access to similar technologies outside of the school. This ‘at home’ access and home usage has been reported as having a greater impact on digital technology use by teachers and

particularly students by several leading authors, who have concluded that for most students learning how to use the technology actually occurs outside of the school environment (Cuthell, 2002; Meredyth et al., 1999). In addition, it has been reported that students have access to more technology based resources at home as compared to their teachers (Cuban, 2001; Cuthell, 2002) and this may be creating a new digital divide.

Another measure of the impact of ICT is data reporting on what technologies are being used, for how long and how individuals perceive the impact of the technology. Given the rapid advances and cost reductions in technologies schools and especially teachers, need to be constantly reviewing the benefits offered by the technology and altering their teaching practices to include newer technologies to maximize the benefits that the technology may bring to the teaching and students' learning experience. In maximizing the benefits offered by technology change needs to be planned and managed (Johnson & Fredian, 1986). Hardy (1989) has suggested that that in educational terms the word "change" was often considered another word for "growth", which was a synonym for students' learning.

Given that change implies learning from the past and from the experiences of others, past exposure to technology has a significant impact on current usage and perception of technology. Within the education sector Fullan (1991) noted that change was dependent on what teachers think and do; and it is as simple and as complex as that. During the same decade as Fullan's concept of change Kook (1997), an educational developer, maintained that ICT would change all aspects of teaching, however, as will be highlighted later in the literature review real change in schools is difficult to accomplish and measure.

Given that technological change in schools is highly dependent on teachers an understanding of how teachers have applied and perceived technology in the past will provide a context and benchmark for the current study. As indicated previously technology can "be a major force in reengineering schools... [and] challenge its day-to-day practice" (Toomey, 2001, p. 36), and so

it could be hypothesized that as the level of technology increases so would changes in how teaching and students' learning occur. Results from a large scale Australian survey (Meredyth, Russell, Blackwood, Thomas, & Wise, 1999) of 1,300 Australian primary and secondary teachers, indicated that teachers were using ICT, such as CD-ROMs to source information, using a specific educational software package to help students' locate information, searching the internet for information, using a computerized library database and catalogue to locate information and resources, and using word processing or publishing software for creative and 'final' products (writings).

Whilst the Meredyth et al. study reported that the majority of teachers possessed basic technology skills, particularly with computers, there was "little evidence that teachers are extending these basic skills in ways that are likely to...change the ways they teach...[and leads to] relatively low-level educational tools" (Meredyth et al., 1999, p. 263). One of the conclusions that can be drawn from the "Real Time" study is that merely focusing on how to use technology, integration and transformation has not occurred because the education sector, specifically teachers, have missed the real issues by focusing on technological skills at the expense of using the technology as a tool for improving teaching and students' learning experiences.

To overcome the dichotomy between technology as a skill to be learnt versus technology as a tool to facilitate teaching and students' learning, a change in mind-set is required by those who use and make decisions to incorporate technology into schools. This may be the "elephant in the classroom", or the elephant in the education sector, because to a large extent the education sector has been myopically teaching "people how to use...technology [rather than] how to solve educational problems [with] technology [as appropriate]" (Kearsley, 1998, p. 50). This led Kearsley to lament that technology had become a distraction to effective students' learning and teaching which gave rise to him labelling technology as the "great siren song of education" (p. 47).

In contrast to Kearsley, other researchers have concluded that providing teachers with more technology resources and training assists them in using that technology for teaching related purposes, such as instruction and course preparation (Hardy, 1998; Hoffman, 1997). Indeed in Australia \$7,392 Million (ABS, 2004) was spent in the financial year 2002-2003 on providing technology infrastructure and support across all government sectors, including the government education sector (Note: discussions with the Australian Bureau of Statics revealed that ICT expenditure in the compulsory education sector was not one of the key statistics that they kept). Furthermore, over the five years of 2008 to 2012 the Australian Commonwealth Government will have spent around two billion dollars to provide access to a computer for every secondary school student from years nine through to twelve (Archer, 2007; Australian Labor Party, 2007; Coorey, 2007). Such expenditure gives valid ground to questioning what has or will this expenditure bring about in terms of proficiency and students' learning outcomes? The financial and physical costs associated with purchasing equipment and housing that equipment needs to be considered in any study into the factors inhibiting or promoting school digital technology use to satisfy the antagonists who would want to know, answers to the question "is it worth the cost?"

Additional costs associated with the introduction of ICT into the education sector were identified by Riffel and Levin (1997) who maintained that the cost of running a school had increased significantly as a result of purchasing and maintaining "computer technology [Sic which] has been an additional expense" (p. 55). Furthermore, this expenditure is on-going as the technology needs to be maintained and regularly replaced (Dede, 1989). Given the on-going and high cost of purchasing, maintaining and training users, technology investment may be seen as an inhibitor, a belief supported by Trotter (1997) who surmised that "some administrators have been hesitant to commit to technology" (p. 30) because of the cost.

In order for schools to successfully utilise ICT for teaching and students' learning, governments have provided schools with technology funding and associated policy frameworks. Furthermore, schools themselves have restructured buildings and their curriculums to accommodate the application of technology. In relation to technology funding several studies have reported that school operating costs have significantly increased to provide technology infrastructure and training and that this expenditure has been an additional expense (Dede, 1989; Riffel & Levin, 1997; Wilmore, 2000). Expenses which an early study found principals were unwilling to commit to because they wanted to "avoid costly mistakes" (Trotter, 1997, p. 30).

One of the key actors or drivers for technology adoption into schools is the economic one. For instance, it has been suggested that:

All people, organisations, societies and nations are affected, although not at the same pace or to the same degree. Those who realign their practices most effectively to the Information Age...will reap substantial benefits. Those who do not will be replaced (Dolence & Norris, 1995, p. 2).

This economic perspective in turn has meant that most schools are now allocating a proportion of their operating budgets to technology infrastructure and staff development. This shift in technology expenditure is ultimately in response to society's call for students to be technologically literate (Lai, Pratt, & Trewern, 2001) to function in the new information age (Capra, 2002; Tong & Trinidad, 2005) all of which "improve[s] teaching and learning" (Hay, 2001, p. 5). Within the compulsory education sector, however, the ICT research literature (Cooley & Reitz, 1997; Schiller, 2000; Slowinski, 2000; Wilmore, 2000) has indicated that school changes in terms of ICT has been slow.

## Context of the school research

This dissertation research study is focussed on two Australian States, Victoria and Tasmania;

therefore, it is worthwhile looking at the specific educational technology-based changes that have occurred in each of these states. During the last decade Victorian schools have undergone numerous changes. These changes have included the state-wide adoption of the Victorian Essential Learnings (VELs), students' assessment changes including monitoring and reporting requirements to parents and school communities, funding formulas for both public and private schools have altered nationally and locally, teachers' career pathways have been ratified, and mass roll-out of technology into schools has occurred (Gurr, 2000; Schiller, 2000).

Similarly over the same time period Tasmania has experienced similar changes. Indeed during the course of this study the Tasmanian government implemented its Essential Learnings curriculum reform program (Department of Education, Tasmania, 2002b), which was then replaced with the Tasmanian Curriculum in 2007. Furthermore, the Tasmanian and Victorian departments of education have created ICT support units for teachers to assist them with using ICT within their new curriculums. The purpose of each State's ICT support unit was to assist schools in accomplishing technology integration in their curriculums by providing teachers with professional development seminars and access to ICT mentors within schools (Chalmers, 2001).

Despite the best efforts by governments and education authorities, the educational benefits offered by technology promoters have not always been met. For example, Victoria and Tasmania have been using digital technologies, specifically computers, for teaching and students' learning related activities since the early 1980s. Indeed, parts of Australia, predominantly the Northern Territory and rural Queensland, have been using some forms of technology since the early 1950s. The two-way radio had been used by the School of the Air to provide school lessons since 1951 (Australian School of the Air, 2009). The use of two-way radio demonstrated that technology could be used successfully to teach and enhance students' learning. Although using radio (like other forms of technology) has required changes in the way lessons were constructed and delivered, as well as changes in the physical layout of the "class" environment to accommodate the technology (Australian School of the Air, 2009). In changing



teaching and students' learning with technology, teachers' educational philosophies need to adapt to accommodate new pedagogies and new ways to operate and teach. This suggests that teachers themselves need to be the key participants in the educational technology debate and implementing ICT school-based change (Watson, 2001).

### Schools as change agents

The literature reviewed in this Chapter has expanded on the often debated notion that the schools usage of ICT is a major driver for change; which, at least according to technology commentator Cuban (1986, 1992, 2001) has largely been unchallenged. This basic belief in technology's ability to facilitate change has been referred to as "technological determinism" (Surry & Land, 2000, p. 146). Therefore, to avoid technological determinism and viewing technology use in education through rose coloured glasses, it is important to understand what is driving the push for the continued introduction and use of technology in the educational sector.

Within the literature empirical data about technological change an underlying assumption is that a higher level of technology usage in schools is equated to school change and improvement (Cuban, 2001; Moersch, 1995; Newhouse, Trinidad, & Clarkson, 2002; Surry & Land, 2000). Whilst this change measures the number of devices, specifically in terms of computer to student ratio, it however misses the point that simply providing more access to and more technology to teachers does not mean that sustainable educational change or educational improvement has or will occur. Even so there are some indirect relationships between education improvements and greater use of ICT in schools. For example, during the ten year period from 1992-2002 university participation rates in Australia rose by 8% to 18% (Nelson, 2003). Coinciding with this increase in Australian university participation rates was government funding for more digital technologies across the compulsory and post-compulsory education sectors (DETYA, 2000). A trend which is being replicated across most western societies (Zandvliet, 1999).

Through the introduction and use of ICT in the education sector governments, schools and others are trying to align the education sector to the new knowledge economy. In doing so, the introduction of that technology has occurred in different ways, some planned and others more ad-hoc. As such, there seems no single agreed mechanism or model for the successful introduction of technology into schools, or indeed how to measure that success. Although, the literature does indicate that the process is a gradual one of enrolling key individuals who in turn use the technology and then recruit others into its use-and the process is then repeated (Aviram, 2001; Cuban, 2001; Dede, 1989; Katz, Rice, & Aspden, 2001).

One of the key “actors” and agents in the school is the principal who establishes and maintains the school’s broad organisational structure and policies; as such Fullan (1991) recognized the principal as a key change agent within a school. By maintaining and enacting the school’s organisational policies, vision, and recruitment the principal plays an important role in setting the agenda and ‘atmosphere’ of the school. It is therefore important for the principal, and other school leaders, to have (and set) clear goals and expectations for technology development and use within the school (Gebhart, 2003). Associated with setting the strategic ICT plan, the principal also needs to allocate sufficient funding for technology infrastructure and regular maintenance, together with on-going staff training.

The decision on how much funding to allocate to what forms of technology is a difficult process not just because of the rapid developments in technology (Slowinski, 2000) but also because principals need to understand the purpose of the technology within the school along with its associated infrastructure requirements and training of staff. For principals to make the right decisions and to successfully manage the schools’ technology, they and the school need to have expectations of what the technology is to be used for and why. Unless there are purposeful expectations for the technology Atkin (1997) stated that the technology may drive the decision-making process (technocentric) rather than its intended purposes. This technocentric decision-making process has been highlighted in the literature and indicated that schools can become

'blinded' by the purchase of the technology more for its own sake and at the cost of the limited innovations that technology sometimes can bring to teaching and students' learning (Atkin, 1997; Selander, 2003; Slowinski, 2000). Several studies have further indicated that the technocentric approach "starts with the technology rather than the education" (Beynon, 1993, p. 228) and that this approach values technical or practical skills over the educational benefits arising from using the technology (Simpson & Payne, 2002; Venezky & Davies, 2002).

Researchers, such as Cooley and Reitz (1997); Hope, Kelly, and Guyden (2000) and Wilmore (2000) in their research on schools as change agents pointed out that the school principal is the key to the success, or otherwise, of school-based innovations. Further to this Wilmore (2000) also noted that an innovation will succeed or fail depending on how the principal actively supports either side, whilst Slowinski (2000) stipulated that effective leaders are "forward-thinking leaders" (p. 1). Given that the principal influences how the school is run researchers, such as Barone (2001), Schiff and Solmon (1999) and Trotter (1997) have suggested that school leaders need to make decisions in consultation with experts and with those to whom their decisions will affect. This is particularly the case with technology as it would be unreasonable to expect the principal to be an expert in this ever changing field. Unfortunately, this approach is not always carried out with Riffel and Levin (1997) revealing that the principal's understanding, related to technology, were often shaped by "relatively narrow sources of information" (1997, p. 62).

Research on effective schools indicated that the principals of such schools actively included staff members in school decision-making and problem-solving (Elliot, 1998). With effective school leadership being a collective task of the principal working along with other members of staff and the broader school community.

In obtaining information to help inform ICT decision-making Gebhart (2003) noted that school leaders, and hence schools, needed to establish clear goals and policies for school wide ICT

development, management and integration. The need for schools to have a concise and descriptive ICT plan and ICT policy is supported in the literature which further indicated that the ICT plan needs to have clear and specific links to financial instruments and curriculum goals (Hay, 2001; Riedel et al., 1998; Riffel & Levin, 1997). In addition, Ringle and Updegrove (1998) claimed that the school technology plan needs to be separated into two components, one to address the 'socio-economic' and the other 'pragmatic or technical'.

Principals need to consider the use of ICT within the overall strategic plan of the school (Hay, 2001; NZ Ministry of Education, 2002; Wilmore, 2000) which is in line with government, business and educational researchers' calls for making learning with technology available 24/7, at home and school or "anytime, anywhere" (NZ Ministry of Education, 2002, p. 1). To accomplish 24/7, anywhere/anytime learning, a school-wide strategic approach to technology adoption is required (Ringle & Updegrove, 1998). Principals therefore need to involve others, who are perhaps more knowledgeable, in assisting them to make technology decisions (Barone, 2001; Hope, Kelly, & Guyden, 2000; Wilmore, 2000).

Whilst it is important that principals, as the key educational leaders in their school manage the process, they must not become insular in the process. Indeed, Trotter (1997), and Riffel and Levin (1997) stipulated that school technological decisions need to also involve technological leaders or consultants from outside of the educational arena so that school technology is reflective of what is available in the corporate or 'outside' world. What schools do with technology is also dependent on what teachers have seen, read or heard occurring in other schools as such "schools' understandings [of technology] are often overly shaped by a relatively narrow sources of information" (Riffel & Levin, 1997, p. 62). This narrow view of technology in turn may lead to "haphazard and serendipitous" (Simpson & Payne, 2002, p. 4) decision-making and technology implementation.

A haphazard and uncoordinated approach to school technology planning runs the risk of placing

those with technological knowledge, or perceived understanding, into positions of power or authority (McClure, 2000). Further to this, several authors have suggested that given the pace of technological change school leaders need to be careful in simply delegating technological decisions to others, as this may lead to fragmentation of whole school ICT planning (Hay, 2001; Ward & Hawkins, 2003; Wilmore, 2000). In relation to technological planning a school needs to have a longitudinal focus which “is driven by the school vision rather than by the technology” (Slowinski, 2000, p. 4). Such an integrated approach attempts to align the school’s vision and technology, so that the technology is not just an *add on* rather it becomes an integral component of the teaching and students’ learning process. By becoming an integral component of the school program, the technology plan becomes a key component of the school’s future vision for teaching and students’ learning. Indeed, Papert and Caperton (1999) related that having a *vision* is a crucial factor in determining the success, or otherwise, of school as a change agent and involved in reforms.

In aligning the technology with the school’s vision the principal needs to seek advice and information from a number of sources. Principals seeking advice need to be mindful in not getting their information from just one source, which is typically from those who are perceived to be ‘experts’ in technology. The reason principals need to get information from a wide variety of informants has been well reported (Pullen & Vaughan, 2008). For instance, Trotter (1997, p. 1) observed, that often information from IT professionals was full of “jargon”, and principals needed to be mindful that often “the techie” (McClure, 2000, p. 108; Pullen & Vaughan, 2008) is placed in a position of power because of the possible mystique that surrounds the technology. To overcome this, educational leaders need to understand not only the technology but how it can be used to support teaching and students’ learning (Fleit, 2000; Riedl, Smith, Ware, Wark, & Yount, 1998). Within the business sector Ross and Weill (2002) identified that successful ICT integration occurred when “managers take a leadership role” (p. 83) in making decisions regarding how and what the technology was used for. The same report also indicated that when managers abdicated technology decision-making to others “disaster often ensues” (p. 83).

Successful technology integration within a school therefore requires the principal to align the technology with the school's vision. To do so the principal needs to gain an understanding of what technologies are available and what they offer from asking pertinent questions from a wide array of informants including IT professionals, business groups, other schools, government policies, and the research literature. For some schools this may be easier said than done, due to how the school is managed and how change has been managed in the past. Thus, school governance is crucial in determining how change occurs and is managed and studies have concluded that good governance is shared across the school, its staff and its community (Beck & Murphy, 1995; Blase & Blase, 1997; Casey, 1993; Dale, Robertson, & Shortis, 2004; Eib, 2001; Hall, 2001; Schiller, 2000).

In terms of technology change, Fullan (1982) noted that implementation or change will occur to the extent that each and every teacher has the opportunity to work out the meaning of the implementation and how it will affect their individual teaching practice. He concluded that teachers should not be expected to implement or drive an innovation unheeded, or with limited time or financial support. Such an understanding supports the notion that school leaders through policy and resourcing play a vital role in helping teachers to deal with the challenges and changes required to improve the teaching and learning programs of the school (Wallace, 1997). Fullan further suggested that policies should not be restrictive as "the more you 'tighten' mandates, the more that educational goals and means get narrowed, and consequently the less impact there is" (Fullan, 1993, p. 23), so there needs to be a balance between policy and practice.

Additional educational leadership studies reiterate the need for principals through policy and resourcing to support staff in embracing change (Jones, 2001; Manson, 2000), and offer staff moral support in times of change (Brennan, 1997, 2000). Moreover, it has been acknowledged that it would be unreasonable for principals and teachers to know all about the myriad of digital

technologies available, but they must understand where technology is going and what the possible ramifications for teaching and students' learning might be (Brennan, 1997; Manson, 2000; Russell & Bradley, 1997). To do these principals need to "work with teachers to develop a vision and an approach to implementing standards" (Eib, 2001, p. 17; Manson, 2000).

### Digital technologies in education- a change process

As has previously cited, economic, social and educational factors are encouraging the adoption of ICT into schools and this process is a major change initiative for schools to manage. Indeed this is a change which most schools in Australia have been tackling since the early 1980's (Pullen & Vaughan, 2008). Indeed, Cuban (1986; 2001) suggested that such technology driven changes have been occurring since the 1920's through technologies, such as radio, film, TV and more recently computers and the internet, with the latter two leading to a second wave of educational technologies (Zandvliet, 1999). The result of the second technology wave is reflected in students' perceptions that a "real computer" is one that is internet connected and multimedia enhanced (Cuthrell, 2002, p. 34), indicating that the notion of what a computer is has changed.

This change is not something that just happens; it is a cycle of events that results in the actual change. In an early technology-based report Pasupathy (1992) described how computers could be used to increase the variety of classroom instructions, to facilitate communication and provide a rich variety of information sources all of which could motivate students' learning and academic progress. Other researchers, in turn, have described how computers can be used to reorganize teaching activities by supporting the preparation of materials and how that material can be used with students (ACOT, 2000; Bottino & Chiappini, 1995; Claeys, 1997; Fluck, 1998; Fluck & Robertson, 2002; Lim & Hang, 2003; McLoughlin & Oliver, 1998; Robertson, Calder, Fung, Jones, & O'Shea, 1997; Saye, 1997; Wheeler, 2001). Technology's potential to shape the economy and the education sector has not been lost on technology development companies.

Indeed, the Novell Corporation signalled over a decade ago that the technology shift:

...will have major implications...and will be strongly affected by parents (in the case of school children), educators, administrators, industry, publishers, media and government (Novell Corporation, 1994, p. 5).

Technology therefore has the potential to help transform and change teaching and students' learning practices as well as cater for more diverse learners in schools and to achieve greater lifelong learning across the society (Darling-Hammond & McLaughlin, 1995; Moursund, 2007; Riffel & Levin, 1997; Trotter, 1997).

In relation to stages of change, Fullan and Stiegelbauer (1991) described two categories of change, first and second-order order changes. First-order changes are those changes that improve the efficiency and effectiveness of what is currently done, without disturbing the basic organisational features; without substantially altering the way that people perform their roles. Second-order changes seek to alter the fundamental ways in which organisations are put together, including new goals, structures and roles. Often the challenge is to establish second-order changes, but usually only the first-order changes are reached. In relation to the use of ICT in schools Bates (2000) argued that if schools are to successfully adopt and use technology, much more than minor adjustments in current practice will be required.

The effective use of technology requires a change or even a "revolution" in thinking about teaching and learning. Part of that revolution necessitates restructuring schools, that is, changing the way schools are planned, managed and organized (Bates, 2000). Bates goes on further to lament that in hindsight history suggests that the introduction of new technology is usually accompanied by major changes in the organisation of how work is done and where it is performed. The use of technology therefore needs to be embedded within a wider strategy for teaching and students' learning. Furthermore, as the organisation starts to use technology



outside its local area, new administrative and academic procedures will be necessary in the areas of admissions, finance and academic policy (Bates, 2000; Manson, 2000). As such, the successful use of technology in the educator sector will require second-order changes.

To understand how these school level influences affect classroom ICT usage the second research question that this current study seeks to address is: *How are schools utilising digital technologies for teaching and students' learning?*

### Summary of Micro (internal to the school) elements

Much of the literature on technology in education strongly supports the view that technology on its own should never drive the process for using technology in schools (Downes & Fatouros, 1995). Instead, the planning for the introduction and use of digital technologies should be driven by the educational and students' learning outcomes offered by the use of the technology (O'Hara, 2004; O'Rourke & Harrison, 2004). Most of the research suggests that technology helps students to learn, promotes higher order thinking (Becker, 2001) and supports teachers to teach more effectively (Higgins, 2003). The research also denoted that despite the widespread roll-out of technology into schools there is little to indicate improvement or transformation of teaching practices, or students' learning experiences (Peck, Cuban, & Kirkpatrick, 2002). The evidence is that simply providing the equipment does not necessarily make a difference; what makes the difference is the way in which the technological tools are used in schools (Higgins, 2003). Aspects for technology use or underuse and the reason why this may be the situation are therefore related to the users of the technology.

### Meso (external to the school) perspectives

In reviewing educational change as a result of technology, Riffel and Levin (1997) noted that schools need to embrace new technologies as they provide opportunities for "rethinking how students learn in schools, not just changing how they are taught" (p. 60). This notion was

supported by Toomey (2001) in a review of ICT on teaching and students' learning which reported that "ICT can be a major force in reengineering schools [and that] the strategic introduction of ICT into a school can seriously challenge its day-to-day practice" (p. 36). This challenge in turn may be due to technology being largely imposed on the education sector by others (i.e. politicians, businesses, and the IT sector) resulting in technology still being seen by educators as an "outsider in...schools" (Watson, 2001, p. 1).

In response to this "outsider" view of technology the education and technology literature on educational uses of ICT can be assigned into two broad categories. The first category relates to the frequency of teachers' use of technology, whilst the second category refers to how that technology is being used in the classroom. Associated with each of these groups are a number of factors which impact on the use or non-use of technology by schools and teachers. Cohen and Kottkamp (1983) summarized western society's views in relation to changing technology with the notion that "new technology is really an old educational enchantment" (p. 122). This is particularly pertinent given the rapid advances with digital technologies, with the same case being made for newer technologies as was made for previous technologies. For example, radio, film and overhead projectors and now it is the internet, interactive white boards and Facebook. As such, the classroom teacher is the key determining person (factor) for technology application within their classrooms.

Teachers are continually being asked to make changes to their practices as their role expands to take on new problems and mandates (Fullan, 1992). The irony though in taking on new roles, is that very few of the old roles, if any, are taken away or diminish to make room for the new changes. Therefore, it is not just teachers and their capacity to change that needs to be considered, it is also their desire for change. Change implementation by necessity needs to include teachers in the process (Hargreaves, 1994).

## Theoretical frameworks explaining use of ICT

Whilst it is not the intention of the current study to prove that ICT changes teaching practice and pedagogy, as several other studies have already addressed this area, this section will mention several prominent models of how ICT can be implemented into teaching practice.

One such model is the Technological Pedagogical Content Knowledge (TPACK) which situates the use of technology around the domains of the content to be studied, i.e. Science or History, the pedagogical knowledge of the teacher and their and their student's technical knowledge (Koehler & Mishra, 2009; McAnear, 2008; Weimer & Hall, 2009). Essential to the TPACK model is the understanding how technology affects pedagogy and scaffolds learning. One of the shortcomings of the TPACK model is that the aspirations are to improve the use of technology but for this to occur a number of other factors need to be considered. These factors include a technology plan and an ICT vision at the school and national level, together with funding for staff development, equipment, maintenance and technical support. The International Society for Technology in Education (ISTE), an organisation for educators advancing the effective use of technology in education, concurs that these factors must be considered in any approach or model of technology supporting teaching (ISTE, 2007; 2008a) and student learning (ISTE, 2008b).

Other ICT models in the literature are derivatives of Diffusion of Innovation Theory by Rogers (2003). Perry states that scholars in the diffusion theory field "define diffusion as the process through which some innovation is communicated within a social system" (2006, p. 675). Perry introduces the idea that 'time' is an important factor in the rate of diffusion. He also stresses the role of individuals and their social influence in the diffusion process (Perry, 2006). Rogers' diffusion model can be divided into three concepts:

- The innovation-decision process
- The characteristics of an innovation, and
- Adopter characteristics.

(see <http://www.stanford.edu/class/symsys205/Diffusion%20of%20Innovations.htm> for more details on this theory).

The degree of interpersonal influence an early adopter possesses within the 'innovation decision process' will affect the dissemination of the innovation to others. Three issues are identified: information flow, opinion leadership, and diffusion networks. At different stages in the diffusion of the innovation, individuals may be either leaders or followers. Leaders have the ability to exert a positive influence over their contacts and to encourage the use of an innovation. Closely aligned with the Diffusion of Innovation Theory is the Technology Acceptance Model (TAM). The Technology Acceptance Model is similar to diffusion theory although it places more emphasis on psychological predispositions and social influences, such as beliefs, attitudes and intentions which are important factors in the adoption of technologies (Bagozzi, Davis & Warshaw, 1992). Bagozzi et al. (1992) stress the importance of the learning process associated with using technology. Their theoretical model places technology-based learning within three distinct components: attitude toward success, attitude toward failure and attitude towards the process.

A more recent ICT model is that of Pedagogy 2.0 (McLoughlin & Lee, 2008a) which is seeking to utilise the newer technologies associated with the second generation of the internet, such as social media and connectivist pedagogical models (McLoughlin & Lee, 2008b) to engage students in learning suited to their specific needs, or learner centred. Whilst the model has merit in students learning through the technology that they use for social-networking, the model offers up issues that will need to be addressed, such as teachers moving to more student centred pedagogies and flexible learning times and assessments. Whilst worthwhile, this would be

difficult to establish in a school due to a wide number of administrative and technical difficulties, such as timetabling and access and training to web 2.0 technologies such as wikis, Facebook, blogs and YouTube, technologies which are often difficult to control access to and can contain material which some might find offensive or non-educational (Norton, 2008).

Regardless of the theoretical model or framework one considers adopting, there are numerous conditions to be met before ICT innovations can be introduced, adopted and diffused through an institution, many of which are addressed in this chapter. By investigating a broad range of scholarly and practice based literature devised to describe and understand attitudes towards, and uptake of, ICT in schools and other organisations, a number of key factors have been identified. Influences from outside the institution also have an impact on adoption of the technology. External influences, such as the political climate, local, national and international ICT policies and directions, together with the aims of funding bodies, parents, local government and businesses, are broader in scope but no less important in setting the scene for new initiatives. This move away from identifying a theoretical model of technology use has been used by other researchers most notably by Cox et al. (2004) in their review of ICT in the UK. Cox et al. (2004) moved away from the instructionist/constructivist framework to analyse ICT practices shaped by pedagogical beliefs. They did this by focussing on teachers' perception of ICT in the teaching process, that is, as a 'servant' to reinforce existing practices or as a 'partner' to change the way the teacher and the children interact with one another and the given task. In this way, trying new approaches to a task is perceived as necessary to utilise the ICT. Evident in the literature reviewed are the influences on teacher beliefs about technology. These influences include technology in society and working life, teacher competency, access in classrooms, the nature of the subject or task and associated pedagogies, how students learn, and the learning outcomes to be achieved. The current study is concerned with examining how ICT is being used in the case study schools, in particular teacher ICT beliefs and practices to gain conceptual understanding of the requirements for ICT professional development, policy and funding.

Identifying the barriers and facilitators to the use of technology in schools by those who have to use the technology, teachers and students, can assist in the process of targeting early technology adopters or potential 'bottle necks'. Broad theories and frameworks are evident in the literature and in academic conferences, and these can be used as a starting point for individual schools or technology projects. However, no single theory or framework can provided the solution to devising a generic framework for the adoption of technology. Additionally, the number of variables that can affect such a framework or model make it difficult to provide sufficient detail to be useful to individual schools.

### Teachers' use of ICT

With increases in purchases of ICT by schools, there is an associated increase or expectation placed on teachers to use those technologies. But the "effectiveness of educational technology is determined by teachers' readiness to use it, not by its mere presence in the classroom" (Jones, 2001, p. 35). The existence of ICT does not transform teacher practices in and of itself. The technology can however be used to enable teachers to transform their teaching practices (pedagogy), given a set of enabling conditions (which are addressed in the barrier and facilitator section of this thesis). Teachers' pedagogical practices and attitudes influence their use of technology. Pedagogical practices of teachers using ICT can range from only small enhancements of teaching practices using what are essentially traditional methods, to more fundamental changes in their approach to teaching. ICTs can be used to reinforce existing pedagogical practices as well as to change the way teachers and students interact.

In relation to ICT use, research studies have revealed that teachers could be grouped as non-users, occasional users (at least once a month) through to serious users (at least weekly, if not more often) (Cuban, 1986, 2001; Cuban, Kirkpatrick, & Peck, 2001; Mathews, 1998). In terms of how teachers have been using that technology in their classroom, there is evidence that it was being used as a supportive tool for student's learning and as a tool to help teachers develop their

instruction procedures (Chalmers, 2001; Mathews, 1998; Pullen & Turner, 2008). Supportive use of technology was referring to teachers who used the technology to support their existing teaching practices, such as lesson preparation, drill and practice, producing lesson materials, managing and reporting on students' outcomes, and communicating with others predominantly through e-mail. Instructional application of technology was predominantly concerned with using computer software and the internet for finding, reviewing, analysing, synthesizing and reporting on data and information. As such, instructional use appears to be favouring more student centred learning activities and more "sage on the side" teaching approaches. Though, several prominent studies concluded that technology used to support the creation of teaching materials, rather than technology being used as an instructional aid, tended to be the main focus for teachers' usage of ICT (Becker, 2001; Cuban, 2001).

Cuban (2001) in a study of Silicon Valley (the 'home' of the microchip) schools observed that teachers predominantly used technology "to prepare for their classes rather than as a tool to facilitate instruction" (p. 85) and used the technology for "managing and communication" (p. 179) and to maintain teachers' "current teaching practices" (p. 97). This notion of ICT as instruction delivery versus ICT to create teaching materials is important to understand because decisions made by the teachers to do either or both of these will affect how they conceptualise ICT usage in their classroom. How teachers conceptualise ICT is related to how teachers conceptualise their role and their involvement in the application of ICT in their classroom. On this point, Hargreaves and Fullan (1992) explained that the role of the classroom teacher was central to any process of change within a school:

Teachers don't merely deliver the curriculum. They develop, define it and reinterpret it too. It is what teachers think, what teachers believe and what teachers do at the level of the classroom... (Fullan, 1992, p. ix).

In support of Cuban's (2001) findings several large scale studies have reported that teachers

were using ICT for instructional purposes. For example, a USA study identified that half of the teachers who had computers and/or the internet used them for instruction, such as word processing, internet searching and solving a set problem (U.S. Department of Education National Centre of Educational Statistics, 2000). The NCES findings were replicated in another US study conducted by Barron, Kemker, Harmes, and Kalaydjian (2003) which stated that of the 2000 teachers surveyed, half reported that they were using technology as a classroom instructional and communication tool on a regular basis (at least weekly).

The instructional use versus supportive use debate is a common focus for survey investigators. For example in Scotland, Conlon and Simpson's (2003) study of 110 primary and 110 secondary schools reported that teachers were using technology mainly for supportive use, as opposed to instructional use. This finding was replicated by another Scottish study that also reported low instructional uses of technology by teachers, despite the availability of the technology in schools, in particular the internet (Williams, Coles, Wilson, Richardson, & Tuson, 2000).

Further evidence on the support versus instructional use of technology was noted in a study by Kozma (2003) that studied 174 classrooms across 28 countries, which reported that:

- 26 percent of teachers used ICT to plan and organize instruction;
- 22 percent of teachers used ICT to monitor and assess students' work;
- 17 percent of teachers used ICT to facilitate students' collaboration, and
- 13 percent of teachers used ICT simulation (or modelling) software for research and experimentation.

Kozma's findings are consistent with the Australian study on 1,300 teachers across Australia which maintained that teachers who use ICT irregularly tended not to integrate the technology



into the learning environment, whilst teachers who were effective technology users engaged students with the technology by using communication techniques, such as e-mail, discussion groups and video conferencing (Meredyth et al., 1999).

Continuing the theme of technology underuse despite its availability, an early study conducted by O'Donnell (1996) reported that the majority of teachers with computers in their classrooms failed to use them for instructional purposes. In a similar finding to the Australian Meredyth et al. (1999) research O'Donnell found that teachers who did not use computers for instructional purposes chose not to because they did not understand how to use them in the teaching process, or did not know how to redesign their instruction (pedagogy) to incorporate the available technology into their teaching. While not disagreeing with this finding, the question is, is this still the case? Associated with the need to answer this question is the need to better understand teachers' perceptions of their own computer skills and the extent to which teachers themselves identified the need for further ICT training.

Further to the O'Donnell study the Pupil Autonomy in Learning with Microcomputers (PALM) project (Somekh, 1989) noted that the main barriers preventing teachers from fully utilising ICT were related to teachers' previous experience of technology; anxiety felt by the teacher based on their competence, and issues associated with teachers' self-concept as teacher in often knowing less than their students about the technology available. Similar findings were reported by Blease and Cohen (1990) who stated that "teachers lack confidence in themselves as computer users" (p. 33) or had a phobia about the use of computers (Russell & Bradley, 1997).

The literature on teachers' use or non-use of technology suggests that having the technology available in the school does not determine if it is switched on, or used well. Therefore, physical numbers of devices are not as important as subsequent usage and usage is highly dependent on the teacher's attitudes and beliefs surrounding that technology. For example, in Tasmania the education department set a computer to student ratio of 1:5 and that all teachers would have

access to their own personal computer by the end of the year 2000 (Department of Education, Tasmania, 2002a). To date these targets have been largely achieved, yet the so called “technological transformation” has not yet seemed to have occurred. This lack of widespread technological transformation, in turn, has led some antagonists to argue that there has been little apparent progress, despite more than a decade of substantial expenditure (Mathews, 2000; Oppenheimer, 1997). This inability of technology to cause substantial change is not due to the technology *per se*, but how it has been implemented, which has led to its failure. It is important to highlight, however, that if technological change has occurred; it is often difficult to see. The reason for this is the ability of technology to cause change beyond its original use (Trotter, 1997). Therefore, in evaluating how teachers are using technology in the classroom it is equally as important to ascertain how they are using technology for planning and personal uses as well. The distinction lies in the intertwined roles of technology as a teaching tool, and as an instrument and agent for change (Lincoln & Guba, 1985).

The literature reviewed indicates that schools are often slow and hesitant, to react to societal changes, which Cuban (1992) referred to as their inherent stability. It has also been reported that technology brings with it its own set of characteristics which need to be considered in any study of technology use in schools. Furthermore, individual members of the school community need to review and even reconstruct their work practices associated with ICT before “lasting change will occur” (Cousins & Leithwood, 1993, p. 305). This means that end users of the schools’ technology, such as students and teachers need to be considered in any study of the application of technology in school. Therefore, as this section has predominantly referred to schools’ and teachers’ use of ICT, the following section explores students’ use of technology.

As part of current educational reforms, such as The Digital Education Revolution 2008–2011 in Australia [Department of Education, Employment and Workplace Relations] (DEEWR, 2009) technological infrastructure such as broadband internet, as well as new ICT equipment, online curriculum resources and ICT training for teachers is being delivered. These changes are first order changes. Second order changes, or pedagogical changes, are harder to implement and

leading researchers believe these have not been undertaken by the majority of teachers (Shriner, Schlee, Hamil & Libler, 2009; Starkey, 2010; Watson, 2006). Regardless of these reforms a teachers' ability to use technology in their classrooms have not been adopted by the majority of teachers (Shriner, Schlee, Hamil & Libler, 2009; Starkey, 2010).

Findings from the literature suggests that the incorporation of technology by teachers leads to changes in pedagogy, such as more student-centred approaches (Donovan, Hartley, & Strudler, 2007; Wonzey, VenKatherinseh, & Abrami, 2006; Zucker & Hug, 2008), flexible and constructivist teaching styles (Mouza, 2008), delivery of learning episodes that are more project oriented and inquiry based (Swan, van t'Hooft, Kratcoski, & Schenker, 2007) and changes in how teachers manage student learning (Conole, De Laat, Dillon, & Darby, 2008). In an Australian context a low level of change in teacher behaviour is evident (Prestridge, 2007). Prestridge's (2007) examination of curriculum reform in Australian schools, found that the majority of teachers were expected to reach targets aimed at augmenting the existing curriculum. In other words, ICT has been 'tacked-on' to satisfy a bureaucratic mandate. As such, it is the author's contention that teachers are likely to plan and implement technology-based activities that generally reflect their notions of teaching and student learning practices. This however, may be changing given the current Australian curriculum reforms (DEEWR, 2009) regarding The Digital Education Revolution 2008–2011 and a move to a national curriculum. The current reform agenda in Australia suggests a 'meaningful change to teaching and learning' described as 'student centric programs of learning' that 'employ contemporary learning resources and activities' (DEEWR, 2008, p.4). As such, one of the areas that the current study will be investigating is that of teacher and student use of technology and how it has changed in Australia over time, in particular since the Real Time Study of 1997. As such, the current study is a response to the finding that even though most teachers and students benefit from access to technology 'only a minority are reaping the benefits of the information technology revolution' (DEEWR, 2008, p. 3).

Student-centred activities that utilise digital resources can be described as ‘Digital pedagogies’ – teaching and learning practices that engage with digital technologies. Teachers who embed ICT in a seamless fashion have been defined as those who use technology in learner-centred constructivist environments as opposed to traditional teacher-directed environments (Ertmer, Ottenbreit-Leftwich, & York, 2007). This does not imply that direct instruction is not appropriate, as Gibson (2001) points out that the most effective learning environment is ‘that in which the teacher, the facilitator, the guide, the instructor is capable of selecting the most appropriate strategy’, knowledge instruction or knowledge construction, and that ICT must be ‘transparent to the learner and allow for ubiquitous learning opportunities’ (p.56). Consequently, if teachers are required to implement the kind of pedagogical change indicated in current educational reform agendas, professional development programs must look beyond first-order barriers to the intrinsic, more complex second-order barriers of teacher beliefs and how they influence ICT implementation in the classroom. The current study provides an examination of teachers’ pedagogical beliefs about ICT that inform their classroom practices by asking teachers and school principals about current ICT use and the barriers and promoters for current and future technology use for teaching practice and student learning activities, rather than trying to assign current practice to differing theoretical models of ICT use.

In Australia several ICT related projects have been implemented during the period of this research study. Of particular note is the Smart Classroom project in Queensland (see <http://education.qld.gov.au/smartclassrooms/>) which encourages teachers to keep up to date with ICT and to use technology purposefully in their teaching practice. Teacher ICT proficiency is acknowledged through an ICT certificate which recognises those teachers who can use ICT purposefully in their own pedagogy. Through ongoing ICT professional and personal development, teachers can produce a portfolio of evidence of their ICT skills and ICT supported pedagogy to gain a digital pedagogical licence. At the heart of the smart classroom project is that the strategy recognises “the demand for seamless movement between school, work, home and play” (Queensland Government, 2011, see

<http://education.qld.gov.au/smartclassrooms/about.html>). The smart classroom initiative has synergy with learning for the knowledge economy section of this thesis and its principles resonate with ICT strategies in both Tasmania and Victoria, where the current research study was undertaken. For instance in Tasmanian Catholic schools and Victorian independent schools many are asking that their teachers obtain an ICT pedagogical license, using the same mechanisms as the Queensland initiative. Furthermore, the student expectations from the Smart Classrooms project are aligned to the students using ICT for inquiring, creating, communicating and operating the available technology ethically and responsibility (as are Tasmania's and Victoria's), elements which are expectations in the draft Australian National ICT curriculum.

In Tasmania the Department of Education has aligned ICT use to that of the Australian Sustainable Schools Initiative (see <http://www.environment.gov.au/education/aussi/> and <http://www.environment.gov.au/education/aussi/publications/pubs/aussi-factsheet.pdf>) in that the use of technology should provide a pathway to life-long learning and a career pathway. As previously mentioned in the literature review life-long learning and learning for the knowledge economy are embraced in the Tasmanian ICT Curriculum as inquiring, creating, communicating and operating with ICT; again aspects which dove-tail with the proposed Australian national curriculum.

At the time the data was being collected for the current study Jamieson-Proctor, Burnett, Finger and Watson (2006) were writing up their study of teacher use of ICT in Queensland state schools. Their findings indicated that teacher confidence was a major factor for ICT use or non-use in the classroom, with teachers preferring to enhance current teaching practice rather than transform teaching with ICT. This approach reflects a conservative approach to ICT usage which the authors argue needs to be further investigated via other studies, such as the current one.

Given the importance of both ICT knowledge and ICT equipment, experience for teachers to effectively utilise technology in their teaching practice the reviewed literature suggests that teachers need to be more practically involved in the ICT projects in their school and in ICT management. This will not only enhance their ICT competence, it will also provide opportunities to be role models to others in the use of technology. The reviewed literature also showed that professional development and the hands-on use of ICT enhances the technology competence of teachers. Thus efforts to encourage teachers to participate in ICT-related professional development and to use the technology available in the schools will help expand their ICT competence. This in turn will encourage more effective technology leadership by increasing the willingness of teachers to embrace new technologies.

### Students' use of technology

Research into ICT in schools is well into its third decade but there is still a pressing need to better understand how digital technologies are influencing learning opportunities. For example in the Australian state of New South Wales (NSW), the introduction of computers into public schools has been a major Government priority that has received over \$AU500 million during the period 2003–2007 (DET-NSW, 2008). The NSW government's Computers in Schools Plan aims to improve learning outcomes for all students in all key learning areas, from Kindergarten to Year 12. It involves a comprehensive program of support to schools that includes: the provision of regularly updated computer hardware and software; connection of all schools to the Internet; provision of training and development of teachers in the use of computers; and, the development of curriculum support materials to enhance curriculum in all Key Learning Areas. The NSW initiative is very similar to initiatives undertaken in other Australian states, like Tasmania and Victoria. However, despite these states' commitment of money and support, the rate of uptake of ICT and the success of school-

based practices varies enormously across the country and from school to school. The gradual emergence of a more critical understanding of the promise and pitfalls of technology integration into schools suggests that the climate is right to rethink some common assumptions about the benefits of ICT for student learning.

In the evolving field of technology for student learning the use of technologies such as robotics, computerised devices that children build and program, is seen by many as offering major educational benefits (Johnson, 2003). Educational theorists such as Papert (1993) believe that robotics activities have tremendous potential to improve classroom teaching. However, Williams, Ma, Prejean, Lai, and Ford (2007) affirm that there is limited empirical evidence to prove the impact of robotics on the K-12 curriculum. Educators have started to generate ideas and develop activities to incorporate robotics into the teaching of various subjects, including math, science, and engineering. However, researchers highlight that most of the literature on the use of technologies such as robotics in education is descriptive in nature, based on reports of teachers achieving positive outcomes with individual initiatives (Caci et al., 2003; Petre & Price, 2004; Mitnik, Nussbaum, & Soto, 2008; Rusk, Resnick, Berg, & Pezalla-Granlund, 2008; Williams et al., 2007) rather than indicating the facilitators and inhibitors of project success, or measuring the learning progress that has occurred.

In regard to student learning, the literature cited has documented increased media literacy (Rockman, 2003), improved writing (Mouza, 2008) and, in some cases, increased scores on standardized tests (Suhr, Hernandez, Grimes, & Warschauer, 2010) due to the use of technology. Students' studying course content via the internet has also been found to promote self-learning (Chang & Tung, 2008). However the same study

found that learning websites need to be made more user-friendly by providing clearer links to and from learning objectives, content and assessment indicating that those designing technology for student learning still need to address fundamental issues such as content management, instructional design and relevance.

In reviewing the use of ICT by students the educational value gained by the use of the technology is not always about increased test scores (Steelman, 2005), as ICT has been shown to benefit students' learning such as their ability to collaborate, apply critical thinking skills and overall the students' themselves feel their work has meaning (LaMont-Johnson, 2007). Research findings indicate that ICT is largely being integrated in ways that support and supplement existing classroom practices and it is important to keep in mind Wang's comment that "technology can assist and enable learning if used appropriately, but cannot cause learning" (2006, p. 37).

A study in the USA by Kuh and Vesper (2001) noted that as students were becoming more familiar with ICT and technology savvy, they were developing important ICT skills and competencies. For instance, students were developing social networking and synthesizing ICT skills which are vital traits for lifelong learning, especially in the new digital economy and information age. As a result of the increased use of technology by students, researchers have indicated that students' learning has been significantly changed by the introduction of technology (BECTA, 2001; Bonk & King, 1998; Hoffmann, 2002; Marina, 2001; Shelly, Cashman, Gunter, & Gunter, 2003; Smith, 2002).

Technology advocates maintain that learning with, and through, technology will better equip students for life and work in the information age (Butzin, 2000; Marina, 2001). For many students learning to use ICT begins at home. The reason for this home ICT learning is due to the



mass proliferation of technology in people's home lives. Technology saturation gives rise to new terminology in particular the term "digital native" which describes anyone born after 1980 that has grown up in a world saturated with digital technology (Palfrey & Gasser, 2008; Prensky, 2001). "Digital Natives" is also the name of the interdisciplinary research collaboration between the Berkman Centre for Internet and Society at Harvard University and the Research Centre for Information Law at the University of St Gallen (see [www.digitalnative.org/#about](http://www.digitalnative.org/#about)). The aim of this project is to understand and support young people as they grow up in a digital age. As the website claims, those who were not "born digital" can be just as connected, if not more so, than their younger counterparts. Therefore, not everyone born since 1980 is a "digital native". Prensky (2001) highlighted a distinction between the "natives" (students) and the "immigrants" (teachers). He described teachers as "immigrants" because of the perception that they are struggling to teach a group of people a new language using the out-dated language they, the students, already have.

Therefore, having access to technology, especially at home and school should help open the door for new and innovative ways for learners to learn. Indeed home learning also creates educational opportunities for students who may not have had ready access to education before (Bates, 2000; Hoffmann, 2002). Ultimately school based learning, home based learning and a blend of the two can enhance the curriculum, and students' learning, but this is dependent on the "effective use of information technology resources as tools to support teaching and learning" (Gilbert & Green, 1995b, p. 17). In this regard students' technology use, skills, confidence, and level of involvement in ICT decision-making is as relevant for students, as it is for teachers (Tytler, Smith, Grover, & Brown, 1999). Similarly, access to technology, specifically a computer and the internet, at home is becoming essential for students' success in a technology rich culture. Moreover, home access to technology is quickly dividing the world into those who "have" access and those who "have-not" (Aviram, 2000).

It has been reported that Australian government expenditure on school technology infrastructure and computer hardware was 1.5% of the total expenditure on school funding (McRae, 1998; 2001; Meredyth et al., 1999). This amount of expenditure resulted in 96% of students reporting regular computer use at school, and that 88% were confident users, and the average student-to-computer ratio was 15 to one (Meredyth et al., 1999, pp. 105-109). At the same time another study reported that 80% of students believed that they used computers at school once a month (Goodrum, Hackling, & Rennie, 2001). In a Tasmanian study conducted in three high schools, Cowley (2002) noted that 75% of students reported having access to a computer at home and believed that they were “confident using them and wish[ed] to use them more for learning at school” (p. 6). Similar findings were reported by the Meredyth et al. (1999) study in that 79% of students reported having access to a computer at home and that 85% used a computer outside of school hours. This finding supports the argument that students are becoming productive and confident users of technology, specifically computers and the internet.

### Factors influencing ICT use in schools

The literature review has described how digital technology is being used by teachers and students for teaching and learning in the classroom, predominantly described in terms of frequency of use and how it is used. Whilst it is important to know how frequently and what purposes the technology is being used for, it is perhaps more important to find and understand the reasons for the use or non-use of that technology. Van Scoter and Boss (2002) pointed out that technology adds to, rather than replaces, the teachers’ complement of tools and activities:

Technology adds to the set of tools available for children to use and adapt, to feel at home with, to make part of their repertoire, and to help express themselves, verbally, visually, and emotionally. New technologies offer teachers additional resources to use as they plan to meet a range of levels, learning styles, and the individual needs of students (Van Scoter & Boss, 2002, p. 10).

Early studies (Goodlad, 1984; Gross, Giacquinta, & Brenstein, 1971; Hyman, 1981) attempted to describe how innovations and change occurred in schools and they identified that teachers were one of the main sources of resistance to school change in ICT usage. Come forward through two decades and educational researchers were still identifying teachers as reluctant to invest in additional time to incorporate new technologies into their teaching (Gillman, 1989, Palfrey & Gasser, 2008). In the past fear was identified as the big de-motivating and inhibiting factor to teachers using technology in the classroom (Kerr, 1991) and teachers saw some technologies as a threat to their nearly authoritarian role (Becker, 2001). Over the next two decades the situation is essentially the same “the...rhetoric is remarkably consistent regardless of the specifics of the machine issue” (Hodas, 1998, p. 21) and that digital technologies are still a “major driving force in re-engineering schools...[and that] the...introduction of ICT into a school can seriously challenge its day-to-day practice” (Toomey, 2001, p. 36) and alter the teaching and student learning process (Barker, 2000; Hopson, Simms, & Knezek, 2002; Marina, 2001; Smith, 2002).

Therefore, as with any educational tool and resource, technology can be used well, badly or not at all (Siraj-Blatchford & Whitebread, 2003). Therefore, the appropriate application of technology in the classroom is dependent on the skills, knowledge and confidence of the user which is often the teacher. This leads to the case that it is no longer a question about whether technology will be used in schools, as ICT has reached almost universal levels, it is now a question of what technologies will be used and how. The Meredyth et al. (1999) study maintained that students were learning how to use ICT predominantly at home, and Brand (1997) ascertained that teachers already knew how to use computers, so the question still remains, why hasn't the digital age impacted more on the education sector? These studies of technology use in schools in the 1990's suggested that the digital age had not yet impacted strongly on the education sector. Perhaps the pertinent question is now in 2011, is the digital age having more of an impact?

## Inhibitors and promoters of ICT use

An understanding of the factors that inhibit or facilitate students' and teachers' use of ICT is crucial in order to understand how to support and improve digital technology use, and to account for and perhaps legitimize the expenditure and time spent on digital technologies in schools.

Australia, like other developed countries, has invested heavily on providing digital technologies for schools, and this expenditure is not a one-off amount as the technology needs to be maintained, upgraded, integrated and users trained, and once this is done it needs to be repeated again as the technology evolves. Indeed, one researcher (Carroll, 2000) compared the scale of ICT-integration expenditure in United States schools to be on a par with the investment made to the NASA space program. This vast funding of technologies for schools has been criticized, especially by Cuban (1999, 2001), because despite the widespread roll-out of digital technologies into schools it has had minimal impact on teaching and students' learning outcomes and performance (Cuban, 2001; Granger, Morbey, Lotherington, Owston, & Wideman, 2002; Hattie, 2009; Scrimshaw, 2004).

In understanding how inhibitors and promoters affect school technology uptake and use, the following subsections will explore each in turn before bringing the factors together to understand the 'counter-levelling' effect that inhibitors and promoters have. To aid comprehension of these important concepts Table 2.1 highlights the inhibitors and promoters, as indicated in this review of the literature.

Table 2.1.

*Inhibitors and promoters to classroom digital technology use by teachers*

<b>Inhibitor</b>	<b>Promoter</b>
Lack of hardware and software (Siraj-Blatchford & Whitebread, 2003);	Competence of the teacher (Siraj-Blatchford & Whitebread, 2003);
Lack of time for classroom use of the technology (Mathews, 2000);	School support (Scrimshaw, 2004);
Lack of teacher training & professional development (BECTA, 2001);	Satisfaction with the technology (Kozma, 2003);
Teachers' fear/attitude (Conlon & Simpson, 2003);	Professional development (Butzin, 2000);
Level of access (Mathews, 2000);	Mentoring (Pullen, Reid, & Lavery, 2008)
Lack of teacher competence/confidence (Smith, 2002);	
Maintenance and reliability (Kozma, 2003);	
Personal beliefs (Smith, 2002);	
Unsupportive social climate (Conlon & Simpson, 2003);	
Gender-female teachers used ICT less (Marina, 2001)	
<b>Factors which can be either an inhibitor or a promoter</b>	
Teachers' professional technology beliefs (Conlon & Simpson, 2003);	
Professional learning (Smith, 2002);	
Lifelong learning (Butzin, 2000), and	
Increasing teaching and learning flexibility, including the delivery and assessment (Van Scoter, & Boss, 2002)	

Given the number of factors inhibiting or promoting teacher ICT use, Sheingold and Hadley (1990) reported that it took teachers five to six years to master computer-based practices and approaches, provided that they were supported by infrastructure; management and time allocated to learn.

A closer examination of Table 2.1 reveals some common findings. First, teachers hold views that persist during innovations; technology use is dependent on available infrastructure and technical support, and second, teachers need time to learn to incorporate the technology into their practice and this may not always be easy due to self-perception and confidence issues. As such, technology-based educational change may be slower than the 'roll-out' of the technology because time is required to up-skill teachers and to give them enough opportunities to practice with the technology to increase their familiarity and confidence.

## Inhibitors

In relation to the underuse of digital technologies, specifically computers, by teachers in the classroom Cuban (2001) offered three perspectives and explanations as to why the digital revolution has been slow to take off in schools:

1. slow revolution or evolution, that is, technological innovations take time to get known, to get people involved and trained;
2. historical, social, organisational, and political context of teaching (and of schools), the structures and historical organisation of schooling makes change difficult, and
3. contextually constrained choices, classroom practices are still predominantly controlled by teachers, hence teachers have autonomy.

Cuban's reasons for the slow take off of technology in schools are hard to comprehend and justify. The reason for this rebuttal of Cuban is that in relation to his first point, this reluctance

has not occurred in other sectors, such as health and business, nor in people's personal lives where consumers have been quick to take advantage of new technologies, for example, mobile phones, internet and home PC's. It may be the case that in the health and business sectors the use of ICT may be more apparent, and that health agencies that don't take advantage of the latest technologies may not be seen as providing the latest forms of care and treatment. Whilst, for businesses not embracing newer forms of technology may suffer a decrease in patronage. In relation to points two and three, schools, and therefore teachers, have been adapting to technological, social and economic changes for some time and so change should be a component of the education system. Therefore there must be more to understanding technology non-use, or underuse in education.

Other reasons for technology underuse or non-use by teachers was investigated by an international study, comprising 16 European countries, 5 Asian countries, Canada, Israel, Iceland, New Zealand and South Africa, by Pelgrum (2001) who studied lower secondary teachers' perceptions of obstacles for classroom technology use in their classroom. The findings from this international study were grouped into two categories: material and non-material obstacles. The material obstacles related to insufficient numbers of computers [ratio of computers to students]; peripherals [such as printers and scanners]; quantities of software [not enough licenses] (see also Pullen & Fluck, 2008), and internet ready computers [multimedia enabled and connected]. The non-material obstacles related to teachers' skills and knowledge in the use of the technology [professional development] (see also Pullen & Cusack, 2007, 2008; Zehr, 1997), difficulties with trying to integrate the technology into their instruction [requiring mentoring] (see also Marlow, McCann, & Pullen, 2008; Pullen, Reid, & Lavery, 2008); difficulties in scheduling enough class time for students to use the technology [student timetabling issues]; not enough time for teachers to get used to using the technology [confidence]; not enough supervisory staff [insufficient numbers of mentors], and a lack of technical support staff [training and timely maintenance] (see also Maddin, 1997; Pullen & Vaughn, 2008; Veen, Vogelzang, Neut, & Spoon, 1992). Pelgrum's issues for non-use could be

reorganized to represent: (1) professional development; (2) workload and (3) curriculum constraints, aspects of which have been identified by several other researchers (Carnoy, 2004; Hay, 2001; McKenzie, 1999; Murray & Campbell, 2000; Plomp, Pelgrum, & Steerneman, 1990).

One of the better known and reported studies of ICT application in schools was conducted for the British Educational Communications and Technology Agency (BECTA) by Jones (2004), who grouped barriers into two distinct groups: teacher and school. Teacher barriers related to: the teachers' confidence and competence in using the technology; teachers' attitudes and resistance to change; anxiety; age and gender differences; and insufficient knowledge concerning the teaching and students' learning benefits of using ICT. School barriers to technology uptake and use were identified as relating to: insufficient time for teachers to use the technology; a lack of or reduced access to the technology; technical malfunctions and anxiety over things going wrong, and for older students the impact of public examinations. This last barrier is particularly pertinent as a contemporary study by Fluck, Pullen, and Harper (2009) indicated that secondary and tertiary school examinations are predominately pen and paper based but for the majority of the time students are researching and creating school assignments with technology.

Other similar inhibitors for ICT use in schools have been identified by researchers (Bradshaw, 1997; Cuban, 1993; Jones, 2001; Pelgrum, 2001) as relating to teachers' fear, insufficient access to ICT, and a 'perceived' lack of ICT support. These barriers are not unique to ICT and similar concerns are associated with other school changes, such as curriculum changes (Hargreaves & Fullan, 1992). These inhibitors or excuses, at least, according to Marsh (1999) need to be ignored or progressed because much of the learning about technology is self-taught. Marsh (1999) and others such as Horsley (1997) suggested that this "I don't know" or "I can't" excuse is best addressed by professional development activities, such as training seminars and peer mentoring. The reasons for this are best summed up by Lieberman (1995):



People learn best through active involvement.....Processes, practices, and policies built on this view of learning...encourage teachers to involve themselves as learners in much the same way they wish their students would (p. 592).

This literature review has described a number of factors which may hinder a teacher's use of technology but there is agreement that teachers' and students' access to technology is a significant contribution to its use or avoidance. Schools with high levels of ICT access tended to report higher levels of technology use satisfaction compared to those schools with less access to technology (Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000). Associated with access was having enough resources in particular hard/software (Morse, 1991), although since Morse's study computer to student ratios have improved, although budgetary restraints are often still present (Jones, 2004).

### Promoters

The identification of promoters for digital technology uptake into the classroom is important because if they are known and can be fostered then it is hoped that digital technology use in the classroom can be facilitated. Scrimshaw (2004) and Jones (2004) both analysed and reported on the BECTA study of teachers' implementation of ICT. From the BECTA study it was identified that factors which promoted or encouraged teachers to use ICT in the classroom related to teachers having their own school computer and access to high quality resources with unlimited restrictions on hard/software access. All of which was supported by technical staff and on-going professional development. The findings by Scrimshaw (2004) and Jones (2004) add credibility to the Smerdon, Cronen, Lanahan, Anderson, Iannotti, and Angeles' (2000) study which reported that having access to higher levels of technology was a determining factor for its subsequent use.

By synthesizing Scrimshaw's (2004), Jones' (2004) and Smerdon's et al. (2000) studies, ICT use could be enhanced when the school provided on-site technical support; ICT related

professional development (PD) and training, together with support and encouragement from the senior school management. All practices which need to be supported by a school-wide ICT policy.

The Sandholtz, Ringstaff, and Dwyer (1997) report on the *Apple Classrooms of Tomorrow* (ACOT) project identified four key promoters for the successful implementation of classroom based technology. These promoting factors were:

- beliefs - teachers need to confront their beliefs about learning and the efficacy of different instructional activities and mediums;
- tools – teachers need to view technology as one of many tools that are available to them to facilitate instruction, and that no matter how good the technology it will have little influence unless it is integrated into a well facilitated (or instructed) and meaningful curriculum;
- experimentation and support – teachers need to work in collegial ways with others to share technology skills and successes, and they need to also experiment or take risks in “trying” the technology for themselves, and
- catalyst – technology should be viewed as a catalyst for change, and that this change is long-term and confronting (challenging).

Further support for technology PD for teachers comes from the ACOT professional development model, which explained that traditional models of PD were less effective for learning about technology because teachers needed a more active ‘hands-on’ approach:

What we knew was that when we introduced technology to ACOT teachers, the old ways of doing staff development didn’t work well...what did work...involve[d]...teachers in conversations about change and reflection on practice...It seemed these conversations [about how to use the technology] had a

greater impact on teachers actually changing what went on in their classrooms than the traditional [PD]...approaches (Yocam, 1996, p. 6).

Whilst the ACOT (Sandholtz et al., 1997) study emphasized the desire for teachers to work together for PD activities, classroom teaching tends to be a fairly isolated profession, with teachers expected to perform their job in the main in isolation from other adults (Rosenholtz, 1991). Rosenholtz's research indicated that the social organisation of the school influenced and gave meaning to the nature of teaching. An important component of making meaning was the value that the school and the individual teachers gave to self-reflection with a "successful school [being a] place where teaching professionals are asked to make reflection" (Rosenholtz, 1991, p. 214) and then use those reflections to improve their teaching practice. In improving practice "principals often orchestrated collaborative relations between more or less successful teachers, explicitly acknowledging that improvement was...expected" (Rosenholtz, 1991, p. 209).

Further in relation to PD, Cuban (1992) described instrumental change which aimed to improve the nature of schooling, and fundamental changes to permanently transform the existing school structures, as vital elements in accomplishing change. For such transformative changes to occur professional development is often seen as the fundamental vehicle for change (Guskey, 1994), but this teacher PD needs to be of high quality if it is to lead to systemic change:

Change is a slow and evolving process. Yet often, there is pressure to 'scale up' and quickly implement broad-based change without considering future ramifications...professional development must shift...emphasis from working on teachers to working with teachers toward improvement of teaching and learning for all students (Cooke & Fine, 1996, p. 6).

A review of the literature revealed a variety of approaches to ICT and teachers' professional development, but a common theme is that ad-hoc, one-off PD is ineffective (Killian, 1994).

Furthermore, the teachers; skills learnt in ICT PD need to be practiced at school and even in the home, if a transfer of these new skills is to occur into the classroom (Russell, T., 1999).

Accordingly, Brown and Duguid (2001) reported that organisations such as schools find it difficult to transfer knowledge between teachers inside the organisation because of internal epistemic barriers. To overcome these structural and epistemic barriers to knowledge promotion and transfer, Brown and Duguid make extensive use of Lave and Wenger's (1991) notion of communities of practice (CoP, see Etienne Wenger's website: <http://www.ewenger.com> for more on CoP). A community of practice focuses on the social and collaborative processes and practices of how individuals work and learn together within the context of finding a solution or an innovation to a problem. As such, a CoP is concerned with situational learning and how individual teachers and group of teachers come together to collaborate on a shared school problem (see Pullen, Baguley, & Marsden, 2009 for more details).

Schools may be places of students' learning but as Leonard and Leonard's (2003) study indicated schools may not be places for teachers' learning, as many teachers feel dissatisfied with the amount, timing and quality of the professional collaborative experiences they encounter. This finding is pertinent, for as Wagner and Masden-Copas (2002) warn, school improvement will not be realized "unless teams of teachers improve together" (p. 43). The community of practice approach offers teachers and schools an opportunity to work together in a collaborative and synergistic way. Within the school community, or organisation, different individuals (humans) and machines (the technology) communicate and collaborate to achieve individual and organisational objectives. This "humachine" (the relationship between humans and technology) interaction needs to be acknowledged when collaboration and communication is facilitated by digital technologies.

Working from within the notion of schools as communities of practice (Brown & Duguid, 2001; Lave & Wenger, 1991) the teacher as peer mentor to others is one strategy that schools can use

to support teaching staff in their: use of digital technologies, their need for communicating knowledge, and for their PD (Pullen & Turner, 2008). Peer mentoring is a professional development strategy that enables teachers to consult with one another teacher to; discuss and share teaching practices, to observe one another's different teaching styles, to promote collegiality and support, as well as to help ensure quality teaching for all students. Teams of teachers can come together to share in conversations and reflect on and refine their teaching practices. Relationships built on confidentiality and trust in a non-threatening, secure environment can help all participants learn and grow together (Pullen, Reid, & Lavery, 2008). A school's leadership team can also support such an approach through supporting an inclusive teacher learning culture that provides staff with:

- scheduled time to work with colleagues;
- opportunities to observe classroom procedures and teaching practices;
- discussion time for curriculum planning;
- opportunities to design lessons with colleagues;
- opportunities to model technology-supported lessons;
- opportunities to observe each other teaching with ICT;
- provision of feedback on lessons taught, and
- active support for teachers to help and learn from each other.

(Pullen, Baguley, & Marsden, 2009).

One way schools can address these and other teacher learning requirements is through the provision of 'on the job' experiences. These can incorporate online delivery and technical support and working in a mentoring team with other 'more capable' as well as 'experienced' teachers. These approaches are sympathetic to the findings from ACOT (Sandholtz et al., 1997) and other studies into effective professional teacher development initiatives (Fullan, 1999; Trimble & Peterson, 1999; Wiburg, 1997; Yocam, 1996) that found for a change in teachers' attitudes and behaviours to occur, particularly with technology, teachers need time and technology exposure, and experience, in order to gradually shift their views. Findings from the ACOT, PD model noted that as teachers became more confident and capable in their use of

technology they changed their teaching instructions from teacher-centred (didactic) towards a more learner-centred (interactive and constructivist) approach, as illustrated in Table 2.2.

Table 2.2.

*ACOT (Sandholtz et al., 1997) teachers' professional development findings*

Attributes of learning	Traditional (instruction)	Extended (knowledge construction)
Activity	Teacher-centred	Learner-centred
Teacher role	Fact teller (expert)	Collaborator (sometime learner)
Student role	Listener & learner	Collaborator (sometimes expert)
Learning emphasis	Facts	Relationships and enquiry
Concept of knowledge	Accumulation	Transformation
Demonstration of success	Quantity	Quality
Assessment	Norm-referenced, multiple choice	Criterion-referenced and performance based
Technology use	Seat work	Communication, collaboration, information access & expression

Additional support for the role of PD in effecting meaningful and lasting change, comes from a large scale meta-analysis of technology based professional development reports by Cox, Abbott, Webb, Blakely, Beauchamp, and Rhodes (2004) that concluded that for teachers' technology-based professional learning to be transferred into their classroom practices "further substantial support for continuing PD is necessary in order that teachers integrate the use of ICT and improve pupils' attainment" (Cox et al., 2004, p. 36). This indicated that merely providing the technology with one-off PD is not adequate in eliciting teachers' professional change. What is required is, access to technology and training when, and as required, by teachers; which is determined by teachers themselves recognizing the importance of technology to their practice and then their need for ICT education and training. Therefore, teachers themselves need to recognize and acknowledge their own PD requirements, if long lasting ICT changes are to occur in their classrooms.

The preceding paragraphs have discussed some of the internal factors that influence the decision of teachers to use digital technologies in their classrooms. These factors are ones that must be addressed as part of the change process for teachers to become more effective technology users. What follows in the next section highlight some of the external factors that influence teachers' application of technology.

### External factors influencing teachers' use of ICT

An example of technology driven changes that are occurring outside of the school and which have implications for technology use inside of the school, is technology use in business and universities. Businesses and universities rely heavily on the use of technology to operate their business and to up-skill their employees and students. It is not known to what extent schools use these two outside sources for information and support. Simpson and Payne (2002) indicated that technical and pedagogical information tended to reach teachers in a haphazard and serendipitous manner, a notion supported by Fleit (2000) who recommended that principals (schools) consult

widely to obtain technical and pedagogical information before they make technology based decisions.

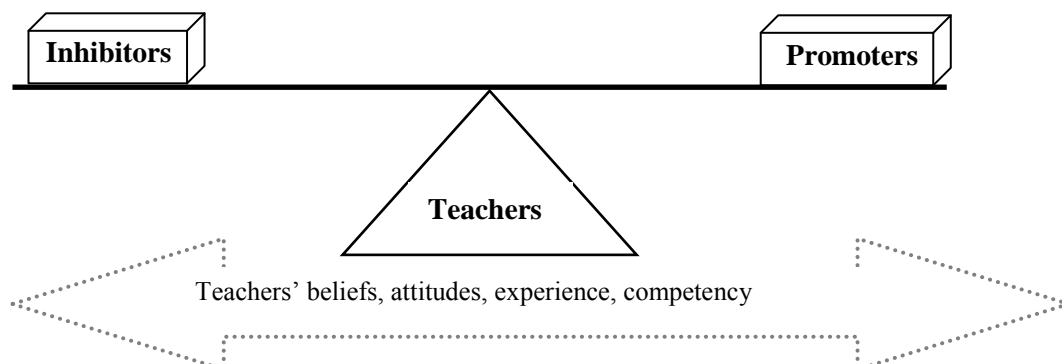
Outside of the school sector there is a growing body of literature and expectations from the community, politicians and education bureaucrats, for schools to use digital technologies with their students. For example, Watson (2001) in writing about ICT in the UK, noted that national policies and investment have been made for the procurement of ICT for schools. Although many teachers in schools were still viewing the technology as something that was imposed on them and so were hesitant to fully use it.

Given that much of the technological imperative for schools to use technology is often imposed on the education system by outside sources, schools have in turn needed to adjust their teaching practices to accommodate this imposed ICT mandate. This outside or top-down approach is a systematic attempt to cause changes in how schools teach and students' learn with technology (Coughlin & Lemke, 1999; Salomon, 1991). Such an approach often leads technology use, and its "effectiveness", to be measured and reported in terms of the technically orientated system. For example, the number of computers available per student, the amount of time that a computer system is used, and when and for how long the internet is operational versus its 'down time'. This approach makes "teachers...vulnerable to blame" (Cuban, 1999b, par. 28) because ICT use and ICT underuse, together with problems and solutions for ICT are framed within the language of the technical system. For instance, the school has a 1 to 1 computer to student ratio, yet the computers are still not being used, therefore it has to be the teacher's fault. These approaches to school-based technology are further complicated by the roles and responsibilities of teachers mostly being defined externally (Conlon & Simpson, 2003). As a result of these two external influences, the role of the teacher in the implementation of technology for teaching and students' learning is often ignored or downplayed, so teachers are less empowered in the decision-making process (Lim & Barnes, 2002).



When teachers, as the main facilitators of students' learning, are not considered as key stakeholders in the school's technology decision-making process they are unlikely to be motivated or high users of the technology, despite how readily available that technology may be to those teachers (Cox et al., 2004). The reason for this is, that historically teachers have been resistant to changes when they have not had a significant and sufficient input into the school's planning, monitoring and reporting process. In relation to technology-based change, policy makers, technology designers and end users such as teachers', need to consider the "contextual and situated" (Ferneding, 2003, p. 61) nature of the technology and how it will be used. This is particularly pertinent in the education sector where any change has to contend with the deep-rooted traditions of teaching (Cuban, 1986; 2001) in addition to competing with the complexities of the technology itself. Therefore, when implementing any change in the education sector all end users of the technology need to be considered, together with the coordination of resources, training and associated on-going refinement of the process (Campbell, 2001).

In terms of the application of ICT in schools there are factors that encourage and discourage this application and factors that are promoters or inhibitors of this application. This interaction between these factors causes oscillations, as best illustrated by the metaphor of a seesaw (Figure 2.2). In the seesaw metaphor the fulcrum represents the teachers and their use of technology which in turn is influenced by the corresponding influences (weight) on each end of the seesaw- whatever end of the seesaw is down has the most influence on technology use and its effectiveness. This simple metaphor is further complicated by the teacher representing the seesaw's fulcrum, which is able to move along the horizontal arms of the seesaw resulting in further fluctuations. The fulcrum in turn is comprised of teachers' specific factors, such as technology-teaching beliefs, experience, attitude and knowledge.



*Figure 2.2 Seesaw analogy*

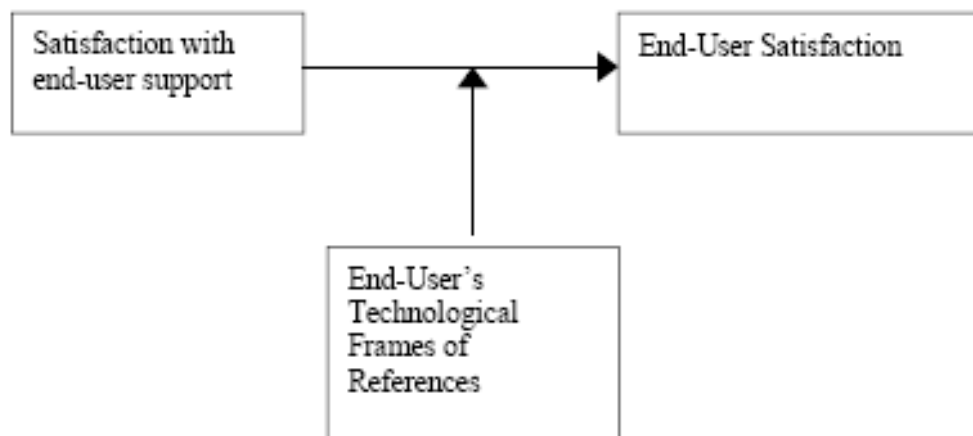
In exploring the inhibitors and promoters around teachers' use of digital technologies the literature identified that there were more than technical, pedagogical, psychological, social and economic factors that contributed to the use or non-use of ICT in the education sector. Indeed:

... it is widely known that many...projects involving new information technology...fail for reasons unrelated to technical feasibility and reliability...both IT specialists and...managers frequently have and hold on to failure-promoting beliefs about their roles in change...Implicit in...IT-enabled...projects ...are expectations that the organisation and its people will operate better when the technology is successfully installed and used (Markus & Benjamin, 1997, p. 55).

Even though the reasons for implementing digital technologies into the education sector, and each school or classroom may be different which leads to “a lack of clarity in the visions for the organisation, a unifying theme runs through all – information technology (IT) is a critical component that is both driving change and enabling survival” (Appelgate, 1994, p. 18). Furthermore, the research literature, educational and ICT, is supportive in its assertion that ICT can improve the quality of services offered (Marginson, King, & Macauley 2000; Mintzberg 1994), provided that stakeholders are consulted in the decision-making process. This final point was also made in Smith's (2001) KPMG Management Consulting report that identified one of the root causes of troubled projects in the U.K. public sector was a lack of involvement and

commitment by the organisation's staff. This in turn appeared to have had an impact on overall stakeholder attitudes about those projects, and was thus felt to be a contributing factor to their reported less than satisfactory project outcomes and general staff satisfaction.

Attitudes and perceptions about the success or failure of an organisation's technology projects are likely to have a significant impact on the way these projects are viewed by others in the organisation. In relation to these points, a meta-analysis of the literature on ICT and users' satisfaction levels indicated that end users' satisfaction was derived from the perceived benefits and convenience they thought were made possible by the technology; the users' previous technology experiences and level of technology use, and how their organisation supports the technology both in terms of staff training but also in relation to keeping the technology functional (Mahmood, Burn, Gemoets, & Jacquez, 2000). Users' satisfaction aspects, as illustrated in Figure 2.3, in turn influence and are themselves influenced by the inhibitors and promoters that were identified in Tables 2.2 and the seesaw notion is illustrated in Figure 2.2.



*Figure 2.3* Mahmood's et al. (2000) concept of users' satisfaction

In considering the relative merits for the success, or otherwise, of school ICT use, three indicators and measures of progress become apparent. These performance indicators, as

tabulated in Table 2.3, were predominantly derived from the literature review; in particular the inhibitors and promoters for ICT use in schools.

Table 2.3.

*Factors which need to be addressed by technology decision-making models*

Factor	Indicators
Infrastructure	Computer: student ratio
	School's technology access to and from home
Usage	How is the technology being used for teaching and students' learning?
Leadership	Vision for how the technology will be used in the school.
	Who is involved in the decision-making process?

The three factors identified in Table 2.3, were synthesized from the reviewed literature by a process of assigning factor names to the key concepts and ideas iterated in reviewed ICT and education articles. These performance indicators in turn have synergy with the inhibitors and promoters for technology school use, as identified in Table 2.2. This is not a surprise, as to make effective decisions for school technology use, principals and ICT school leaders need to ensure that the technology will be used, and for this to occur they need to minimize the inhibitors whilst maximizing the promoters.

In relation to infrastructure the literature reviewed indicated that having access to technology does not necessary mean that it will be used. Even so, much of the literature indicated that having high levels of access to technology within the school is essential for the further use of

ICT (Kenelev et al., 2004). School leaders need to make decisions which will give students access to technology and the skills required to utilise that technology both at school and home, which then moves education towards 'anytime, anywhere' delivery. In addressing the infrastructure requirement schools need to ensure that the ICT is maintained and is functioning when required by staff and students. Furthermore, the technology and its associated infrastructure (i.e. hard/software, networking, peripherals and accessories such as printers) have to be updated on a regular basis in order to keep the technology functioning and current. Indeed Dede (1997) maintained all newly purchased technology would "become obsolete in five years" (p. 14) and so the school requires a policy and operational plan to update the technology before this time. Given the technology life cycle may be considerably less than expected constant technology maintenance and upgrading needs to be a planned event, which in turn has financial and ICT training repercussions.

By addressing the infrastructure question school leaders also need to ensure that the financial and physical effort of placing the technology in schools has an effective outcome. To this end school leaders are making decisions to ensure that the technology improves "teaching and learning experiences and streamline[s] administration" (Hay, 2001, p. 5). To achieve this, technology has little effect if it is 'pasted' "onto existing pedagogy, evaluation procedures,... [and] work practices" (Russell & Russell, 1997, p. 130). The 'pasted' technology approach may help to explain why some studies have found that technology integration into the curriculum have had disappointing results (Becker & Ravitz, 2001; Simpson & Payne, 2002). To overcome the sometimes disappointing technology and curriculum integration school leaders have often provided all their teaching staff with ICT professional development on how to operate the technology and how to use it in their teaching practices. Despite teachers' technology knowledge and skills improving it is still difficult to ascertain how the technology has been integrated to change teaching practices (Llomaki, Lakkaa, & Lehtinen, 2004) and that technology, rather than pedagogy, is still driving the educational-technology agenda (Hay, 2001; Selander, 2003). Therefore, in order to address usage, more than professional

development may be required. Perhaps what is required is not to see technology as the panacea to the educational problems of the 21<sup>st</sup> Century but for schools to ask themselves questions about what do they want from the education process of using technology (Riffel & Levin, 1997). This in turn empowers the education sector to select technologies which best suit the type of teaching and students' learning environments that the school wishes to promote. "i[I]dentifying the education goals and ensuring the technology is appropriate [or adapted] to serve" (Beynon, 1993, p. 228) ensures that technology is a tool for teaching and students' learning and not something which has to be 'pasted' in to fit political or community expectations.

## The Principal

Effective school technology use therefore requires forward-thinking leaders (Slowinski, 2000) and the research literature indicated that the principal holds a key role for implementing technology into schools (Cooley & Reitz, 1997; Hope, Kelly, & Guyden, 2000; Trotter, 1997; Wilmore, 2000). In making decisions educational leaders "cannot [operate] in a...vacuum" (Barone, 2001, p. 47), as such technology leadership decisions need be made in consultation with a variety of informed individuals from inside the school and from other sources such as business, computer firms and research findings. Though, as previously pointed out, school decisions tend to be shaped by relatively narrow sources of information (Riffel & Levin, 1997). Such narrow sources can include the ICT coordinator. Whilst studies reported that having a school technology coordinator is essential for the successful integration of technology into the curriculum and that technical support should be supplied by technicians (Lai, Pratt, & Trewen, 2001), these coordinators should not be relied upon to be the sole drivers of the technology change in the school. This is because the ICT coordinator is usually a teacher and so their main understandings would be directed towards teaching and students' learning (Lucock & Underwood, 1981) whilst technicians tend to focus on technical aspects above all else (Pullen & Vaughn, 2008; Ward & Hawkins, 2003). So effective technology leadership relies on the school

leaders having an educational vision, which is dependent on the principal coordinating information from a number of financial, pedagogical, technical and research sources to better understand how technology can be “applied to accomplishing the tasks” (Hope, Kelly, & Guyden, 2000, p. 369) set in the school’s vision or mission statement and enacted in the teaching and learning experiences of teachers and students. Given that there are many factors which promote or hinder ICT uptake in schools, this study’s third research question sought answers to: *What are the inter relationships between teachers’ and students’ background, access to technology, and attitude towards technology?*

### Summary of meso (external to the school) elements

Arguably school leadership plays an important part in a school’s technology decision-making process. Nevertheless, it is the teachers who ultimately have the final say in if and how the technology will be used. The literature indicated that teachers utilised new teaching aids or materials all the time (Howard, McGee, Neil, & Purcell, 2000; Richardson & Anders, 1994; Stiegelbauer, 1994). Conversely, these same studies and others (Hope et al., 2000; Yocam, 1996) have also showed that teaching style tended to remain stable over time, despite teachers integrating more modern practices into their teaching (for example, small groups and learning contracts). Therefore, an essential aspect that school leaders need to encapsulate into their education vision and planning is the ability of the leadership to be inclusive, which according to Senge “if people don’t have their own vision, all they can do is ‘sign up’...The result is compliance, not commitment” (Senge, 1990, p. 211). Consequently the “school culture has a major influence on the quality of opportunities...[provided to] each child...and the ethos of the school...have a direct bearing upon teaching and learning” (Dalin, 1993, p. 20). As such the beliefs and attitudes of teachers towards the utilization of ICT in their teaching practice is fundamental in understanding how ICT is currently being used by teachers in Australian schools and goes some way to identifying what needs to be done to improve the use of technology in Australian schools.

## Justification for research questions

The literature review reported in this chapter has highlighted and discussed how technology is helping in changing the world from the industrial age to the information age. A fundamental aspect of this transformation process is the requirement for workers to be lifelong learners and productive workers in a knowledge based economy. This transformation process is dependent on the education sector preparing students to be capable and confident users of digital technologies. In preparing students to become productive users of technology the education sector is challenged by a number of factors which need to be considered in the planning and subsequent use of those technologies in the classroom. This leads to the generation of the overall research question:

*RQ1 How can schools successfully embed digital technologies for teaching and students' learning?*

The reviewed literature indicated a disparity between the expected outcomes of employing digital technologies and the reality of its adoption and use by teachers in schools. To understand this disparity, it is important to be aware of the dissonance between the experiences of the end users of school technology (teachers and students) and how technology success is often reported (i.e. access and hours). Consequently this access and usage gave rise to the subsidiary research question:

*RQ2 How are schools utilising digital technologies for teaching and students' learning?*

Given the vast amount of time, money and effort that has been devoted to providing digital technologies to the education sector to the point of near universal deployment, why is it that despite available resources, usage is not higher?



The nearly ubiquitous deployment of digital technologies into the compulsory education sector has often been driven by governments, businesses, educators, and social commentators in the belief that technology will revolutionize how teaching and students' learning will occur. In essence, ICT is being seen by some to offer possibilities to fundamentally change the delivery and "landscape" of education. In utilising ICT in schools the technology itself brings with it intended and unintended consequences. Additionally, teachers themselves are having their beliefs and values challenged by the technology, but also by the changing nature of education delivery to students and the wider knowledge economy. Even so, as Cuban (1986) iterated in his substantial review of technology and innovations, sometimes neither the technology nor the innovation lead to substantial changes in educational and school practice. Consequently, what is required is an understanding of how all of the previously mentioned factors come together to affect the use of digital technologies in schools. This understanding is important, for in order to elicit substantial and sustained technology-based classroom change, the divide between the espoused notions of the benefits derived from ICT and the observed reality of current technology use need to be bridged. This leads to the articulation of the final research question:

*RQ3 What are the inter relationships between teachers' and students' background, access to technology, and attitude towards technology in their teaching?*

## Chapter summary

This chapter reviewed previous literature and studies on ICT application in schools, in particular the inhibitors and promoters to digital technology use in the classroom by teachers and the school decision-making processes behind the reason to use or not to use ICT for teaching and students' learning purposes. The literature revealed mixed levels of digital technology, specifically computer, use in the classroom where they were predominately used to support existing teaching practices, rather than as a tool for more personal and self-directed instruction

and students' learning. The literature further indicated there were multiple factors that inhibited or promoted teachers' uptake of ICT for classroom use.

The literature reviewed and the resultant discussion in this chapter has offered some reasons and explanations for technology use or under use in classrooms. Many of the studies tend to focus on only one of the factors at a time. Furthermore, much of the recent ICT and school research focuses heavily of inhibiting factors without references to wider social or political influences on schools. The literature reviewed also fails to adequately identify a comprehensive theoretical basis for explaining how these factors relate to each other and ultimately to the use or rejection of ICT in the classroom by teachers. The teachers' decision to use or not to use ICT was influenced by multiple factors, including the technology, the curriculum, the teachers' pedagogy (specifically their perceptions of the technology) and time to 'learn'. In addition, the literature indicated that technical planning needed to be built into a school's overall educational mission or vision, which incorporated teaching and students' learning. All of these aspects come together in the formulation of the study's research questions.

In summary, this Chapter has reviewed and analysed the pertinent literature as it relates to ICT and education culminating in a number of research questions. In seeking answers to these questions the following chapter (Chapter Three) describes and justifies the methodology used to provide those answers. This is then followed by Chapter Four which presents the findings to those questions. Finally, Chapter Five summarizes the research findings, discusses the findings in relation to the study's research questions; suggests implications for teachers and school leaders and outlines areas for further research.

## Chapter 3 Methods

### Introduction

The previous chapters have provided the contextual factors and antecedents for this study. Chapters 1 and 2 indicated that western societies are in the process of changing from an industrial base to knowledge based economies. Facilitating this economic change is information and communications technology, which is requiring a shift in when and how individuals learn, to the point that learning is being viewed as a lifelong process. Within the compulsory education sector ICT is seen by many (Hancock, 1993; Middlehurst, 2003) as a mechanism for promoting lifelong learning. However, the compulsory educator sector, unlike other sectors such as health and commerce, appears slower in being transformed by the technology revolution. Given this understanding the current study seeks to comprehend the issues associated with ICT use or non-use in order to provide answers to the study's first research question of *how can schools successfully embed digital technologies for teaching and students' learning?* (RQ1).

To provide answers to RQ1 this chapter illuminates the study procedures used for data generation, data analysis and writing. The first section begins by examining the different methodological approaches that guide research, before explaining the rationale behind the chosen methodology. This is followed by more detailed sections addressing the populations for the study, design of the research instruments and use of the research tools that were utilised in the study.

The overall research question was broken down into two subsidiary questions which focused on: (a) the current use of technology and (b) what influences the use of that technology to provide a different perspective on perhaps an old question.

A better understanding of the nature of school technology use and how decisions are made to

use that technology can form a strong basis for understanding not only current school practice but how to improve that practice. Following this line of thought, the subsidiary set of research questions were:

*RQ2 How are schools utilising digital technologies for teaching and students' learning?*

*RQ3 What are the inter relationships between teachers' and students' background, access to technology, and attitude towards technology?*

### Research methodology –paradigm

A research methodology needs to consider the nature of the phenomenon to be investigated, and then address the question of which method will best describe, explain or interpret this phenomenon. To achieve this, researchers need to examine methodological concepts and to then state their methodological and epistemological position (Deshpande, 1983; Flick, 1998; Maxwell, 1998). Researchers also need to understand and adapt to a theoretical paradigm (Deshpande, 1983). A paradigm is a framework, and a set of basic beliefs (Guba & Lincoln, 1994) that researchers need to understand the phenomenon being investigated. The basic principles or paradigms are methodology, epistemology and ontology (Mulaik & James, 1995; Neuman, 2003). Given the objectives of this study which concern ontological, theoretical, methodological, and practical issues associated with researching how teachers use (or do not use) digital technologies in their teaching practice, and their level of involvement in the school's decision-making processes to adopt new technologies. This approach raises the question and problem of 'how' to conduct research on digital technology in an educational setting given that it is simultaneously a problem which concerns technology, society, economy, pedagogy, culture and politics. It is a trans-disciplinary problem, or a heterogeneous problem and the research requires a methodology that reflects the heterogeneity of those problems.

Accordingly, Bateson (1972) stated that “human beings are guided by highly abstract principles” (p. 320) which encompass beliefs about ontology (the nature of reality) and epistemology (the relationships between the inquirer and the known). These beliefs in turn determine how we know the world and gain knowledge of the world; as such provides a methodology (Silverman, 1993, p. 2) and a research paradigm to guide inquiry and understandings. Given the complexity of researching human and technology interactions (humachine) the chosen methodology needed to be robust enough, yet flexible, to capture the actors in the school network.

Historically, researchers in the field of education, educational psychology, educational sociology and technology have sometimes tended to rely on either a qualitative or a quantitative approach, however this distinction has arguably become less of a concern and researchers are now combining the two (Berg, 2007; Denzin & Lincoln, 2000). In ascertaining which research method to adopt for the current study the approach was taken to use whatever tool would do the job. This approach is supported by Miles and Huberman (1994, p. 2) who asserted that “people who write about methodology often forget that it is a matter of strategy, not morals”. Given this approach the study utilised a mixed methods (quantitative and qualitative) approach, which followed the lead of others in the field of sociology, especially in sociological life studies (Flick, 1992; 1998; Maxwell, 1998).

This methodology helps determined how best the research question/s could be answered and is underpinned by the method/s used to collect and analyse the study’s data (Silverman, 1993). Similarly, Guba and Lincoln (2000) considered that researchers need to choose the most appropriate research methodology and methods for their study using a broad understanding of ontology and epistemology (p. 19). Further to this Harding (1987) defined methodology as “a theory and analysis of how research does or should proceed” (p. 3). As such, the researcher attempts to achieve methodological reflexivity in which reflexivity aims to align research methodology and practice with researchers who then theorize about the reality of their subject

(Alvesson & Skoldberg, 2000; Giddens, 1984; Rice & Ezzy, 1999). The methodology therefore establishes how the research questions can best be answered and this is underpinned by the methods used for the collection of, and, subsequent data analysis.

This current study contributes to methodological reflexivity in digital educational research by asking how this research field should proceed, given the heterogeneity of the topic being investigated. The research questions are framed in light of this heterogeneity by asking: how digital technologies can be embedded for teaching and students' learning and what factors affect the decision-making processes behind this innovation? Therefore, this study adopts Giddens' (1984) notion of research reflexivity by acknowledging that all actors are inherently reflexive, yet "operates only partly at a discursive level" (xxiii). For example, in this study the researcher actively engaged in reflexivity at both a practical and discursive level by recognizing that not all could be known or written about, an approach that is supported by Garson (2003). For example, this research does not assume to understand or to know all about the decision-making culture and digital technology use in all the schools investigated. Additionally, the study does not assume to know if the decision-making or the decision to use digital technologies was a shared, individual, or school perspective or if it represented individual teacher interests. Furthermore, it was not assumed which factors impacted on teachers' decisions to use (or not to use) digital technologies in their teaching practices.

Therefore, for this study three different research paradigms were considered as possible methodologies-positivist, critical science and interpretative-based on the study's purpose to understand teachers' use of digital technologies and the factors that inhibited or facilitated this use. Each of these research paradigms differ in their underlying assumptions which in turn guides the choice of research methods that the researcher can adopt. The main differences between the three paradigms are summarized in Table 3.1 (adapted from Cantrell, 1990, p. 3; Kim, 2003, p. 10).

Table 3.1.

*Methodological Paradigms*

Methodological Paradigms			
Underlying assumptions and beliefs about:	Positivism	Critical Science	Interpretivism
Purpose of research	is the assumption that there are universal laws that govern social events, and uncovering these laws enables researchers to describe, predict, and control social phenomena	seeks to explain social inequities through which individuals can take actions to change injustices	seeks to understand values, beliefs, and meanings of social phenomena, thereby obtaining a deep and sympathetic understanding of human cultural activities and experiences
Epistemology – nature of knowledge	events are explained based upon knowledgeable facts, real causes or simultaneous effects; predictable regularities exist	events are understood within social and economic contexts with an emphasis on ideological critique and praxis	events are understood through mental process of interpretation which is influenced by and interacts with social context-people act on what they believe
Relationship between the knower and the known	Independent	Interrelated, influenced by society and is committed to emancipation	Interrelated, dialogue
Role of value(s) in research	Value free	Value bounded; ideological and concern for inequalities	Value bounded

Drawing from Table 3.1, positivistic researchers utilise scientific methods of enquiry to research their fields of study. From this perspective society exist independently of the researchers who usually come to know it through observation, experimentation and rational induction. The positivist approach includes proposing a hypothesis, choosing methods to collect data to support or disprove the initial hypothesis, and from this, formulating a theory based on the factual evidence collected in the study. The main difficulty of the positivistic approach is that when it is applied to a social setting, as in this study, it:

...regards human behaviour as passive, essentially determined and controlled, thereby ignoring intention, individualism and freedom (Cohen, Manion, & Morrison, 2000, p. 19).

A critical science paradigm, as shown in Table 3.1, is concerned with a commitment to social change and a critiquing of ideologies. As such, the paradigm is concerned with emancipation and addressing of inequalities. This particular approach was not considered appropriate for the current study as the goal of this study was not to address inequalities but to interpret processes and practices as they occurred in a natural social setting.

The third column of Table 3.1 indicates the interpretative paradigm by which researchers seek to understand how individuals' construct their world and their societies. From this perspective knowledge about the world is usually constructed in human culture and social terms. The interpretive approach allows the researchers to therefore construct and understand the "reality" being investigated within the social and cultural setting (natural setting) of the participants who are being studied. This type of approach is open to criticism because it is believed that the researcher cannot be 'value free.' However, Freeman (1998, p. 18) maintained that:

...what people believe to be true is more important than any objective reality; people act on what they believe ... (sic with) real consequences to their actions.

This belief is also supported by Smith (1988, p. 171) who stated that:

...inquiry is not a matter of offering interpretations, but one of offering interpretations that become reality.

For these reasons an interpretative paradigm (Freeman, 1998; Smith, 1988) was chosen because it suited an investigation into ICT use, governance and effectiveness without prior assumptions.



## Research approach

The ontological perspectives adopted by a study helps the researcher to determine the research methods to be employed. For this study, qualitative and quantitative data collection methods were used. This section therefore examines and discusses the different methods that can be used within interpretative research. Issues that may arise from using qualitative and quantitative research methods are also examined.

To put the paradigm of enquiry into practice Guba and Lincoln (2000) stipulated that the researcher needs to employ a number of inquiry strategies to connect the researcher with the participants who are being researched. Cohen, Manion, and Morrison (2000, p. 45) referred to this as “approaches for exploring and predicting the research field.” In order to connect the social researcher to the participants, the study can employ either qualitative, quantitative or both types of data collection and analysis methods.

Qualitative methods attempt to show meaning and patterns through an authentic understanding of people’s experiences (Silverman, 1993) and show a more ‘in-depth’ view of a social setting or phenomenon under study, than do quantitative methods. This approach enables the researcher to discover underlying meanings and relationship patterns (Babbie, 1983). Table 3.2 (Adapted from Freebody, 2003, pp. 75-89; Hatch 2002, pp. 1-35) summarizes the advantages and disadvantages of each of the main qualitative research methods. As a method, qualitative research involves non-numerical examination and interpretation of observations or interviews, for the purpose of discovering underlying meaning and relationships (Bogdan & Biklen, 1998; Hammersley, 1993). Qualitative researchers attempt to get a multiple focus on the topic that is being investigated. Merriam (1988, p. 17) called this approach a worldview in which “there are multiple realities, that the world is not an objective thing...but a function of personal interactions and perception.” As these changes are dynamic and change over time a method or methods that capture these changes and the experiences of the participants is required.

Table 3.2.

*Comparison of main qualitative methods*

	<b><u>Advantages</u></b>	<b><u>Disadvantages</u></b>
<i>Ethnography</i>	<ul style="list-style-type: none"> <li>. detailed exploration</li> <li>. observational</li> <li>. wide ranging</li> <li>. generalisable</li> <li>. flexible</li> </ul>	<ul style="list-style-type: none"> <li>. long term</li> <li>. time consuming</li> <li>. considerable data analysis</li> <li>. validity</li> </ul>
<i>Case Study</i>	<ul style="list-style-type: none"> <li>. in-depth analysis</li> <li>. focused</li> <li>. careful observation</li> <li>. validity</li> </ul>	<ul style="list-style-type: none"> <li>. time consuming</li> <li>. not generalisable</li> <li>. single phenomenon</li> </ul>
<i>Action Research</i>	<ul style="list-style-type: none"> <li>. problem solving</li> <li>. implements change</li> <li>. participative</li> <li>. careful observation</li> <li>. collaborative</li> </ul>	<ul style="list-style-type: none"> <li>. time consuming</li> <li>. individualized</li> <li>. not generalisable</li> </ul>
Grounded theory	<ul style="list-style-type: none"> <li>. inductively derived from the study of the phenomenon it represents</li> </ul>	<ul style="list-style-type: none"> <li>. considerable data analysis</li> <li>. how are data grounded?</li> </ul>

Quantitative research on the other hand involves numerical representation and manipulation of observations for the purpose of describing and understanding the phenomena that was observed. The numerical data can then be used to identify and explore relationships between the variables being examined (Casebeer & Verhoef, 1997; Miles & Huberman, 1994). For example, using surveys quantitative data can be pooled together to make generalizations about the behaviour being studied.

Both qualitative and quantitative methodologies have a large body of literature indicating the relative merits and limitations of each approach and employing both (a mixed methods approach) within the same study offers unique advantages (Greene, Caracelli, & Graham, 1989; Krathwohl, 1993). A mixed-methods approach can provide a richer understanding of the phenomenon being studied than a single method alone. The reasons for this are that a qualitative data collection method within a school environment can provide a greater depth and breadth to understanding of the school phenomenon being investigated by giving the participant's point of view (Tobin, Kahle, & Fraser, 1990). Furthermore, within a school environment qualitative approaches are enhanced by the use of quantitative methods which can help to contextualize some of the qualitative findings (Patton, 2002; Tobin & Fraser, 1998). Within these approaches the case study method (qualitative) augmented with a survey (quantitative) appears best suited to answering the questions about digital technology use for teaching and students' learning and the decision-making processes and the factors that influence those processes and practices. An explanation of the reasons behind the chosen method and subsequent data collection techniques will be discussed in the next section.

## Choice of Methods

Schools as case studies and triangulation of school data from a range of stakeholders in that school were chosen as the two key methodological approaches used in this research. This section explains why these were appropriate to the study. Digital technology use for teaching and students' learning, is still a comparatively young field as compared to psychology and sociology, so excessive attention to methodological issues might detract from the production of indispensable, albeit preliminary, research findings. However researchers should not delay or postpone discussions about methodological issues in favour of the early production of substantive results. Latour and Woolgar (1979, p. 18) suggested methodological clarification and discussion can and should take place at an early stage of development. For this reason the

case study method will be examined in more detail in this section and the underlying assumptions and reasons leading to the choice of methods will be indicated.

## Case Studies

A case study, according to Yin (1993, 1994), should not be confused with the similar strategy of ethnography. Ethnographic methods are largely derived from cultural anthropology. In studying organisations such as schools, these methods might help the researcher to extract cultural and social knowledge and identify actions and instruments that participants utilise in their everyday life (Prasad, 1997; Schwartzmann, 1993). Yin (1994) distinguished ethnographies from case studies in that the former takes a long period of time to conduct and requires very detailed observational evidence. Case studies, by contrast, are conducted within a defined period of time and do not necessarily imply the use of ethnographic techniques. Researchers conducting case studies need not even visit the organisation under study; they could collect their data by consulting secondary sources or interviewing respondents telephonically or by e-mail.

Furthermore, a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, and this approach may have the boundaries between the phenomenon under study and its context in the ‘messy’ realm where the boundaries of context and phenomenon overlap and/or are poorly defined. That was the case with this research in which the school and technology boundaries overlap and extend beyond the schools’ walls and into the homes. Yin (1994, p. 13) stipulated that “the case study allows an investigation to retain the holistic and meaningful characteristics of real-life events such as individual life cycles, organisational and managerial processes, neighbourhood change, international relations and the maturation of industries.” Therefore, the case study approach is especially useful in situations where contextual conditions of the events being studied are critical and where the researcher has no control over the events as they unfold. The case study, as a research strategy, should therefore encompass specific techniques for collecting and analysing data, directed by clearly

stated theoretical assumptions. Furthermore, data should be collected from different sources and its integrity should be ensured.

Within case study methodology a case can be classified as being singular or multiple. Accordingly, Smith (1988) and Yin (1994) described that the single case study approach is best used when the case is:

- i. unique or critical, or when the researcher is able to access a previously remote phenomenon;
- ii. critical to testing a well formulated theory, and
- iii. a pilot or exploratory study that is representative of a larger population.

Several case study researchers, such as Herriott and Firestone (1983) and Stake (1994) considered that evidence collected from multiple case studies is more rigorous and complete than if it is only collected for a single case study because of triangulation. It is for this reason that a multiple school case study approach was adopted for the current study.

Another important case study requirement indicated by Lincoln and Guba (1985) recommended that case study research should establish “trustworthiness” in order to verify the findings as worthy. They proposed that researchers should question themselves on “truth”, “value”, “applicability”, “consistency” and “neutrality”, in addressing issues in relation to the terms of conventional research methods of “internal validity, external validity, reliability, and objectivity” (p. 290). Further to this approach, Burns (1997) contended that the effort required to produce trustworthy findings that provide authentic understanding might be more time-consuming and rigorous than expected (p. 383). Whilst Isaac and Michael (1997) claimed that case study data-gathering mechanisms were similar to other data gathering methods, except that “the characterization is distinctly different” (p. 221), and case study mechanisms seek to produce findings that are “credible”, “transferable”, “dependable” and “confirmable” (p. 221).

## Triangulation as a research strategy

As discussed, rigor and validity are major concerns of researchers (de Laine, 1997; Schwandt, 2001) and triangulation is a means of ensuring research integrity (Wiersma, 1995). Triangulation is a method used to study the same phenomenon (e.g. digital technology use and decision-making) from more than one source, to provide “rich” data (Dootson, 1995; Kushner & Morrow, 2003; Maggs-Rapport, 2000). Triangulation seeks to examine data from multiple sources to strengthen interpretations. By examining data from different sources and collected by different methods, findings can be corroborated across data sets, minimizing potential biases and so giving greater confidence in the findings. For example, data triangulation assumes that if data is collected from multiple sources, researcher bias is reduced. Moreover, triangulation of data from different sources and standpoints increases the validity of that data by verifying the repeatability of the observation and its interpretation by the researcher. Carter (1990) avowed that triangulation of data collection methods not only increased internal validity but also minimized researcher bias. He also postulated that “no single method can hope to capture the complexity of...life” (p. 276) and so a mixed-methods approach utilising triangulation offers a better solution as a research method. In order to maximize a mixed-methods approach, leading researchers in this field (Cohen, Manion, & Morrison, 2000; Patton, 2002; Silverman, 1993; Tobin, Kahle, & Fraser, 1990; Tobin & Fraser, 1998; Woods, 1995; Yin, 1994) have suggested that triangulation can be achieved by:

- i. using different data sources (data triangulation);
- ii. using two or more investigators (investigator triangulation);
- iii. using different perspectives to interpret data (theory triangulation), and
- iv. using multiple methods to gather data (methodological triangulation).

Using the above triangulation and using mixed-methods can result in one of three possible outcomes (Erzberger & Prein, 1997):

- i. qualitative and quantitative results may *converge* (results lead to the same conclusion);
- ii. qualitative and quantitative results may relate to different aspects of the phenomena, but are *complimentary* (each supplements the other);
- iii. quantitative and qualitative results may be *divergent* (results contradict each other).

Cohen et al. (2000) and Yin (1994) each ascertained that multiple data sources increased reliability and trustworthiness of a study's findings and also identified relevant similarities and difference associated within the data. The difficulty is that multiple data sources and techniques can create multiple interpretations. For instance, in this study, many actors (teachers, principals, students and parents/guardians) were asked about digital technology use and school decision-making, at different times and in different educational settings. In order to find consensus from different data sources Giddens (1984) recommended that the researcher needs to look for consensus and conflict within the data. Giddens (1984) related that researchers should look for commonalities and differences, and these need to be noted in order for the researcher to gain a deeper understanding of the study, although one interpretation or experience may not be any more 'real' or 'truer' than the next. The triangulation approaches previously mentioned (Cohen, Manion, & Morrison, 2000; Silverman, 1993; Yin, 1994) have been termed triangulation of *time, place and person* (Denzin, 1997) which Giddens' (1984) termed *contextuality*.

### Other methodological considerations

An effective method of viewing multiple cases is "to consider multiple cases as one would consider multiple experiments" (Yin, 1994, p. 46). As such, each similar case is a replication of the others, and an element within a larger case study. For example a single school could be a case study but a group of schools could be a case study of community of schools associated with a district or region.

In addition to choosing a single or multiple case study approach the researcher also has to decide how the data would be collected, recorded, analysed and reported. On this point Gall,

Borg, and Gall (1996) defined the terms “qualitative”, and “interpretive” as being synonymous with natural settings where “attempting to make sense of, or interpret phenomena, is considered appropriate for the study of people in natural settings” (p. 29).

In choosing a research design that involved data-gathering methods that occurred in a natural setting the researcher needs to address issues of validity and reliability. The issue of validity “hinges around the extent to which research data and methods for obtaining the data are deemed accurate, honest and on target” (Denscombe, 1998, p. 241). Reliability is concerned with “stability, accuracy and dependability of data” (Burns, 1997). However, researchers using case study design do not easily accept the positivist terms for validity and reliability. Wolcott (1994) believed that case study researchers using quantitative data-gathering methods needed to “generate understanding” (p. 136), and Silverman (1993) advocated that “authenticity rather than reliability is often the issue in qualitative research” (p. 10). Thus triangulation within and between a number of cases was expected to provide a higher degree of internal validity associated with the findings.

### Data collection techniques

A key component of validity and trustworthiness is the unit of analysis, or what is to be studied and how. The unit of analysis is typically a system of action/s rather than an individual and/or group of individuals (Yin, 1994). Accordingly, Darke, Shanks, and Broadbent (1998) suggested:

...the unit of analysis identifies what constitutes a ‘case’, and a complete collection of data for one study of the unit of analysis forms a single case. [sic This] may be an individual, a group, an organisation...or some other phenomenon (p. 280).

As a result the unit of analysis approach, case studies tend to be selective, focusing on one or two issues that are fundamental to understanding the system being investigated. In the current study the unit of analysis was enhanced by describing where the decision to use digital



technology for teaching and students' learning occurred, whether that unit is internal or external to the unit being examined. In other words this can be at the level of the school itself, but also a department level or class level, a network or machine level and even on a personal (teacher or student) level. To study and analyse the system of action in the current study (the decision to use digital technologies for teaching and students' learning and the implementation of this decision) the results of the case studies have to be brought to a higher level than the individuals themselves. To obtain this data, collection techniques needed to match the purpose of the investigation. This section therefore examines the different data collection techniques and the merits and limits of each approach. From this discussion those considered most appropriate for the study are described.

There are a number of potential sources for data collection in case study research. Stake (1994) and Yin (1994) identified at least six sources of data based evidence associated with case studies research:

- documents
- archival records
- interviews
- direct observation
- participant-observation
- physical artefacts

These six sources of evidence can be re-categorised into three sources – documentation (including artefacts and archival records), interviews, and observations.

### Case study schools and the data collection process

Having identified that a multiple case study approach would be used in this study, the next step was the selection of assessment procedures. Because this study is an examination of schools' digital technology use and the decision-making process used in those schools, data would be

collected by interviews and surveys. As such, it is the goal of this study's design to try to accurately describe and give "voice" to the human and technology (humachine) being studied.

The following sections examine in more detail (1) the processes by which the case study schools were selected; (2) the data collection tools and processes involved in the collection of the data, and (3) the mechanisms used to analysis the data to gain meaning from the that data.

## Participants

The current study drew upon six schools selected across Australia to sample independent and government schools' use of ICT. The targeted population of respondents for this study was a random sample of 10% of the teaching staff in each of the schools; one class of students (selected by the principal) and their guardians/parents, and the principal of each of the participating schools. In effect, the sample was one of convenience and the study size was selected to be manageable whilst still giving the research an insight into the use of ICT in the study sites.

The current study's participants can be considered to be a purposive (non-probability) sample. It resulted in the follow participants being selected 6 principals, 56 teachers, 120 students and 84 guardians/parents. This was a volunteer population, as documented by previous studies (Creswell, 2003; Tashakkori & Teddie, 2003). When working with purposive cohorts, Tashakkori and Teddie (2003) suggested that the researcher "uses some criterion or purpose to replace the principle of cancelled random errors" (p. 279). In this case the researcher worked with a selected group of ICT and education leaders to identify schools to participate in the study. These educational leaders held the positions of: university educational academics; ICT academic, computing sociologist, director of an international educational ICT company, education department learning technology manager, and State education portfolio Minister. Each of these individuals was asked to list 5 schools, which they had contact with and with

whom they thought would be interested in participating in the study. At the end of this “listing” process, 30 schools were identified.

In order to manage the current study several criteria were established to select the case study schools. These criteria were to include schools from the Independent, Catholic and Government education sectors. Furthermore, it was decided to select schools that were located in postcodes which corresponded to Australian Bureau of Statistics (ABS) low, low-middle, middle, middle-high and high socio-economic status. In addition the researcher wanted schools which had different student enrolment numbers. That is, small student enrolments through to schools with a high number of enrolled students. The researcher was also interested in studying the responses of students in the middle years of schooling (typically grades 5 to 9) and so the school had to cater for grades in this range. One last criterion was that the schools had to be in an area that was readily accessible to the researcher; to this end only schools from Tasmania and Victoria were to be selected. From the initial list of 30 schools, 2 Tasmanian and 4 Victorian schools matched the required criteria. These schools were then approached by the researcher who subsequently explained the research; this resulted in both the Tasmanian schools and 4 Victorian schools expressing their willingness to participate in the study. A key condition for each school to participate was for their identity to be protected in subsequent reporting and publications. To this end, each school was assigned a pseudonym at the beginning of the study (School A, School B, and so on). A brief description of the schools and their participants is given in the proceeding sections.

Table 3.3 provides an overview of the six schools, indicating the number of participants at each site, together with student-to-computer - ratio, school specific information and economic status of the school postcode area.

Table 3.3.

*Overview of case study schools*

School name	School A	School B	School C	School D	School E	School F
Total Student enrolment	301-400 (moderate)	1301-1400 (very large)	701-800 (moderate)	1001-1100 (large)	901-1000 (large)	<50 (small)
Computer: student ratio	1:10	1:3	1:5	1:1	1:1	1:5
Grade surveyed (number of students surveyed)	6 (30)	9 (22)	7 (24)	7 (12)	7 (14)	4-6 (18)
Number of teachers surveyed (and interviewed)	3 (1)	25 (4)	9 (1)	7 (1)	9 (2)	3 (1)
Number of guardians surveyed	21	8	17	17	14	7
ICT specific contexts	Reliance on a computer lab for student computer use	Staff Computer Mentor scheme	Laptop banks & yr 6 Tablet PC trial	Laptops since 1998	Laptops since 1997	Use of non-school computers via an online access centre
Average weekly income for school post code <sup>1</sup>	\$875	\$1008	\$1572	\$1331	\$1331	\$853
Average weekly rent for school post code <sup>3</sup>	\$150	\$231	\$240	\$250	\$250	\$90
Social-Economic-Status ranking	Middle/low	Middle	High	Middle-high	Middle-high	Low

<sup>1</sup> The average weekly income and rent for schools was obtained through a process of matching the school's postcodes to Australian Bureau of Statistics (ABS, 2001) social-economic indexes for area <http://www.abs.gov.au/ausstats/abs@.nsf/2f762f95845417aeca25706c00834efa/459c3882fad473a2ca2570eb0083be84!OpenDocument>

## Data collection instruments

The main data collection techniques used in the study were interviews, participant questionnaires and publicly assessable school artefacts such as websites, prospectuses and annual reports. The participant questionnaires formed the largest and most important source of information, especially as the data from the surveys will be used to better understand technology use (or non-use) in the case study schools.

Four structured questionnaires: Principal (school); Teacher; Student, and Guardian (Parent), were used as the research instruments in the study. Each survey was comprised of items about personal beliefs and attitudes, open-ended responses, and demographic variables (gender, age, grade and digital technology use). Because the study used latent variables which were not directly observable, the use of multiple item scales or repeated questions was used to ensure greater variability and enhance reliability of the item being measured which minimizes errors, because the errors of each item would cancel out the other (DeVellis, 1991).

The survey instruments were developed by combining items from previously validated questionnaires and from items raised in the review of the literature. A number of theoretical constructs or models relating to ICT use were available. Prominent among these were technology behavioural beliefs by Kwon (2002), normative belief questions arising from studies by Marcinkiewicz (1996) and Meredyth et al. (1999), and belief and use questionnaires developed by Taylor and Todd (1995), Lumpe and Chambers (2001) and Preston, Cox, and Cox (2000).

Each survey was accompanied by an information sheet introducing the researcher, and giving the purpose and general format of the study as a part of the process of gaining informed consent. This effectively acted as a cover sheet for the questionnaires. It was decided that the surveys would be deployed to the teachers, guardians and students in a paper format as the researcher

did not know their level of access to technology as this was one of the issues that the investigation was seeking to discover. It was ascertained through discussions with principals when they agreed to participate in the study that they had daily access to a computer and the Internet. The principal survey was therefore given in both paper and electronic formats in case the principal chose to disseminate parts of their survey to other staff to complete. Furthermore, confidentiality had been guaranteed on the information sheet, and was followed up with a reminder in the questionnaire forms. Informants were reminded that participation in all or part of the study was voluntary, but their opinions were valued. The acceptability of all responses was emphasized, and respondents thanked for their help. A more in-depth description of the development of each survey is discussed below.

### Principals' Survey

The *Principals' Survey* (see Appendix 1) adapted questions from the Australian Real Time study by Meredyth et al. (1999) and examined school's ICT equipment and principal perceptions of ICT usage at their school. After lengthy discussions with the same education and ICT industry leaders who helped to identify possible schools for the current study, it was decided to change the format of many of the Real Time questions from stem responses to Likert-type responses so that more detail could be collected from the questions asked. Furthermore, an additional 28 questions were added, as compared to the Real Time study, in order to collect additional information on ICT decision-making and the influence of a range of internal and external actors on ICT decision-making and use. As such, the Principals' Survey consisted of 68 questions organized into 10 sections.

Each section related to a different aspect of the school and its ICT. Section One (7 questions) used stem cell responses to collect demographic and background information on the school, for example, the number of teachers and students; whilst Section Two (4 questions) used Likert-type questions to elicit principal responses to a range of school interactions with other

organisations. For example, question 8 used a four point Likert scale of “Not at all”, “Low”, “Moderate” or “High” for principals to answer the following: “Please indicate in your view how important the following aspects are in the mission (statement) of your institution: Interaction with higher education institutions”. Section Three (12 questions) reviewed policy and leadership processes-typically who was involved in ICT decision-making and how were they involved. This section used stem cell responses, such as question 18 “Which of the following groups of actors do you consider of most importance with respect to the on-going implementation of the learning-technology related policy in your institution?” The principal could then choose from 8 options, including “we don’t have a learning technology policy” or naming additional actors by indicating “other”. This section also used the four point Likert scale to indicate the level of involvement of actors; together with some questions, such as question 13 “Is the systematic adoption of new learning technologies an on-going part of your institution’s planning” requiring a “Yes”, “No” or “Uncertain” response.

The fourth section (6 questions) comprised stem cell questions pertaining to ICT in-school funding and ICT technical support, and in addition question 25 required principals to write what percentage of their learning technology budget was funded by school fees, levies, donated, sponsored or leased. There were also 2 questions requiring a “Yes” or “No” type response with a third option relating to “No, but considering”. Sections Five (5 questions) and Six (9 questions) used Likert responses together with “Yes” or “No” questions to ascertain the principal’s opinions regarding student and teaching staff access and usage of ICT at school. Technology allocation and where the principal thought that that technology was being used were ascertained by Likert questions in Section Seven (6 questions). The principal’s opinions regarding the influence of external organisations on the school’s use of ICT was asked in Section Eight (3 questions) using a five point Likert scale “Not at all”, “Little”, “Some”, “Much”, and “Very much”. This section was influenced by the literature review which indicated the breadth of external actors’ influence on school planning and policy, for instance, “parent groups” and “education authorities”.

The impact of ICT on the school was ascertained using a five point Likert scale in Section Nine (6 questions); whilst the final section (Section Ten-10 questions) used a combination of Likert and stem questions together with an open-ended question to ask the principal to make some predictions regarding ICT use in the near future. In general, the Principals' Survey was designed to elicit information about the school together with the principal's perceptions on current and future ICT usage. Whilst the survey was designed to be completed in 30-minutes, principals reported that it typically took about one-hour as they were not aware of all the answers to some questions, and so had to ask others on staff.

### Teachers' Survey

The *Teachers' Survey* (see Appendix 2) was comprised of 25 questions arranged into four sections and adapted questions used in previous studies, in particular Kwon's (2002) study of teachers' ICT beliefs, normative belief questions from Marcinkiewicz (1996) and Meredyth et al. (1999), and ICT use questions utilised by other researchers (Lumpe & Chambers, 2001; Meredith et al., 1999; Preston, Cox, & Cox, 2000; Taylor & Todd, 1995; Williams, Wilson, Richardson, Tuson, & Coles, 1998). At the beginning of the survey teachers were informed that the questions related to four different types of technology use and five measures to determine frequency of usage. These areas and measures were:

Technology used for:

**Classroom practice** e.g. using ICT to support your teaching in the classroom.

**Professional development** e.g. networking with other teachers; using software packages for developing professional skills.

**Administration** e.g. monitoring student progress; recording student grades.

**Personal use** e.g. finding information for personal interest; playing computer games.



### **Frequency of technology use:**

**D** = Daily, **W** = Weekly, **M** = Monthly, **T** = Termly, **N** = Never

Section One (7 questions) used stem cell and a five point Likert response scale “Definitely agree”, “Tend to agree”, “Neither agree nor disagree”, “Tend to disagree”, and “Definitely disagree” to ascertain participants’ current technology use and perceived competency level with the technology across the four technology use domains. Section Two (5 questions) asked teachers about how they kept up-to-date with ICT, and relied on stem, Likert and closed response (i.e. “Yes”, “No”, “Comments”) to elicit this information. For example, question 10a “Have you received ICT training, in the last 12 months?” used the closed response type of question, but then asked the participant to give details about the training and aspects of the training which were useful and not so useful. Whilst question 11 asked participants to answer a series of ICT attitude and belief statements using the five point Likert scale. Some of the statements were worded positively, i.e. “I am interested in learning more about using ICT”, whilst others were worded negatively. For example, “I don’t need to use ICT in my teaching”. The reason for the use of positively and negatively worded statements was to encourage the participant to read each question carefully before responding. The next section (Section Three) was comprised of 11 stem questions that asked participants about their teaching experience and their personal demographics. The final section (1 question) used an open-ended question to ask teachers how they thought ICT would be used for teaching and students’ learning in the near future. At the completion of the survey teachers could indicate their willingness to participate in a follow-up interview by completing the “I am interested in taking part in the interviews” section.

From the random sample survey of 10% of teaching staff, teachers who indicated a willingness to participate in the semi-structured interviews later in the year indicated this on their Teachers’ Survey forms. Upon return of the Teachers’ Surveys those teachers who indicated that they

would be willing to be interviewed were contacted via mail or email to set up an interview date. Following the test case process this procedure was improved to include an interview appointment letter, which aided the teacher in remembering and scheduling the interview, whilst also providing them with the interview questions so that they could prepare for the interview.

The use of interviews is a widely accepted and valid method to collect data (Benbasat et al., 1987; Yin, 1981). The use of semi-structured interviews also allows the interviewer to probe widely and deeply on particular topics. Despite these benefits interviews also have limitations because of the type of questions asked and possible interviewer bias. The wording of questions, together with misdirected prompting can influence and possibly misdirect the interviewee (Yin, 1994). Through the test case several questions were re-written or omitted all together in order to improve the interview technique and data collected. In designing the teacher interview Bell's recommendations were followed:

...the type of interview selected will to an extent depend on the nature of the topic and what exactly you wish to find out...Once you have decided what you need to know, a decision will have to be made about the type of interview which is most likely to produce the information required (1993, p. 94).

### Teachers' Interviews

The *Teachers' Interview* (see Appendix 3) contained 14 questions grouped into two sections. The interview questions were derived from issues raised in previous studies, as described in the literature review. In designing the questions and their order, advice offered by previous researchers pertaining to "questions asked at an earlier point in the questionnaire can affect the answers supplied in later stages" (Denscombe, 1998, p. 100), and Neuman (1997) relating to sequencing were considered.

The questions were designed so that 'building up' of ideas and opinions became a strength of

the data collection. The aim of the interview was to expand and extend information gained from the teachers' questionnaires. The questions were ordered so that experience/behaviour questions came first. The reason for this is that these "are generally the easiest ones for a respondent to answer and are good places to begin to get the interviewee talking comfortably" (Glesne, 1999, p. 71). As such, Section One (1 question) asked the participant to describe their role within the school and to discuss their current and previous experiences of using ICT for teaching and students' learning. Questions which asked teachers to comment on the effectiveness or to give an opinion were considered to be potentially more threatening or anxiety raising and therefore were contained in Section Two (13 questions) of the interview. This section asked the participant to use the information that they recounted from Section One to help identify what factors facilitated or inhibited their use of ICT; together with how they perceived their school to be managing ICT. For example, question 2 asked "Which factors are important in the decision by your school to start using new forms of learning technologies?" seeking teachers for their opinion. The term "learning technology" was used during the interviews, as opposed to ICT, because the pilot case interviewees felt the term better represented those technologies used for teaching and students' learning. Whilst question 3e "Is the use of new forms of learning technologies in education voluntary or is there coercion / pressure to use it?" required more insight and acknowledgement on the part of the respondent regarding subtle and not so subtle 'political' influences on decision-making than question 2.

The interviews typically lasted 30 minutes and were conducted over the telephone at a time that was convenient for the teacher. In addition, each interview was digitally recorded with the consent of the interviewee.

All interviews were digitally recorded for transcription purposes which increased the reliability of the transcripts (Peraklya, 1997). Peraklya (1997) also indicated several factors which affect the reliability of recording and subsequent transcripts. These factors included:

- the decision of how much to record;
- the technical quality of the recordings;
- the adequacy of transcripts, and
- the inclusion of facial or body expressions.

These issues were considered and dealt with in the research. Where interviewee consents to record were given (100%) they were recorded using a digital recorder allowing electronic copying and transcribing. As only 10 interviews were conducted it was decided to record and transcribe all interviews completely allowing for a full coverage of the interview process, including many aspects of vocal expression. Full recording also allowed the researcher to have access to the full interview at a later date when themes emerge (Peraklya, 1997).

During the interviews, the cross-checking mechanisms for the data pertaining to each case study were of an evolutionary nature, that is, the questions were clarified and also refined during the process of gathering the data. The key informants have checked the results of the analysis by reviewing transcriptions of the interviews (when requested), and meetings were also held with some key participants in order to give them a chance to reflect on their comments. Participants checking their interview transcripts is one mechanism for data validation (Carspecken & Apple, 1992) whilst group meetings with several of the participants provided an opportunity for further ‘revealing’ of dialogical data (Carspecken, 1996). The group feedback was opportunistic, i.e. it took place with participants on an ad-hoc basis and not conducted as a focus group and provided the researcher with the opportunity to seek feedback on the research.

The continual researcher-participant (principal and teacher) feedback was an important approach that enabled the researcher to build a sense of trust and respect with the school community. This ‘intimacy’ allowed the researcher-participant engagement to be taken beyond a ‘clinical’ partnership to one of more depth and meaning (Fontana & Frey, 1998). This process

was maintained until the topic became “saturated” (Glaser & Strauss, 1967). Once this “saturation” point is reached additional information from this one source at this point in time can reveal few findings.

### Students’ Survey

The *Students’ Survey* (see Appendix 4) was primarily based on Meredyth’s et al. (1999) *Real Time Study* and consisted of four sections and 14 questions that focused on the students’ own experiences with ICT inside and outside school. The first six questions (Section One) used stem responses to collect students’ demographic information. Section Two (6 questions) used stem cell responses to ascertain students’ use of ICT, which was followed by Section Three (1 question) which asked students to rate their own technology competency levels using a four point Likert scale of “Don’t know”, “Not competent”, “Competent”, and “Very competent”. The final section and question used an open-ended question to ask students’ to predict how they thought ICT would be used in the classrooms in the near future.

### Guardians’ Survey

The final survey was a self-developed *Guardians’ Survey* (see Appendix 5) which was comprised of 12 questions organized into 4 sections. The first section (4 questions) ascertained student access to ICT in the home by asking closed questions (“Yes” or “No” type questions). Section Two (5 questions) asked parents to inform the researcher what ICT related activities and skills their child should be doing at school using open-ended response questions. For example, question number 8 “What do you think the school could be doing to increase students’ access to technology? (Please list)”. This section also asked parents about how satisfied they were with their level of involvement in school ICT decisions. Section Three (2 questions) used stem questions to ascertain current guardian’s perception of their child’s ICT use at school; whilst the last section used an open-ended question to ask parents’ to predict how they believe ICT will be used in the classroom in the near future.

## Test case process

All four surveys and the teachers' interviews were pilot-tested and slight variations made in the questions asked and in how they were administered prior to the current study commencing, as discussed below.

The field procedures and instrumentation were piloted for several months in a school in which the researcher was previously employed, to further refine the survey tools and procedures with the selected cohort.

A key requirement from the test case school to participate in the study was the need for the study to be based on a sound research design. To this end, a detailed research proposal (study protocol) was prepared. Yin (1994) recommended the use of a case study protocol as part of a carefully designed research project. This included an overview of the project (with project objectives and case study issues), field procedures, questions and a guide for the report. Next, the case studies have to be designed, carried out and analysed. The analysis of the case study is the critical factor in this research. In relation to this, Yin (1994) identified five components of research design that are important for case studies:

- the study's questions;
- its propositions (if any);
- its unit(s) of analysis;
- the logic linking of the data to the propositions, and
- the criteria for interpreting the findings.

Another approach is presented by Soy (2003), who draws upon the work of Stake (1995) and Yin (1994). She proposed six steps in conducting case study research:

1. determine and define the research questions;
2. select the cases and determine data gathering and analysis techniques;
3. prepare to collect data;
4. collect data in the field;
5. evaluate and analyse the data, and
6. prepare the report.

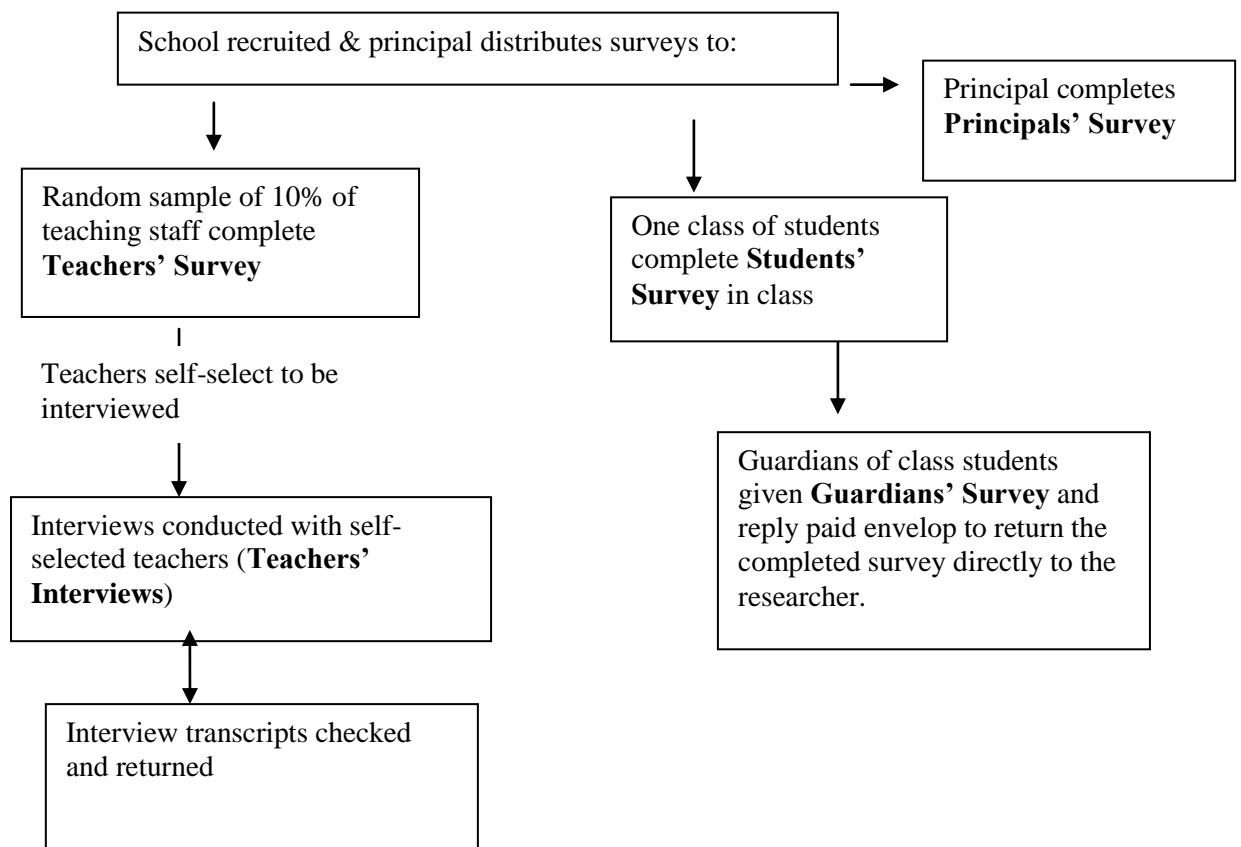
To address the issues raised by Yin (1994), Soy (2003) and Stake (1995), formal university and school-based (e.g. Department of Education, Catholic Education Office and individual school) ethics applications were submitted and subsequently approved. These applications essentially set out the research design, purpose, information on how to participate, and what would happen to the research data.

As a result of the piloting several questions were rewritten or omitted altogether. It was also decided that the interview reminder letters or emails would be sent to teachers two weeks, then one day, before their scheduled interview. The reason for this was to aid the teachers' memory and allow them time to re-read the interview questions to be better prepared for the interview.

In an interview situation the claim is that the interviewer can directly or indirectly influence the person's responses (Bell, 1992; Benbasat et al., 1987; Neuman, 2003) These influences included observer/recorder bias, obtrusive influence, language assumptions and the Hawthorne effect (making changes because of being in the study or observed) (Marsh, 1987). All of which can affect the reliability and validity of the data collected. Such influences are considered to be reduced when there is a focus on ethical behaviour and trust in the interview situation (Lincoln & Guba, 1985).

## Collection and Organisation of Data

In designing case study research Yin (1994) indicated that the researcher needs to avoid becoming dependent on a single informant or source of data, but to seek the same data from other sources to verify its authenticity. In this research, documents (participant surveys) and archival records (such as, number of staff and students, number of computer facilities) were used. Direct observations and collecting physical artefacts was not be used unless a case study site offered them (for example, if the respondents demonstrated a particular new form of digital technology used in their teaching). Interviews were only conducted with participants who indicated that they wish to be interviewed (as indicated in the teachers' survey). Figure 3.1 depicts the data collection methods utilised in the current study.



*Figure 3.1* Data collection methods used in each school



During the data collection phase, which spanned 13 months, a range of data were collected. Patton (1990, 2002) observed that when voluminous data are collected it needs to be well organized to avoid problems arising during subsequent analysis. To overcome potential problems surveys were numbered and placed into satchels, corresponding to each type of survey, (i.e. teacher or guardian), and each satchel was placed into a corresponding document storage box corresponding to the appropriate school from which the surveys originated from. Telephone interviews were audio taped, where consent was given and notes were taken verbatim, and immediately transcribed when the interviews were conducted. The transcripts were then sent back to the interviewee for cross-checking and validation. During this transcription process, Patton's (2002) observation about this process was supported, in that "...the grammar in natural conversations comes out atrocious when transcribed. Sentences hang incomplete, interrupted by new thought before the first sentence was complete" (p. 411). That is, where possible the interviewee's natural grammar and interrupted speech (thoughts) were kept. Interview transcripts were then placed in satchels and into corresponding document boxes according to school. Data collection for this study began in July and concluded 13 months later in August. Data were predominantly collected from primary resources, including interviews and surveys.

## Data analysis

Quantitative data were analysed using Statistical Package for the Social Sciences (SPSS) version 16.0 and qualitative data were analysed using and qualitative data were analysed using Leximancer qualitative analytics software version 3.0. Prior to analysis, data were examined for the accuracy of entry, missing values, outliers and assumptions of univariate and multivariate analysis. In the cases of missing data review of original survey forms was conducted and where keying error was identified, data were corrected. Finally, if missing values remained, the participant was excluded from analyses.

Traditional descriptive statistical analysis was carried out for all variables followed by reliability analyses for all surveys. These were then benchmarked against published values. Analysis for variance was carried out for gender, age and academic year. Correlational and exploratory factor analyses were applied to explore relationships among the latent (unobserved) constructs and indicator variables. Finally, structural equation modeling, using AMOS version 18, was used to identify the significant of causal inter-relationships (structural equation modeling).

The data analysis process consisted of a range of methods drawn from both qualitative and quantitative approaches. As the data has been selected from each survey tool, the methods were also selected on the basis of these issues in order to optimise the breadth and depth of exploration. In the results chapter each research instrument is examined more thoroughly to elicit findings to help address the research questions posed in Chapter 1 and answered in the final chapter. As new data analysis methods are used in the following chapter they are firstly introduced before results are presented.

## Ethical considerations

The current study was undertaken in two Australian states (Tasmania and Victoria) and three school sectors (Independent, Catholic, and Government). For this reason three separate, though interdependent, ethics applications were submitted (University of Tasmania, Victorian Catholic Education Office and Tasmanian Department of Education).

To maintain participants' confidentiality and protect their privacy (Polit & Hungler, 1995) from a very early stage in the analysis, the names of the schools and the participants were replaced with pseudonyms, and these have been used in all public occasions since. To further ensure protection but without wishing to compromise the data, some details about some of teachers' current classes, some histories and other minutiae have been altered in complementary ways to preserve the overall integrity of the data record. Also, transcripts and audio tapes with the

original participants' names have been stored securely in a locked cabinet at the University of Tasmania, and will be held for at least a minimum of five years, when they will be erased and destroyed.

### Ensuring the quality of the data

The credibility and trustworthiness of the data and subsequent analysis are key research requirements, which need to be asked of all research studies and in particular those that are interpretative (Lincoln & Guba, 1985; Maykut & Morehouse, 1994). To achieve data trustworthiness and research credibility Lincoln and Guba (1985) suggested a set of criteria be applied to the research. These criteria are: credibility; transferability; dependability; and confirmability and these are all means of improving the trustworthiness of the data. Within a positivist research approach similar terminology exists: validity; external validity; reliability; objectivity; and rigour.

All researchers want to contribute to results that are credible and trustworthy. Triangulation is supported through multiple forms of data from multiple sources and in this study was achieved by using surveys from different stakeholder groups and interviews with teachers. The data from each of these groups can then be compared across and between groups to identify trends and limitations arising from the tool design (Patton, 2002). Authenticity is supported through clear description of how the project was conducted and how the findings were elicited from the data. Reliability is not about whether the data can be replicated but “whether the results are consistent with the data collected” (Merriam, 1998, p.206). This requires transparency in the process of the research by providing details of how the research is conducted, authenticity. In this research the process of participant selection, data collection and tool design have been described and pilot tested. The validity of the current research was achieved using triangulation of data from multiple perspectives-teachers, students, guardians and principals. Using quantitative methods the data was analysed using recognised statistical methods, as outlined in the results sections,

and tool reliability values, i.e. Cronbach Alpha values were reported and shown to be within acceptable limits indicating that the internal design of the tools was sound and robust (Malhotra, Hall, Shaw, & Crisp, 1996; Nunnally, 1978). The qualitative findings were based on an interview tool that was pilot tested before use and interview transcripts were checked by the participants which leading qualitative researches state improves the reliability and validity of the interview tool (Denzin & Lincoln, 2000; Gay, Mills, & Airasian, 2006). The data from each participant group was then analysed by tool, or participant group, in the results chapter before coming together to address the research questions in the final chapter.

Within this study trustworthiness was established using two mechanisms. First, surveys and interviews were conducted with different individuals with different perspectives on the research problem who were administered the same question set and implementation process.

Second, all data collected from the participants were retained so, if required, the interview data could be traced to the original sources, whilst survey data could be traced to particular participant groups. This traceability establishes a process of data dependability and confirmability.

Analyses of data were undertaken by following trends or patterns that emerged in the course of examining the data. For example, when interviewing respondents, the researcher listened for narratives about why things happened in the way they did in each context and so collected multiple interpretations with all their contradictions and detail (Yin, 1994).

## Chapter Summary

Caelli, Ray, and Mill (2003) contended that in any research enough detail about the study, the approach and the methods needs to be included so that the reader can appropriately evaluate the research. To achieve this worthy aim, this chapter began with a discussion of the different

methodologies that can be used to guide the research process. Of these methodologies or paradigms, the interpretative approach, was chosen for this particular study. This approach was selected as it enabled the researcher to understand the problem from the perspective of the participants, whilst also allowing the findings to be transferred to other similar settings. Following this, the rationale for the research approach and data collection methods were given. The research instruments and data analysis techniques were then described, along with a description of the test case that was used to refine the research instruments and processes. As a visual summary, Table 3.4 depicts the decisions and methodological approaches that were considered in this chapter. This is then followed by Chapter Four which presents the findings to the research questions. Finally, Chapter Five summarizes the research findings, discusses the findings in relation to the study's research questions; suggests implications for teachers and school leaders and outlines areas for further research.

Table 3.4.

*Summary of the research design*

<b>Epistemological and ontological assumptions</b>	<b>Interpretive</b>
Research strategy	Multiple case studies (six sites)
Research techniques	Semi-structured interviews and participant questionnaires (principals, teachers, students and guardians)
Organisations	Six schools
Cohorts	Principals, teachers, students and guardians
Timeline	Data collection – over 18 months
Participants	Use of digital technology in schools and the decision-making processes underpinning this use by teachers and students

Collectively, the methodological decisions made in this chapter provided an abundance of data sources for subsequent presentation and analysis of the study research questions:

*RQ1 How can schools successfully embed digital technologies for teaching and students' learning?*

*RQ2 How are schools utilising digital technologies for teaching and students' learning?*

*RQ3 What are the inter relationships between teachers' and students' background, access to technology, and attitude towards technology?*

## Chapter 4 Results

### Introduction

In this study students' and teachers' ICT attitude, perceptions and ICT usage were the main dimensions being investigated. In determining these variables data were collected across four cohort groups: guardians (parents); students; teachers, and principals, and across six schools from two Australian states. This study used quantitative and qualitative analysis. Therefore, the quantitative results of this chapter have been organized into four main sections: first the survey results from the guardians; second survey results from students; third survey results from the teachers' and fourth survey results from the principals. Further qualitative analyses were undertaken using descriptive and inferential analysis techniques. Following this, the major findings of the study are briefly summarised.

As described in Chapter Three, the data were collected and analysed by a mixed methods approach. Statistical analyses were used for the quantitative analysis of the responses to the surveys. Qualitative data obtained through semi-structured interviews were processed using content analysis to identify themes.

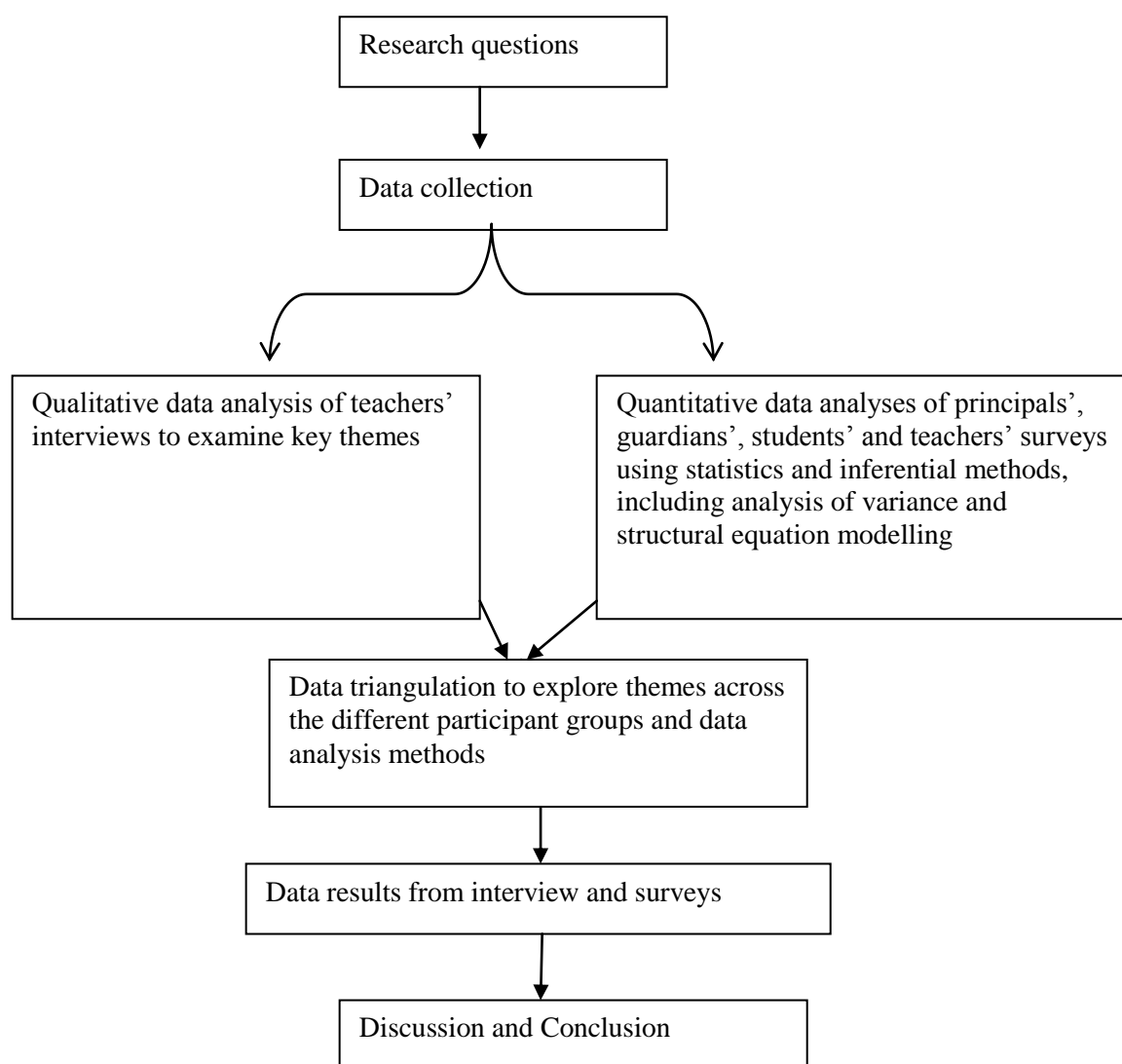
Both the quantitative and qualitative research methods were used to gain an understanding of the level of digital technology adoption and utilisation by schools, teachers and students. To further clarify the procedures used to investigate the three research questions, the steps involved with this study are outlined in Figure 4.1.

The study's three research questions:

*RQ1 How can schools successfully embed digital technologies for teaching and students' learning?*

*RQ2 How are schools utilising digital technologies for teaching and students' learning?*

*RQ3 What are the inter-relationships between teachers' and students' background, access to technology, and attitude towards technology?*



*Figure 4.1* Overview of the mixed methods research design

As an overview, the collected data were entered into two statistical software programs, Statistical Package for Social Science (SPSS) 16.0 (for factor analysis, correlations and analysis of variance) and AMOS 18 was used to identify the significant of causal inter-relationships (structural equation modeling). In addition Leximancer qualitative analytics software version 3.0 were used to analyse the qualitative data from the teacher interviews.



## Surveys

The current study used four survey instruments to ascertain participants' ICT use and their attitudes across four school groups. First the guardians' survey contained 12 questions related to ICT access in the home and the guardians' perceptions of their child's ICT use at school. The second survey was the students and it contained 14 questions related to students' use, and their self-perceived of their ICT competency at school and home. The third survey instrument was the teachers and it contained 25 questions related to the types of technology used at the school and in their homes; their perceived competency with ICT; and their perceptions about ICT professional development. The final survey was the school principals' survey and it contained 68 questions related to the use and supply of ICT in their school at the time of the survey.

## Establishing the Cronbach measure for each test

One of the first tasks after the survey data were entered into the statistics software SPSS was the establishment of each test's Cronbach Alpha, which is a measure of the survey's internal reliability, which indicates how closely the question matched the characteristic to be measured. The reliability of the four surveys, as measured by the Cronbach Alpha, ranged from 0.70 to 0.85 and as such these were all within acceptable limits (Malhotra, Hall, Shaw, & Crisp, 1996; Nunnally, 1978). These results were not unexpected, as the majority of the measures were based on well-established instruments with high reliability scores from previous studies, and the survey instruments were stringently pilot tested before the full study commenced.

## Participants' results

A total of 84 parents/guardians (NB: the term guardian is generally used in this study rather than parent as this was the predominant term used by schools when referring to the legal care provider of students), 120 students, 56 teachers and 6 school principals, from six schools across Tasmania and Victoria, Australia, responded to the surveys in the present study. The numbers of participating schools were two from Tasmania and four from Victoria.

From the total number of respondents, 28 (33.3%) guardians, 48 (40%) students, 6 (10.7%) teachers and 2 (33%) principals were from Tasmania. This sample breakdown is reflective of the relative student enrolments of the two Tasmanian schools being smaller (moderate and small), than the four Victorian schools (moderate to very large).

The following pages present the results from the four surveyed groups with those results presented according to survey sections. The chapter concludes with a summary of the main findings from the data analysis which will be discussed in the final chapter (Chapter Five) of the thesis.

### Guardians' (Parents') Survey

The guardians' survey sought to understand students' access to technology at home and the guardians' perceptions of how technology was being used at their child's school and at home, to provide answers to research questions 2 and 3.

#### Home ICT access

From the six schools which participated in the study a total of 84 parents/guardians completed the Guardians' Survey. Of these 98% ( $n=83$ ) stated that their child had access to a computer at home and that their child had home internet access. The one family without a computer at home reported being able to access a computer and the internet after school and on weekends at a family member's place of business or grandparent's home. Furthermore, 80% ( $n=66$ ) reported that their children never visited a library or other public place, such as an internet café to use a computer or access the internet.

## Guardians' perceptions of students' use of ICT at school

In relation to how often guardians believed that their child used ICT at school almost 95% ( $n=80$ ) thought their child did so daily. Further to school ICT use, guardians were asked if they would support an after-school ICT lab or class for their child, if one was made available; around 75% or three quarters ( $n=65$ ) stated they would. One parent went further by writing on the survey that the school should *"make the computer labs accessible to students before school, during lunchtimes, and after school"* (School C, Guardian Survey respondent 005).

When asked what ICT should be used for at the child's school, the majority of the guardians responded by indicating that: (1) students should use the technology to learn research skills using the internet (95%); and (2) to be able to use software that was reflective of the corporate and future work environments (90%). This corporatizing of the schools' ICT environment was reflected in one guardian's comment: *"Frankly, I believe that the computers (programs) should reflect what's out there outside of school"* (School C, Guardians' Survey respondent 005). Whilst another guardian was more interested in ascertaining what was actually being used and taught: *"Would be interested in hearing or reading exactly what they are using them for and what the child is actually learning. My son actually helps others in class, one teacher we had (Sic name removed) he was showing her how to do some things – so I think our teachers need to be more fluent on computers"* (School E, Guardian Survey respondent 006). Almost 60% ( $n=49$ ) of guardians stated that they had enough involvement in how technology was being used at their child's school, though not all parents agreed *"I should have had the opportunity to voice this before now"* (School C, Guardian Survey respondent 005).

## Correlation data from guardians' survey

Guardians' responses to the survey questions are presented as percentages in Table 4.1 and two rating questions are reported as means and standard deviations in Table 4.2.

Table 4.1.

*Guardians' survey responses (N=84)*

<i>Survey question</i>	<i>Yes (%)</i>	<i>No (%)</i>
Home access	98	2
Home internet	98	2
Never visited library in last year	80	20
Visited library 1-2 times last year	12	33
Visited library 3-5 times or monthly last year	10	30
Child does visit library sometimes	21	41
Want after school lab access	75	25
Commented on child's school related tasks in after-hours lab	80	20
Commented on computer/technology skills child should be learning at school	81	19
Commented on what school could do to increase student access to technology	67	33
Parent-school involvement	60	40
Comment on parental involvement in LT at school	40	60
Child does use ICT in class daily	95	5
Made future prediction	74	26

Table 4.2.

*Survey response for guardians' responses means and standard deviations*

<i>Survey question</i>	<i>Means</i>	<i>Standard deviation</i>
Library visit frequency*	1.37	0.82
Class ICT use#	3.46	0.67

Potential responses to the survey questions in Table 4.1 and 4.2 included no (score=0) or yes (score=1), whilst those with an asterisk (\*) included never (score=1), once or twice (score=2), three to five times (score=3), and monthly (score=4). For those questions marked with a hash (#) potential responses included rarely (score=1), monthly (score=2), weekly (score=3), and daily (score=4). The results from Table 4.1 and 4.2 are ordered in terms of survey question presentation. As can be seen in Table 4.1, guardians' responses to providing home computer and internet access were uniform in that this technology was almost universally available at home. To further understand the guardian's responses, Table 4.2 indicates how frequently guardians took their child to a library and their perception of how frequently their child used ICT at school.

### Students' survey

A total of 120 students were surveyed to ascertain their use, perception and self-reported competency level of ICT at their school and in their home. Of responding students, two thirds or 67% ( $n=81$ ) were girls and ranged from Grades 4 through to Grade 9. Their ages ranged from 9 years of age through to 15 years of age.

Of the 120 students, 90% ( $n=108$ ) reported being born in Australia. Three (2.5%) reported being of Aboriginal or Torres Strait Islander ancestry, and 15% ( $n=18$ ) reported speaking a language other than English at home, with these languages being: Afrikaans, Chinese dialects, Greek, Hindi, Indonesian, Japanese, Korean, Malaysian, Maori, Polish, Spanish, Tamil, Thai, and Vietnamese.

### Students' use of technology

Students overwhelmingly (93%,  $n=112$ ) reported using a computer outside school. Of that subgroup, all reported using a computer at home, twenty at a library, two at a drop-in centre, four at an internet café, and seven elsewhere, such as a parent's business or grandparent's home.

In terms of time spent using technology devices students had the highest usage for entertainment, with the least frequent use being for school related activities, see Figure 4.2.

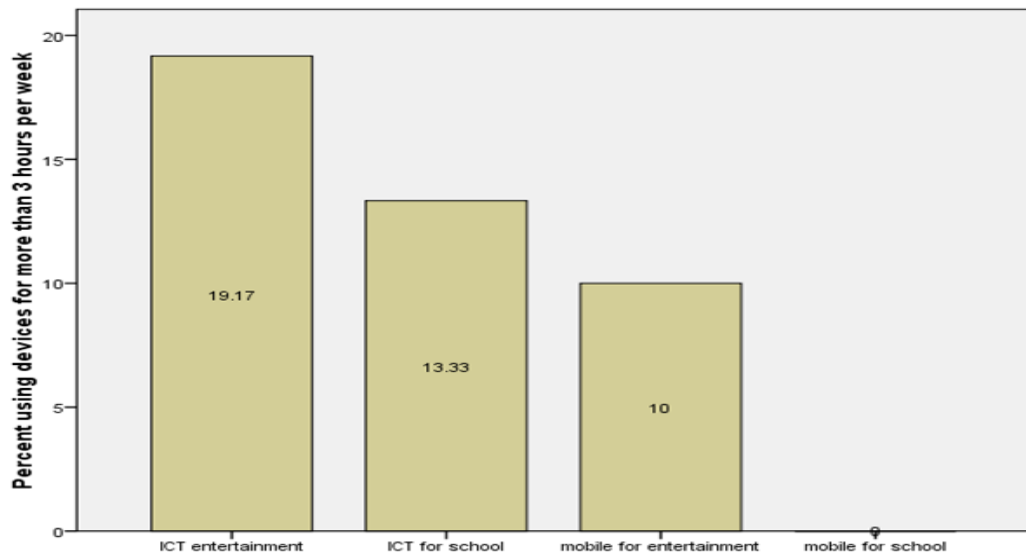


Figure 4.2 Percent of students using technology devices for more than 3 hours per week (N=120)

### Comparison of school with at home

In order to understand students' use of the nominated technology (tools) at school and outside of school (personal), a paired sample *t*-test was undertaken to compare the level of use reported at school compared with personal outside of school. The paired samples *t*-test compares the means of two variables. It computes the difference between two variables for each case, and tests to see if the average difference is significantly different from zero. Table 4.3 indicates *t*-test values, computed based on numerical codes assigned to the five response categories (Daily, Weekly, Monthly, Termly [at least once a term] and Never).

With reference to the breakup of time spent on different ICT devices the most popular in terms of time was the World Wide Web. The full list is reported in Table 4.3 and is based on a five-point scale based of never (score=1), termly (score=2), monthly (score=3), weekly (score=4), and daily (score=5). Items in the table are ordered in terms of question presentation in the survey.

Table 4.3.

*Comparison of school and personal use of 16 ICT tools (paired sample t-tests, df, 119)*

<i>Technology</i>	<i>At school</i>		<i>At home</i>		<i>Comparison</i>	
	Mean	Std. Deviation	Mean	Std. Deviation	<i>t-value</i>	<i>Sig. (2-tailed)</i>
WWW	3.97	0.79	3.82	1.27	.89	NS
email	2.39	1.70	3.10	1.56	-4.02	***
Network computer conferencing	1.19	0.71	1.21	0.77	-.310	NS
Video conferencing	1.08	0.35	1.12	0.44	-1.47	NS
Fax	1.08	0.35	1.21	0.52	-2.97	**
Word-processing	3.90	0.99	3.58	1.21	2.88	**
Databases	1.76	1.32	1.68	1.21	.69	NS
Spreadsheets	1.99	1.31	1.63	1.05	3.23	**
Desk Top Publishing	2.00	1.08	1.78	1.14	1.89	NS
Digital camera	1.83	0.97	2.90	1.27	-9.13	***
Digital scanner	1.48	0.78	1.68	1.05	-1.92	NS
Educational software	2.77	1.33	1.70	1.21	7.38	***
Self-produced educational software	1.75	1.28	1.30	0.74	4.49	***
CDROM information	2.00	1.18	1.96	1.16	.29	NS
Online information	2.62	1.29	2.18	1.36	4.67	***
SMS on mobile phone	1.54	1.25	2.77	1.75	-8.34	***

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

As can be seen from Table 4.3 students used the web (WWW), email and word processing software just as frequently at school and at home, and that they did so uniformly as a cohort. Whilst, use of mobile phones and digital cameras occurred more frequently at home, compared to at school.

Data from the paired sample *t*-test also revealed that students were significantly more likely to use email, fax, digital cameras, and mobile phones in their personal lives as compared to the same technology being used at school. In contrast, students were significantly more likely to use word processing, spread sheets, and educational software at school.

The frequency of technology used by these students is shown in Figure 4.3 which indicated that television and music players were the most frequently used home technologies.

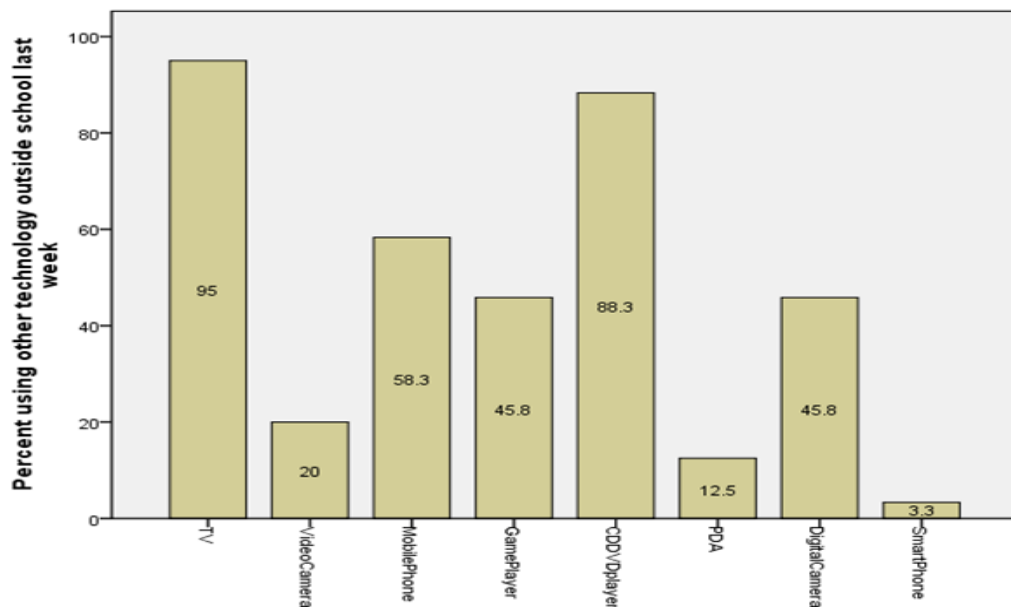
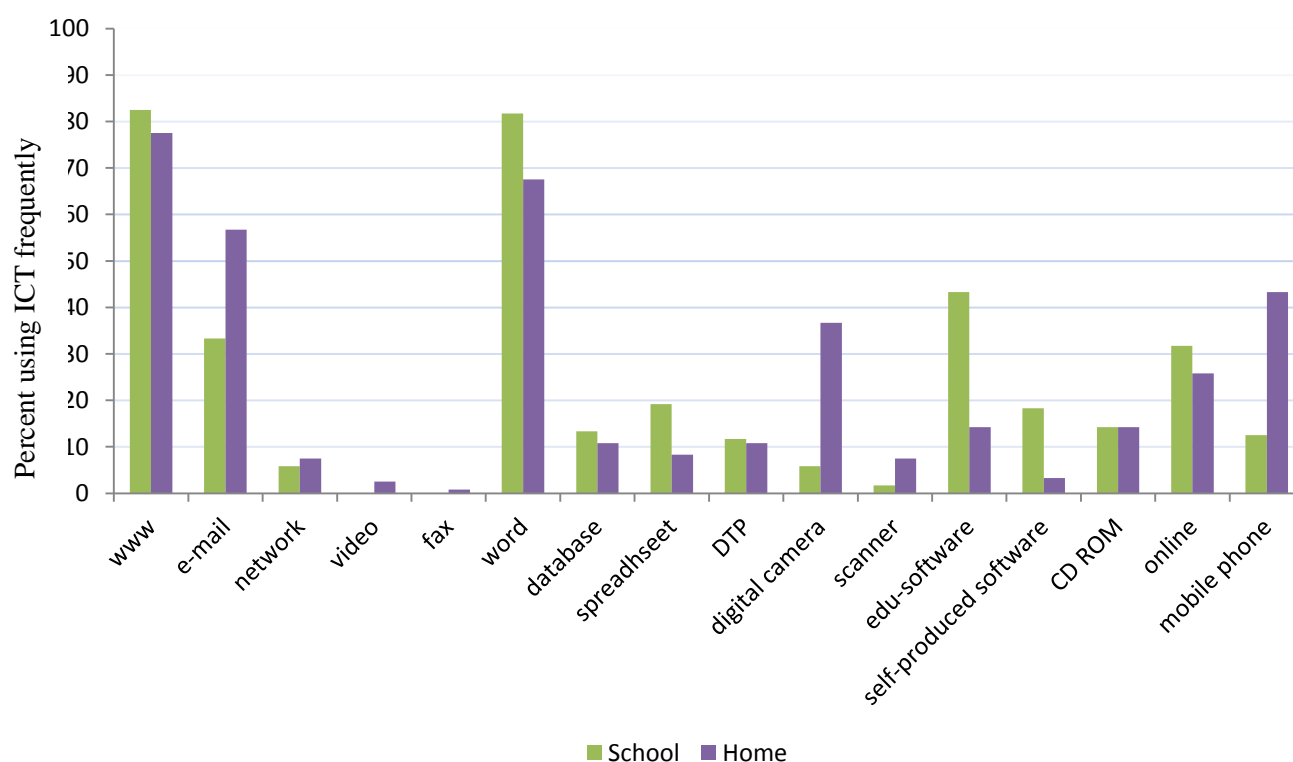


Figure 4.3 Percentage of students using different technologies outside of school last week (N=120)



To further understand students' use of technology at home and school the survey asked students to rate how frequently they used a range of different technologies. Usage frequency included daily (coded as 5), weekly (4), monthly (3), termly (2), or never (coded as 1). These results are graphed (see Figure 4.4) with over 80% of students reported using the world-wide web or a word-processor at school frequently (coded as daily or weekly). In contrast, less than 20% reported using network computer conferencing or desk-top publishing (DTP) at school on a frequent basis. Similarly, students were most likely to report using the world wide web, a word-processor or email frequently (daily to weekly) for personal usage. Less than 20% of students reported using network computer conferencing or desk-top publishing for personal purposes.



*Figure 4.4* Percentage of students using a selection of 16 ICT tools at school and outside of school (N=120)

## Students' technology competence

To further understand students' technology use they were asked to assess their level of competence in terms of use of 15 ICT tools. The number of technology tools was reduced from 16 to 15 for this section of analysis as the use of online information sources was taken to equate to the use of the world wide web. Table 4.4 indicates the means and standard deviations for students overall self-reported technology competency for each of the 15 technology tools using a four-point scale: don't know (score=1), not competent (score=2), competent (score=3), and very competent (score=4). Items in the table were arranged in order of question presentation in the student survey tool. More than 80% of students believed that they were competent (very competent or competent) in 5 out of the 15 technology tools, with these tools predominantly being 'office' type software such as email, word processing and the internet. Students were less confident in the use of conferencing tools and desk-top production and publishing software (see Figure 4.5).

Table 4.4.

*Means and standard deviations for student ICT tool competency (N=120)*

Technology	Mean	Std. Deviation
WWW	3.15	0.80
email	2.95	1.18
Network computer conferencing	1.06	0.98
Video conferencing	1.10	1.03
Fax	1.28	1.13
Word-processing	3.24	0.88
Databases	1.49	1.22
Spreadsheets	1.90	1.36
Desk Top Publishing	1.64	1.26
Digital camera	3.03	1.21
Digital scanner	1.70	1.31
Digital video camera	2.27	1.31
Using CD-ROMs for assignments	2.50	1.27
Using CD-ROMs for entertainment	3.48	0.68
SMS messages on mobile phone	2.70	1.50

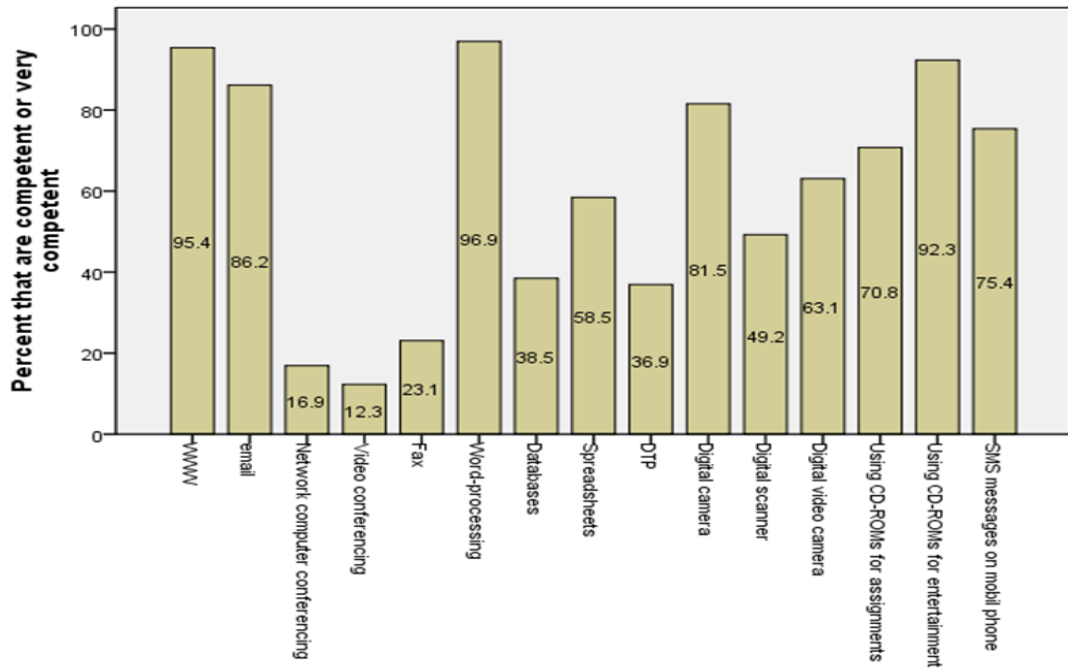


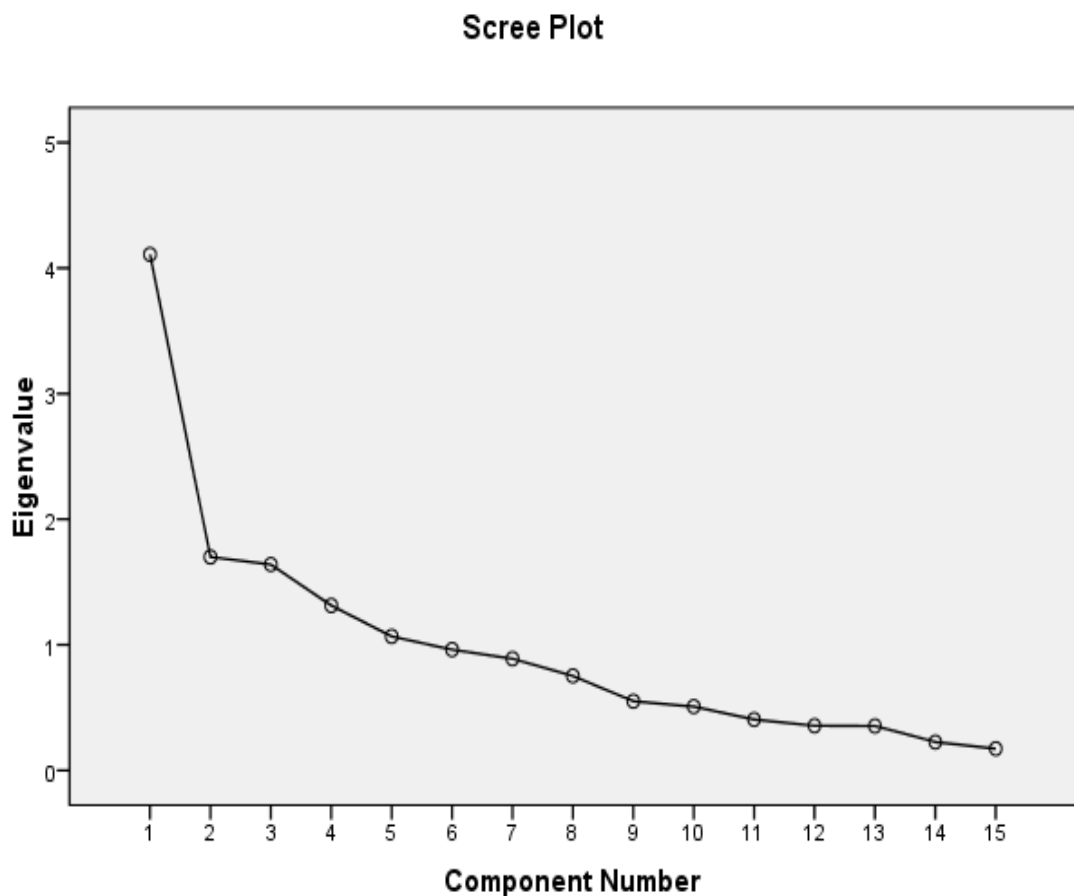
Figure 4.5 Percentage of students rating themselves as competent/very competent in using ICT tools ( $N=120$ )

### Students' ICT use and competency

To identify associations and correlations between the use of technology and self-reported competency, exploratory and confirmatory factor analytic procedures were used to understand the extent to which these 15 technology items clustered.

Understanding the percentage of students using different forms of ICT and their self-reported competency level for those forms of technology provides a 'benchmark' of their performance. To investigate the internal cluster pattern associated with the *Students' Survey ICT use and competency* items a factor analysis was conducted based on the full student data set of 120 participants. Exploratory factor analysis was used to determine the number of continuous latent variables that are needed to explain the correlations among a set of observed variables. The continuous latent variables are referred to as factors, and the observed variables are referred to as factor indicators. The goal of principal component analysis is to reduce a large number of

related variables to a more manageable number of factors prior to using them in other analyses, such as multiple regression or multivariate analysis of variance (Pallant, 2001). To determine how many components to extract the Kaiser's criterion of components with an eigenvalue of 1 or more was used. Items with low values on the Keiser-Meyer-Olkin (KMO) measure of sampling adequacy were excluded. The factor extraction method was principal component analysis, and the rotation method was Varimax with Kaiser Normalisation. The rotation converged in 3 iterations. The Eigenvalues scree plot identified that the 15 ICT usage items formed three main factors (see Figure 4.6).



*Figure 4.6* Scree plot of factors for students' ICT use and competency ( $N=120$ )

The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was 0.79 which is on the threshold of being said to be meritorious (Colbeck, 2007; Field, 2005). The internal reliability of the resulting measure of each theme was assessed using Cronbach's alpha and an overall Cronbach alpha of 0.86 was obtained.

Bartlett's test of Sphericity measures the multivariate normality of the set of distributions; whilst also testing to determine whether the correlation matrix conducted within the factor analysis is an identity matrix revealed a significance value of less than  $<0.05$  indicating that the data did not produce an identity matrix and was approximately multivariate normal and acceptable for further factor analysis (George & Mallery, 2003).

As indicated in Table 4.5, the exploratory factor analysis of the 15 technology skill items produced a three-factor solution with seven items related to presentation tools (factor 1), six items related to communication tools (factor 2) and two items related to productivity tools (factor 3).

Based on the students' survey data an explorative factor analysis produced a three-factor solution (Table 4.5). To further investigate this pattern a confirmatory factor analysis (CFA) was also conducted to validate this finding. In confirmatory factor analysis procedures, the researcher utilises the findings of the explorative factor analysis and uses this as a model to confirm the internal structure of the survey instrument (Schreiber, Nora, Stage, Barlow, & King, 2006). This confirmation is by overall statistical fit indexes that are generated by the CFA, and the generation of the individual pathways so that the strength of each item in the survey can be estimated as it relates to that particular factor. The advantage of this is that low pathway measures may indicate that the item fits better with another factor.

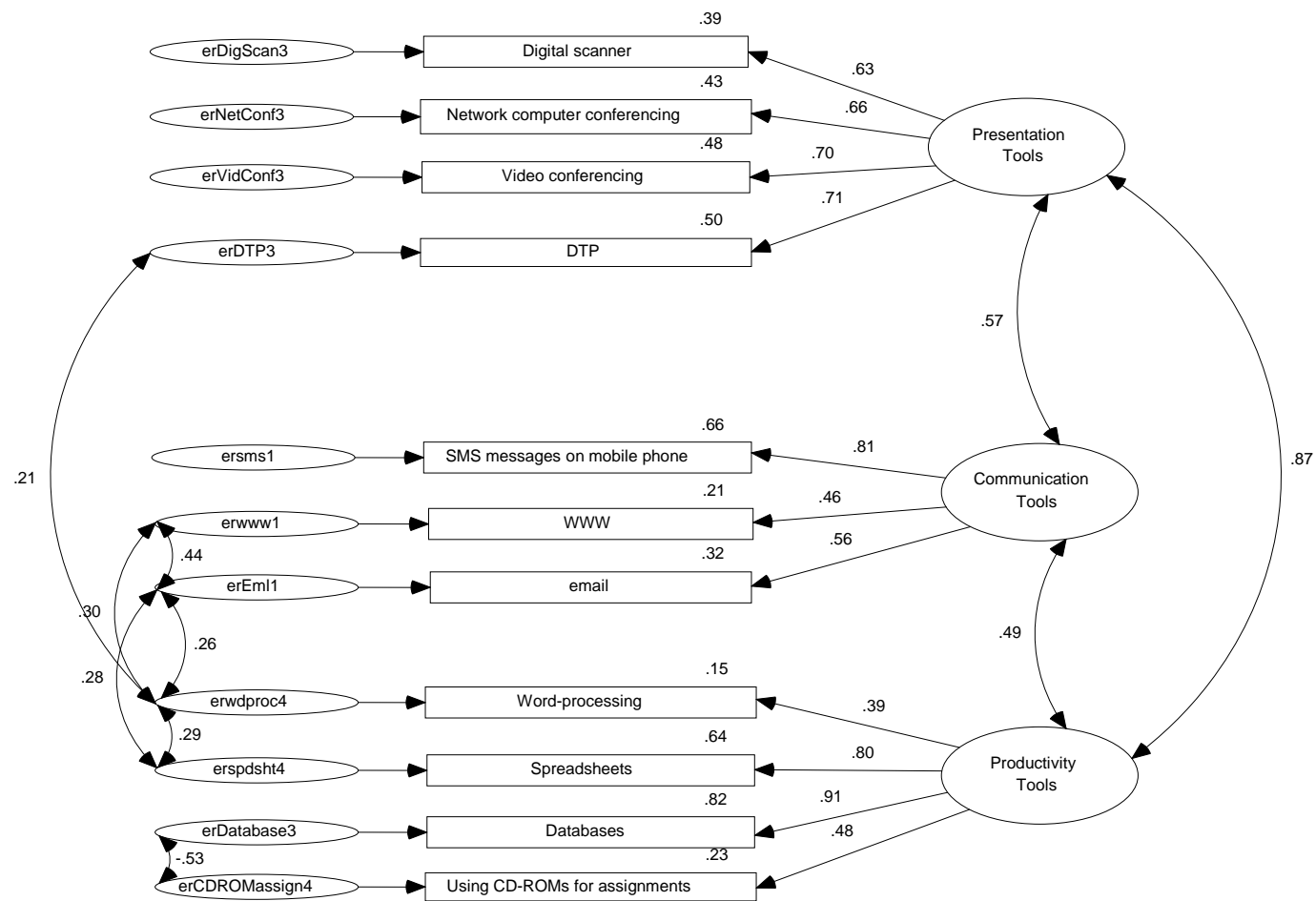
Table 4.5.

*Pattern matrix for students 15 technology skill items (N=120) demonstrating a three factor solution*

<i>Items</i>	<i>1 (Presentation)</i>	<i>2 (Communication)</i>	<i>3 (Productivity)</i>
Desk-top publishing	.79		
Video conferencing	.76		
Network computer conferencing	.65		
Databases	.63		.52
Digital scanner	.63	.26	
Using CD-ROMs for assignments	.51		
Fax	.47		.27
Digital camera		.72	
Email		.69	.56
SMS messages on mobile phone	.30	.66	
Digital video camera	.57	.62	
WWW		.57	.43
Spreadsheets	.55		.70
Word-processing			.67
Using CD-ROMs for entertainment		.54	

With CFA models, the circles are the latent (unobserved) factors, in this case, the first factor is use and confidence with presentation tools, the second factor is communication tools; the third factor is productivity tools. The placement of these items were revised according to a mixture of empirical and conceptual considerations; a number of iterations took place and items which failed to reach a significant effect size were eliminated until a criteria of 0.9 on the Normal Fit Index (NFI) (Kaplan, 2000) was achieved (see Byrne, 2010, for procedural details). In all, 11 prime items remained in the parsimonious model reported below (see Figure 4.7). The rectangles are the obtained item responses from each of the participants, often called the observed factors, while the eclipse are the residual or error value associated with how well the item relates to the factor. The curved double arrow lines represent correlation, while the straight arrows are the pathways, in CFA these pathways go from the factor to the item (see Ullman, 2001, for a more detailed explanation).

The CFA program AMOS (Arbuckle, 2008) was used to test the validity of the three-factor structure of the ICT use and competency instrument. The result of these analyses is reported in Figure 4.7. In this figure the strength of the pathways that form the factors are shown on the arrows and the residual (error) values are recoded to the right of each rectangle. As reported, the fit of the three factor structure to the use and self-reported competency data sets is very good and the pathway measures are also very satisfactory, thus confirming that the internal structures generated using explorative factor analyses procedure are stable.




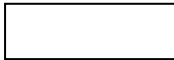
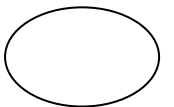


Key	
Symbol	Meaning
	Residual or error values for the ICT tool used
	ICT tool used
	Latent variable or tool type
	Pathway
	Correlations

Figure 4.7 Three-factor confirmatory factor solution for students' technology skills, based on the 11 significant items of 15.



The various measures of goodness of fit for this 3 factor CFA model were all very acceptable, with the overall chi-square ( $\chi^2$ ) statistic being non-significant, GFI (Goodness-of-Fit Index), in excess of 0.90, being that the closer to 1.0 the better the correlation amongst the data points. The regression coefficients were all highly significant, as were correlation coefficients. These measures all indicated that a CFA approach was an appropriate statistical technique to use. For example, the chi-square was non-significant with a value  $\chi^2=28.14$ ; the nominal fit index (NFI) was 0.94 giving the CFA model a probability level of 0.74, indicating a good fit between the model and the observed data. This indicated that the three-factor CFA solution presents an acceptable model of students' ICT use and self-perceived ICT competency, with the three-factor solution of presentation, communication and production.

### Home and school influences on students' ICT competency

A core issue in this research is the influence that both home and school have on students' ICT development and which factors are more developed out of school (in the home). While correlation can be of assistance in understanding this concern it is unable to identify the direct or pathway between factors. Given that the students' survey data contained items that investigated home and school usage of the different types of ICT, and students' perceptions of their ICT competencies across each of the ICT tools it is possible to develop a model to identify the pathways from home ICT usage and learning and from school ICT usage and learning and investigate how these home and school settings interact and most importantly how they influence students' level of competencies in ICT. To date no such model has been attempted, because of a lack of valid information on how to classify the different ICT tools available. Given that the factor analysis reported above identified that the students' ICT tools can be validly grouped into three factors (1) presentational, (2) communication and (3) productivity and the survey data provides information on each of these three factors in relationship to home, school and competency then a pathway model can be developed to clarify which ICT students' competencies are more influenced by home usage and learning and which ICT students' competencies are more influenced by school

usage and learning. It is also possible from the student data set available to identify the interactions between home and school. The student data set also contains information on the students' age and out of school use of ICT outside of school and also need be considered as logical influences on students' ICT competencies development. The critical question being investigated is what influences students' competencies to use presentation ICT (i.e., computed conferring), communication ICT (i.e. e-mail) and productivity ICT (i.e., word processing). This model is shown in Figure 4.9, but before testing this model the procedure to identify the significant pathways is briefly reviewed. The testing of pathway models is referred to as Structural Equation Modeling (SEM).

Structural Equation Modeling is a statistical procedure designed to reduce a number of observed variables into a smaller number of latent (unobserved) variables by examining the co-variance among the observed variables. SEM has been described as a combination of explorative factor analysis and multiple regression pathways (Hoyle, 1995; Statsoft, 2008; Ullman, 2001).

Specifically, SEM examines a set of relationships between one or more observed independent variables, either continuous or discrete, and one or more dependent variables, either continuous or discrete; both of which can either be factors or measured variables (Jodie, 2000; Schumacker & Lomax, 2004) by combining factor analysis and path analysis (Kaplan, 2000; Shipley, 2000). A SEM model consists of two parts: a measurement model and a structural model. The measurement model is made up of observed variables (or indicator variables) linking to latent variables via a confirmatory factor model. The measurement model is also known as a confirmatory factor analytic model. The structural model is made up of latent variables linking to each other via systems of simultaneous equations, with arrows specifying the direction of hypothesized causal paths. As such, a structural model is analogous to a path diagram, and structural modelling is likened to path analysis.

Statistical programs, such as AMOS (Arbuckle, 2008) provide a range of fit indexes which show how well the theory being tested as the interrelationship between its variables relates to the data.

It is possible to “improve” the fit of the model by taking away pathways between variables that are not statistically significant and rerunning the analysis, although researchers, such as Cheung, Hattie, and Ng (2001) have maintained that while a high goodness of fit index is important, it should only guide the researcher, as the main purpose of SEM is to test theoretical constructs. That is, to test how a set of interrelated variables simultaneously interacts, so that the directional pathways between the variables (factors) can be estimated (Schreiber et al., 2006).

In any data set a range of research questions can be tested using SEM procedure, however, the focus of this research is the impact of personal and school ICT usage on students’ ICT competency.

In the model to be tested below (see Figure 4.8) for each latent variable a residual or error variable is calculated and shown as an eclipse. In the model the curved double arrow lines represent the correlation between the variables, while the single arrows are the directional pathways between two variables, similar to the regression “influence on” pathway.

In the Figure 4.8 saturated or full test model the top row of variables are the “in school” factors (presentation, communication and productivity) and the bottom row are “personal” (presentation, communication and productivity). The lined arrows between these two are investigating the influence between these two sets. To the left of the model are the factors: students’ age and their ICT use outside of school. To the right of the model are the students’ competency skill levels in the three areas of presentation, communication, and production. These are the outcome variables and the aim of the model is to investigate the strength of the influence of the other variables on these three, as well as the interactions between personal (home) and school.

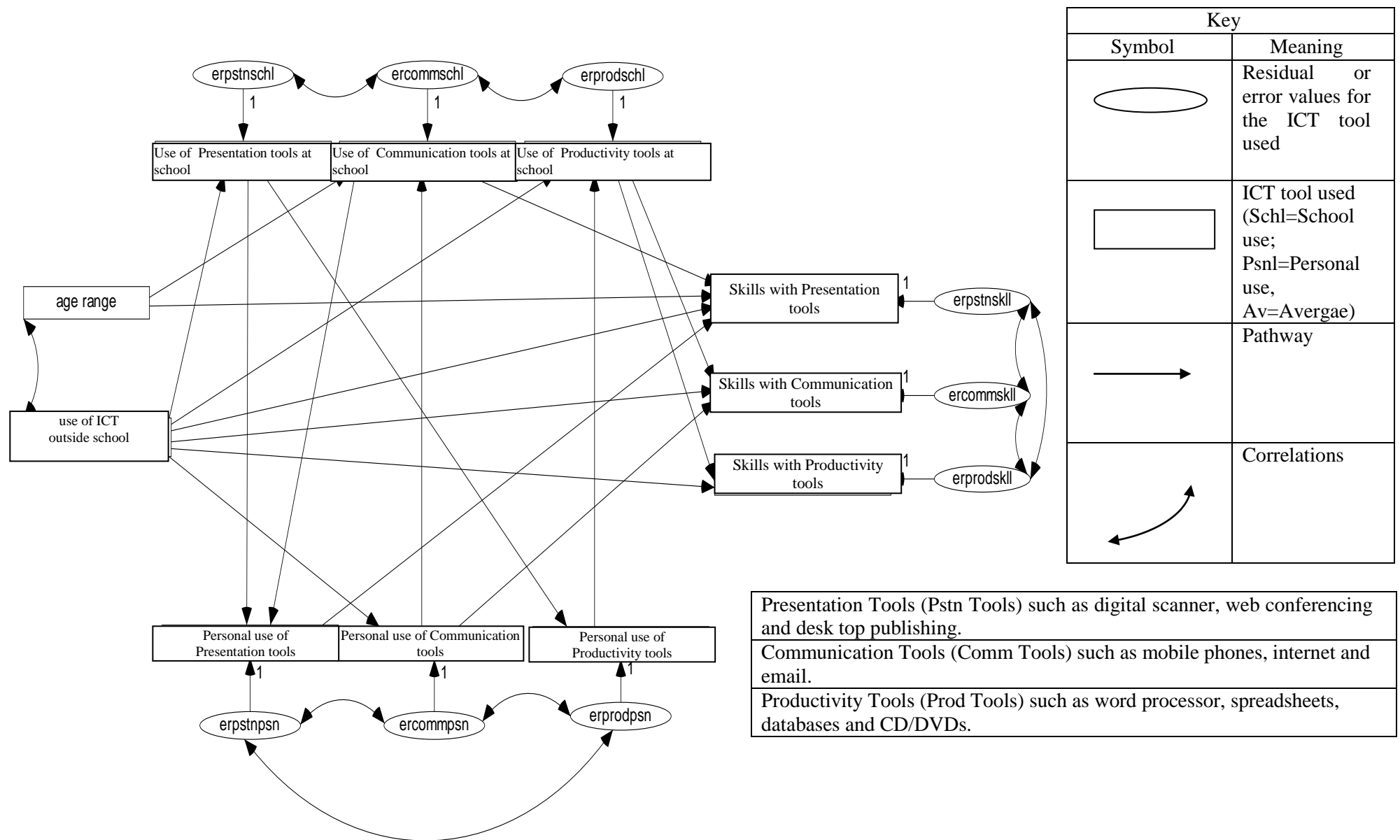


Figure 4.8 Proposed Path Analysis model using structural equation modelling tools for predictors of tool skill

### The Tested model of students ICT competency

The model presented in Figure 4.8 is the initial input model to be tested and contains the pathways that initial regression analysis suggest should be influential. Explaining how this input model is constructed, as already mentioned with the straight arrows are the pathways and the curved ones are the correlations, each of the observed (rectangles) and error (eclipses) variables are labelled. The numbers on the model, usually 1, are the estimated start values that AMOS requires to begin an estimation of the pathways. In this model all the straight arrows are moving from left to right because the model is from participant characteristic to examined variable from left to right.

The output model is this initial model which the strength of the pathways shown (Figure 4.9). This model was based on a sample of 120 school students' responses to each of the observed variables. The Goods of Fit Index (GFI for the model (see Figure 4.9) was 0.95, the Norm Fit Index (NFI ) was 0.94; the chi-square was non-significant with a value  $\chi^2 = 32.4$ , indicating a good fit between the model and the observed data. This indicated that the SEM presented a robust or sound structural equation model of the impact that home use and learning and school use and learning have of on students' ICT skills and competency development in the three areas of presentation, communication and production. Personal presentation and personal communication influenced students' competency in these domains. The output model and the output tables provided below.

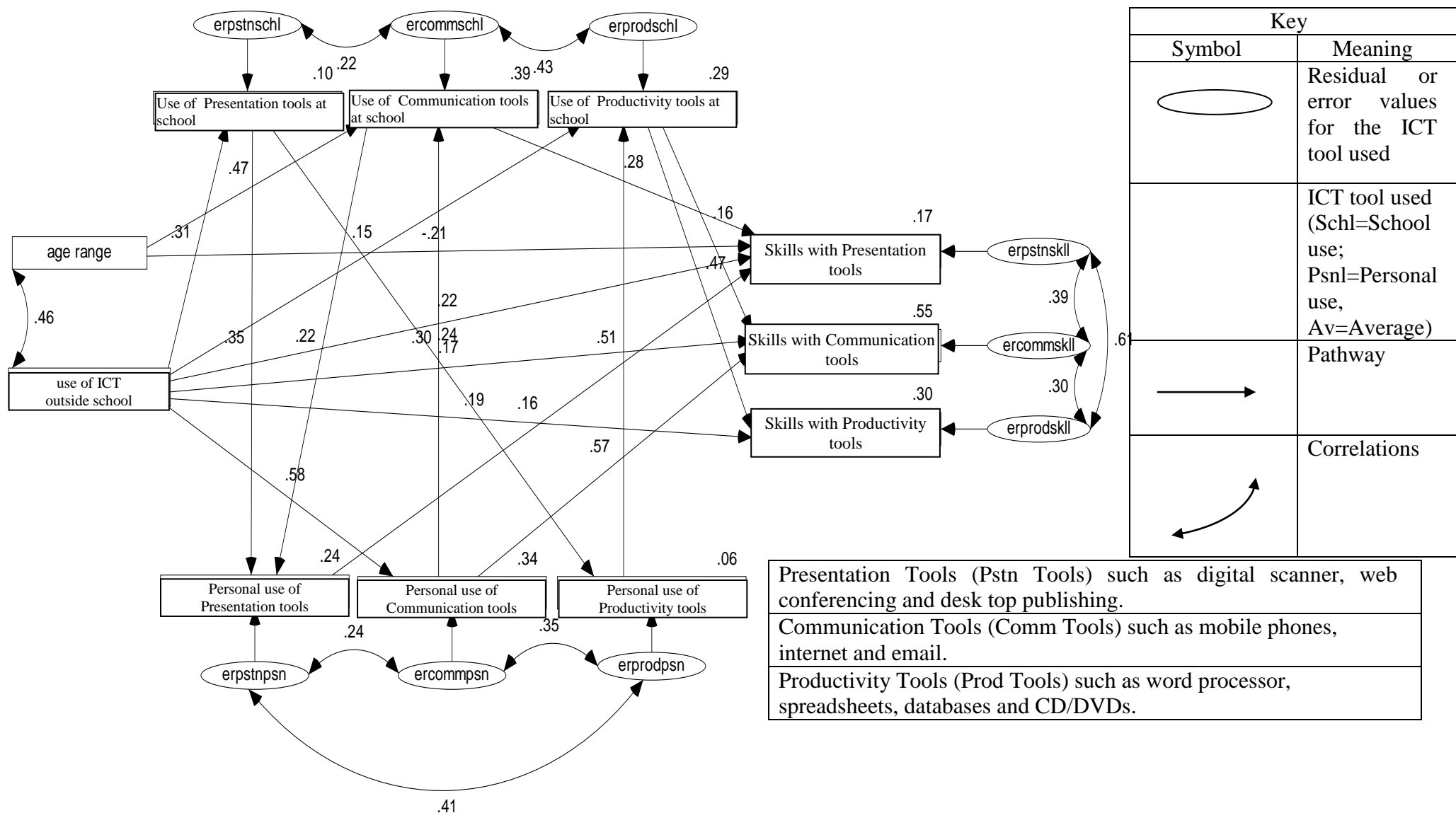


Figure 4.9 SEM for variables influencing students' competency in presentation, communication and production skills

The main output pathways of the tool use prediction of tool skill model are reported in Table 4.6, along with the significance of each of these pathways. The abbreviations associated with Table 4.6 are:

Abbreviation	Title and example
PstnTools	Presentation soft/hardware such as PowerPoint and data projectors
CommTools	Communication software such as Internet and email
ProdTools	Productivity software, such as excel and Microsoft office word
Schl	School's use of that ICT software or tool at school
Psnl	Personal reasons for use of those ICT tools
OutsideSchl = the use of that tool at home	outside of school and home and use of ICT

Table 4.6.

*Pathway estimates and their significance, output to predict students' tool competency*

<i>To</i>	<i>From</i>	<i>Estimate</i>	<i>P</i>
CommToolsPsnl	< ICTUseOutsideSchlAv	.58	***
	-		
CommToolSkillAv	< CommToolsPsnl	.57	***
	-		
ProdToolsSchl	< ProdToolsPsnl	.51	***
	-		
CommToolsSchl	< age	.48	***
	-		
PstnToolsPsnl	< PstnToolsSchl	.47	***
	-		
ProdToolSkillAv	< ProdToolsSchl	.47	***
	-		
PstnToolsSchl	< ICTUseOutsideSchlAv	.31	***
	-		
CommToolsSchl	< CommToolsPsnl	.30	***
	-		
PrstnToolSkillAv	< CommToolsSchl	.28	.001
	-		
ProdToolsPsnl	< PstnToolsSchl	.24	.005
	-		
PstnToolsPsnl	< CommToolsSchl	.22	.006
	-		
PrstnToolSkillAv	< ICTUseOutsideSchlAv	.22	.019
	-		
ProdToolSkillAv	< ICTUseOutsideSchlAv	.19	.015
	-		
CommToolSkillAv	< ICTUseOutsideSchlAv	.17	.025
CommToolSkillAv	< ProdToolsSchl	.16	.007
	-		
PrstnToolSkillAv	< PstnToolsPsnl	.16	.026
	-		
ProdToolsSchl	< ICTUseOutsideSchlAv	.15	.044
	-		
PrstnToolSkillAv	< age	-.21	.011
	-		

To further clarify comprehension as to which are the significant interactive pathways a “stripped down” version of the model only showing the most significant pathways is demonstrated in Figure 4.10.



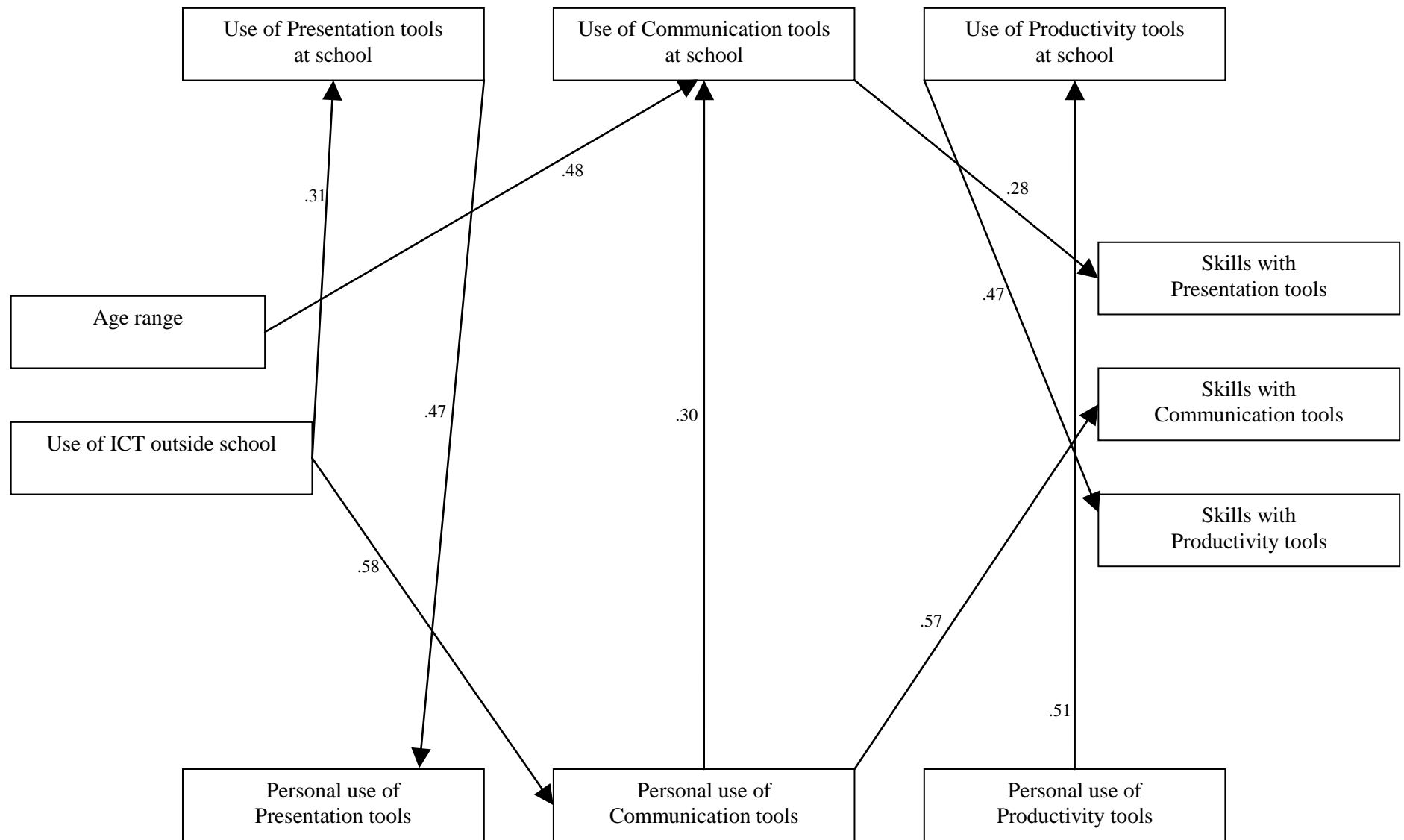


Figure 4.10 “Stripped down” version of the ICT model showing the most significant pathways

## Interpreting the findings

The tested model Figure 4.9 indicates that students' learn to use presentation tools, such as digital scanners, web conferencing facilities and desk top publishing software at school and then transfer this application knowledge to the use of similar technology in their personal lives. Conversely students' use and knowledge of how to apply communication tools, such as mobile phones, the internet and email; together with productivity tools such as word processors, spreadsheets, databases and CD/DVDs occurs in their personal lives with subsequently use and knowledge transferred to their use of similar technology at school. Of note however, is that students' self-reported skill level with these technologies is more influenced by their usage of the technology at school, as compared to their home use of that technology, given that two out of the three categories of technology skill level is directly influenced by the use of that technology at school. That is both home and school influence students' level of ICT competency development.

Further examination of Figure 4.9 reveals that students who use ICT outside school are more likely (positively associated) to use presentation and productivity tools at school, as well as using communication tools at school and outside of it. Furthermore, outside school use of ICT is positively associated with student competency or skill level in their use of presentation tools, communication tools, and productivity tools at school and outside of it.

These direct pathways are supplemented by further associations between presentation tool use at school and presentation tool use outside of school; an association between presentation tool use at school and outside school usage of productivity tools, where these in turn are either directly or indirectly associated with skills in the use of presentation and productivity tools.

As shown, the participant age was positively associated with their use of communication tools at school and with their self-reported competency level in the use of presentation tools. Of note is

that students' communication tools use at school is also positively associated with their self-reported competency levels in terms of the use of presentation tools (i.e., an indirect pathway via communication tool use at school as well as a direct pathway between age group and competency level in the use of presentation tools).

The model demonstrates that high levels or frequency of tool use has a positive influence on students' ICT competency. That is the more experienced students are with ICT the more competent they become.

### Students' survey summary

The findings from the students' survey revealed that they had access to a range of technologies both at home and at school, however the use of these technologies was not a daily occurrence. The findings do reveal that older students used technology more frequently than their younger counterparts and that students who used ICT tools for personal communication, such as using email at home, and used presentation tools, i.e. PowerPoint, were not only more confident technology users but also tended to be more frequent users of technology at school. The path model identified that age is a factor in school use which may reflect curriculum use but younger students are also high users of technology. As demonstrated in Figure 4.10 students' use of presentation tools, such as digital scanners, computer and web-based conferencing and desktop publishing (DTP) was influenced by the level of teachers' instructions provided on these applications. That is, teachers who taught about ICT and allowed their students to work with these technologies in a school context directly influenced the students' out of school use of that technology. In this context what students are learning in school in terms of ICT is being applied in and transferring to their out of class behaviours. The structural equation model supports the argument that teachers are influential in students' ICT development and that students are learning how to use those technologies within the school environment and subsequently

applying and adapting that knowledge from school into a wider social context and into their personal lives.

There is also a feedback pathway from the home back to the school in that students' use and confidence gained at home with using productivity tools, such as word processing, spreadsheets, databases and using CDs/DVDs is subsequently transferred back into the students' performance with ICT technologies at school. In part this more independent and extension work with technology in the home illustrates the motivation power of ICT to engage students and for students to transfer this engagement to different settings be it in the classroom, in the community, and in the home.

Home also provides students with opportunities in terms of time and out of school peer interactions to practice with and to gain confidence with communication tools, such as mobile phones and emails and exploring the world wide web. These activities report more personal usage than school usage and their confidence with these forms of technology are transferring from the personal usage domain to the school domain. This is not that unexpected because home use of word processing skills and research skills associated with the world wide web while introduced in the classroom but are often practiced and extended in a home setting would facilitate the students' abilities to do homework and school assignment and also increases the likelihood that the student would become a more independent learner.

Of note is that students' use of communication tools at school and students' use of productivity tools at school have a greater influence in their confidence and skills to use those technologies than their use of those technologies outside of school. That is the students are gaining techniques, knowledge and advice about how to use ICT in school which is building their confidence about how and when to use ICT. Given that the Goodness-of-Fit Index (GFI) for the model in Figure 4.10 was 0.95 the associated pathways were considered sound and to be indicative of students' use and competency with the given technologies.

In summary, based on the structural equation model there was a iterative interaction between ICT and home and school use, particularly in terms of ICT that is used for producing an assessable assignment or an output that is linked to the students' writing of text, use of visual, digital media, and multiliteracies, seeking new information, and using software to solve problems. Schools played a major role in enhancing students' confidence about ICT while home provides opportunities to practice with that technology and facilitate communication using a range of ICT tools. Both home and school enhanced the students' ICT skills and had the effect of making the student a more independent learner and user of ICT.

### Teachers' Survey

The teachers' survey asked 25 questions that were organised in four sections that asked teachers to indicate their use and perceptions of ICT across four domains. The domains related to ICT use for teaching or class instruction; administration, such as recording attendance and results; professional development and for personal usage. Findings from the teachers' survey were used to ascertain answers to research questions 2 and 3 pertaining to schools' current use of ICT for teaching and students' learning.

### Teachers' personal and educational characteristics

A total of 56 teachers, from six schools completed the teachers' survey (see Appendix 6 for teacher demographic data by school), ten (18%) of whom were also interviewed. All surveyed teachers indicated that they used ICT in their teaching practice. Of note from the teachers' responses were that male teachers represented 28% ( $n=16$ ) of the survey respondents. Table 4.7 reports the means and standard deviations for the teacher characteristic questions.

Table 4.7.

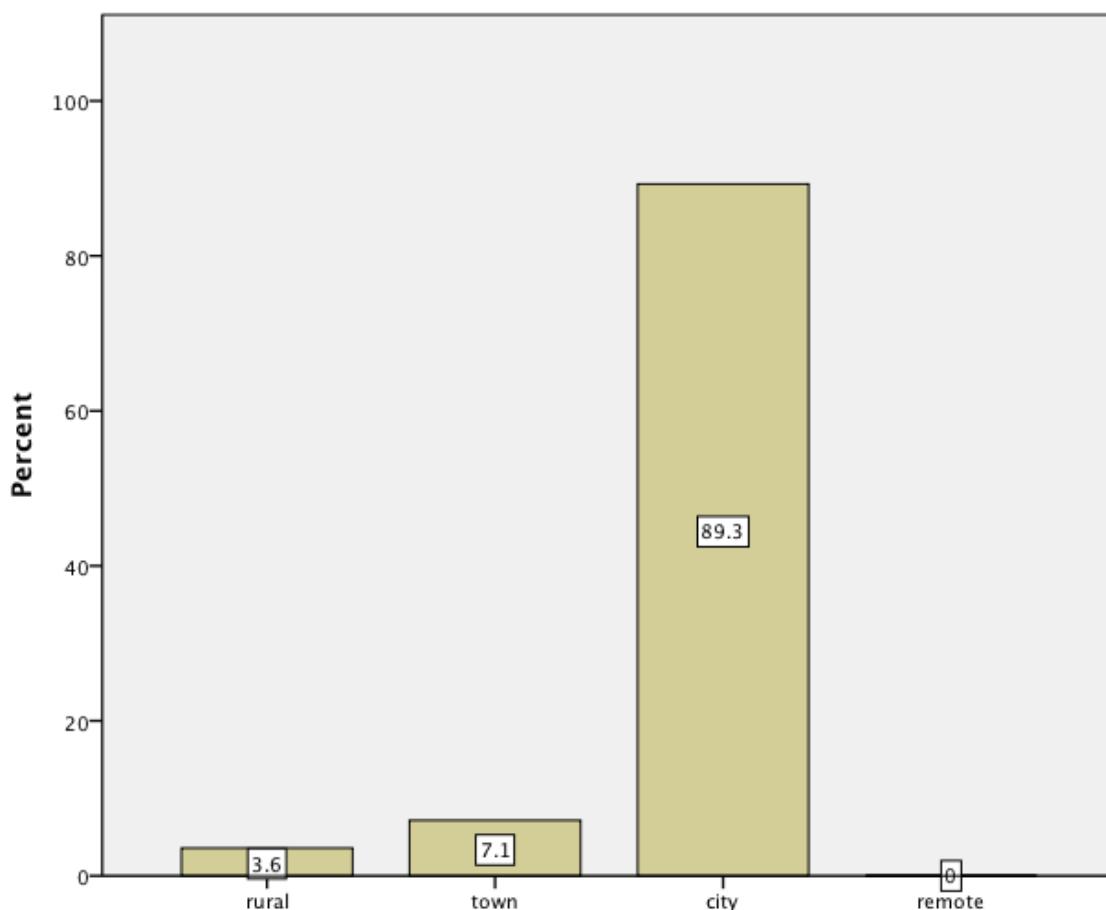
*Typical responder for teaches' characteristics (N=56)*

Items	Mean (characteristics)	Std. Deviation
Teaching years	3.61 (ten plus years)	0.76
Teaching role	1.96 (teacher/senior teacher)	1.21
Teaching type	1.16 (full time)	0.50
Teaching qualifications	2.85 (Bachelor & post grad)	1.13
Number of schools taught in	3.16 (at least three schools)	1.40
Age range	2.83 (40 to 50 years)	0.97

Potential responses to the questions in Table 4.7 varied based upon the question asked. Teaching years was scored as teaching less than one year (score=1), one to five years (score=2), six to ten years (score=3), and ten plus years (score=4). Teaching role responses included teacher (score=1), senior teacher (score=2), subject head (score =3), grade or form head (score=4), teacher administrator i.e. principal or deputy principal (score=5). Responses to teaching type included full time (score=1), part time (score=2), relief (score = 3), and mixed (score=4). Teaching qualification responses included diploma (score=1), bachelor degree (score=2), masters (score=3), postgraduate diploma (score=4), postgraduate certificate (score=5), and PhD (score=6). Potential responses to number of previous schools taught in included none (score=1), one other school (score=2), two other schools (score=3), three other schools (score=4), and four or more other schools (score=5). Age range responses included 20-30 years of age (score=1), 31-40 years of age (score=2), 41-50 years of age (score=3), 51 to 60 years of age (score=4), and 61 years plus (score=5). Items in the table were presented according to question number in the teachers' survey tool. In terms of teachers' age, the survey asked for their age group rather than their age in years, as it was felt during the pilot testing that this would be less intrusive. The largest subset of the 56 was in the 41-50 year age group (44%,  $n=24$ ), and the next in the 31-40 year age group (28%,  $n=15$ ). Four of these teachers were in the 20-30 year age group, eight in the 51-60 year age group, and three were or more years old years old. Two of the 56 did not provide information about their age group.

The 56 teachers reported completing a variety of teaching qualifications and all but one (98.2%) held a formal teaching qualification. Of those teachers with a formal qualification almost half (47.3%,  $n=26$ ) held a qualification above a bachelor degree level. Of interest in the teaching qualification data were that 21.4% ( $n=12$ ) had completed a research higher degree (either at a Masters or PhD level). Of the 56 teachers, 96% ( $n=54$ ) named an Australian university as the institution at which they had undertaken their initial teacher training, whilst the remaining two teachers (4%) indicated that they had trained at an Australian teaching college.

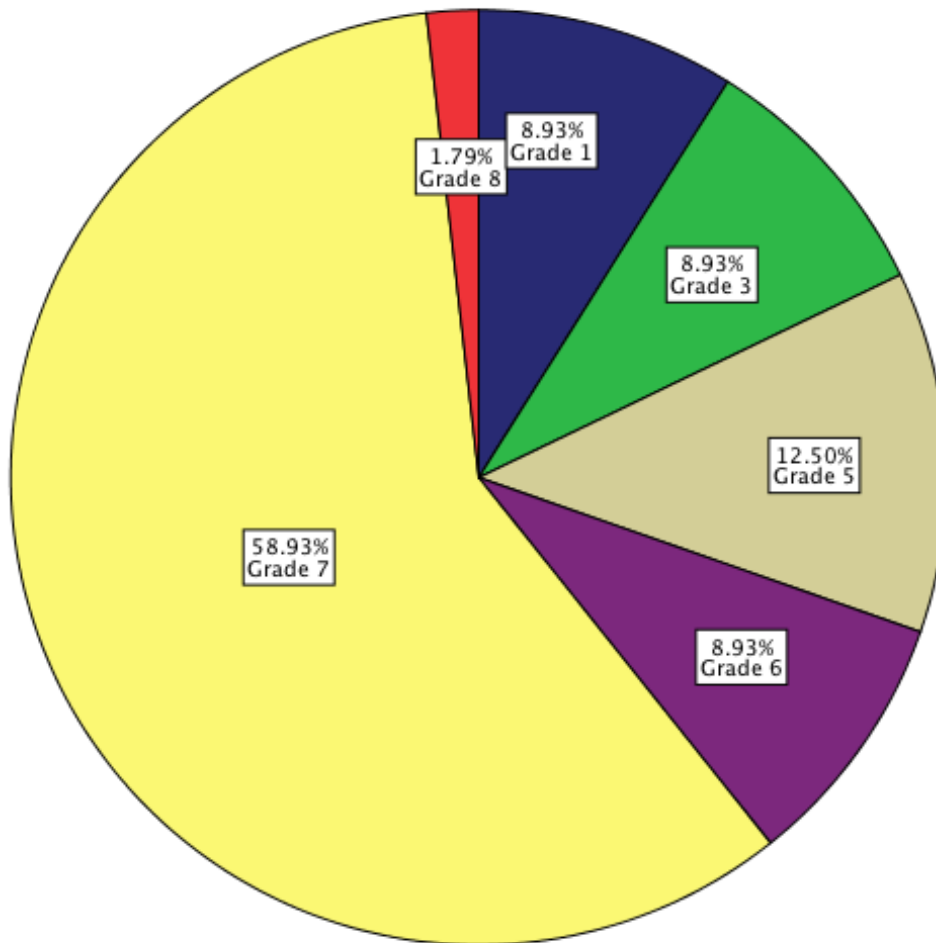
Just over four-fifths (84%,  $n=47$ ) of surveyed teachers reported that they had worked in at least one other school besides their current school. The largest subset of these teachers reported having taught in two schools (29%,  $n=16$ ) or in four or more schools (25%,  $n=14$ ). The remaining 46% reported they had taught in no other schools (16%,  $n=9$ ), one school (16%,  $n=9$ ), or three schools (14%,  $n=8$ ). As indicated in Figure 4.11, the 56 teachers reported that they had mostly taught in city schools (89%,  $n=50$ ), with four (7%) others reporting teaching in town or rural schools.



*Figure 4.11* Percentage of teachers that had taught in each of four types of schools (classified by location) ( $N=56$ )

The teachers' data indicated that three-quarters ( $n=42$ ) of responding teachers had taught for more than 10 years, another seven for 6-10 years, another six for 1-5 years, and one teacher had been teaching for less than a year. The majority of responding teachers taught at grade / year 7 level as demonstrated in Figure 4.12, and were employed as a class teacher (48%,  $n=27$ ). The employment status of the remaining teachers were 11% ( $n=15$ ) as senior teachers, 14% reported working as subject heads ( $n=6$ ), Grade/Form heads ( $n=5$ ) or as teacher administrators ( $n=3$ ). The majority (88%,  $n=49$ ) of surveyed teachers reported being employed full-time, and another 11% ( $n=6$ ) part-time with one teacher being employed on a variable basis that was dependent on students' numbers for the subject of religious education each semester.





*Figure 4.12* Percentage of teachers teaching at a particular grade/year level ( $N=56$ )

To further understand the teachers' demographic data and the associations between attitudes to ICT, and attitudes to ICT training were examined via stepwise regression analysis (see Appendix 6). Stepwise regression involves automatic selection of independent variables. Stepwise regression can be achieved either by trying out one independent variable at a time and including it in the regression model if it is statistically significant, or by including all potential independent variables in the model and eliminating those that are not statistically significant, or by a combination of both methods. This statistical procedure was used to identify variables that had an impact on teacher perceptions and use of ICT. The resulting matrix indicated that a number of the

associations were significant. Interpreting the data from Appendix 6 it is hypothesized that personal and professional characteristics are influential in shaping teachers' attitudes to ICT and their subsequent ICT training. In summary then:

- Older teachers were more likely to be negative about the use of ICT in their teaching practice than younger teachers;
- Female teachers were more likely to be positive about the use of ICT in their teaching practices than were male colleagues. Further to this, a one-way ANOVA was conducted to assess differences in ICT positive use attitudes. The independent variable was gender and the dependent variable was ICT attitude. The ANOVA was significant  $F(4, 1423) = 23.5$   $p < .01$ ;
- Teachers from regional schools (non-city) were more positive towards the use of ICT than teachers in city schools;
- Teachers who have taught at four or more schools were more positive towards the use of ICT in their teaching practices than colleagues who had taught in fewer schools;
- Teachers with a graduate degree were more positive towards the use of ICT in their teaching practices than colleagues who held postgraduate certificate/diploma qualifications;
- Teachers with Masters teaching qualifications were more positive towards undertaking further ICT-based professional development and were more positive towards the use of ICT in their teaching practices than were teachers who held other qualifications;
- Teachers employed as subject heads or as senior teachers were less positive towards the use of ICT in their personal lives than those employed as teachers, and
- Finally, teachers with good self-efficacy (i.e., rated their ICT skills highly) were more likely to state that they believed ICT use in the classroom can distract students' learning.

## Teachers' technology use

All 56 teachers reported that they used ICT in their teaching practice. These teachers were asked to specify their use of 16 nominated technologies. Teachers were also asked to indicate the frequency of that usage (daily=5, weekly=4, monthly=3, termly=2 [at least once a term] or never=1) in each of four settings or domains: (1) classroom practice e.g., using ICT to support your teaching in the classroom; (2) administration, e.g., monitoring students' progress; recording students' grades; (3) professional development, e.g., networking with other teachers; using software packages for developing professional skills, and (4) personal use, for example finding information for personal interest; playing computer games. Table 4.8 lists the means and standard deviations for teachers' use of technology across the four usage domains (class use, administration, professional development, and personal usage) using a five-point scale, with items ordered according to mean.

Table 4.8.

*Means and standard deviations for ICT teachers' use (N=56)*

<i>Technology used</i>	<i>Mean</i>	<i>Std. Deviation</i>
Email Professional use	4.89	0.59
Email Personal use	4.71	0.68
Word Professional use	4.70	0.63
Word class use	4.34	0.88
WWW Personal use	4.34	0.75
WWW Professional use	4.27	0.96
Email use for administration	4.23	1.39
Word use for administration	4.13	1.21
Word Personal use	4.11	1.11
WWW class use	3.80	1.07
WWW use for administration	3.14	1.54
Database use for administration	3.13	1.44
Email class use	3.13	1.66
Database Professional use	3.05	1.52
Digital camera Personal use	2.98	1.02
Spread sheet use for administration	2.89	1.41
Educational software class use	2.88	1.38
Spread sheet Professional use	2.88	1.44
Educational software Professional use	2.79	1.37
Spread sheet class use	2.59	1.30
Digital camera class use	2.55	1.06
Digital camera Professional use	2.39	1.15
Database class use	2.38	1.40
Internal software (self produced) Professional use	2.29	1.33
Mobile phone Professional use	2.23	1.35
Scanner Professional use	2.23	1.10
Database Personal use	2.21	1.32
Educational software Personal use	2.21	1.47
Internet class use	2.21	1.30
Fax Professional use	2.20	1.05
Internal software (self produced) class use	2.20	1.30
CDRom Professional use	2.18	0.97
Spread sheet Personal use	2.18	1.19
Internet Professional use	2.14	1.29
CDRom class use	2.14	1.03
Desk top publishing Professional use	2.07	1.23
Educational software use for administration	2.07	1.44
Desk top publishing class use	2.00	1.22
Scanner class use	1.98	0.82
Scanner Personal use	1.98	0.92
Mobile phone use for administration	1.95	1.41
Fax use for administration	1.93	1.13
Internal software (self produced) use for administration	1.91	1.34

<i>Technology used</i>	<i>Mean</i>	<i>Std. Deviation</i>
Internet Personal use	1.86	1.23
CDRom Personal use	1.84	1.01
Fax Personal use	1.80	0.96
Internet use for administration	1.75	1.13
Desk top publishing Personal use	1.66	1.07
Internal software (self produced) Personal use	1.63	1.17
Digital camera use for administration	1.61	0.95
Desk top publishing use for administration	1.57	1.02
CDRom use for administration	1.55	0.95
Scanner use for administration	1.54	0.81
Fax class use	1.45	0.91
Network conferencing Professional use	1.43	1.06
Mobile phone class use	1.39	1.11
Network conferencing use for administration	1.36	1.05
Network conferencing Personal use	1.30	0.93
Network conferencing class use	1.27	0.86
Videoconferencing Professional use	1.07	0.32
Videoconferencing class use	1.05	0.30
Videoconferencing use for administration	1.04	0.27
Videoconferencing Personal use	1.04	0.27

Given the density of the information collected for the teacher survey question, Table 4.8, outcomes will also be presented in a figure (Figure 4.13). The frequency of teacher use for each of the 16 technologies compared in each of the four settings will also be graphed. To further simplify this description, the percentage of teachers using these technologies more on a daily or weekly basis (termed frequent) are displayed.

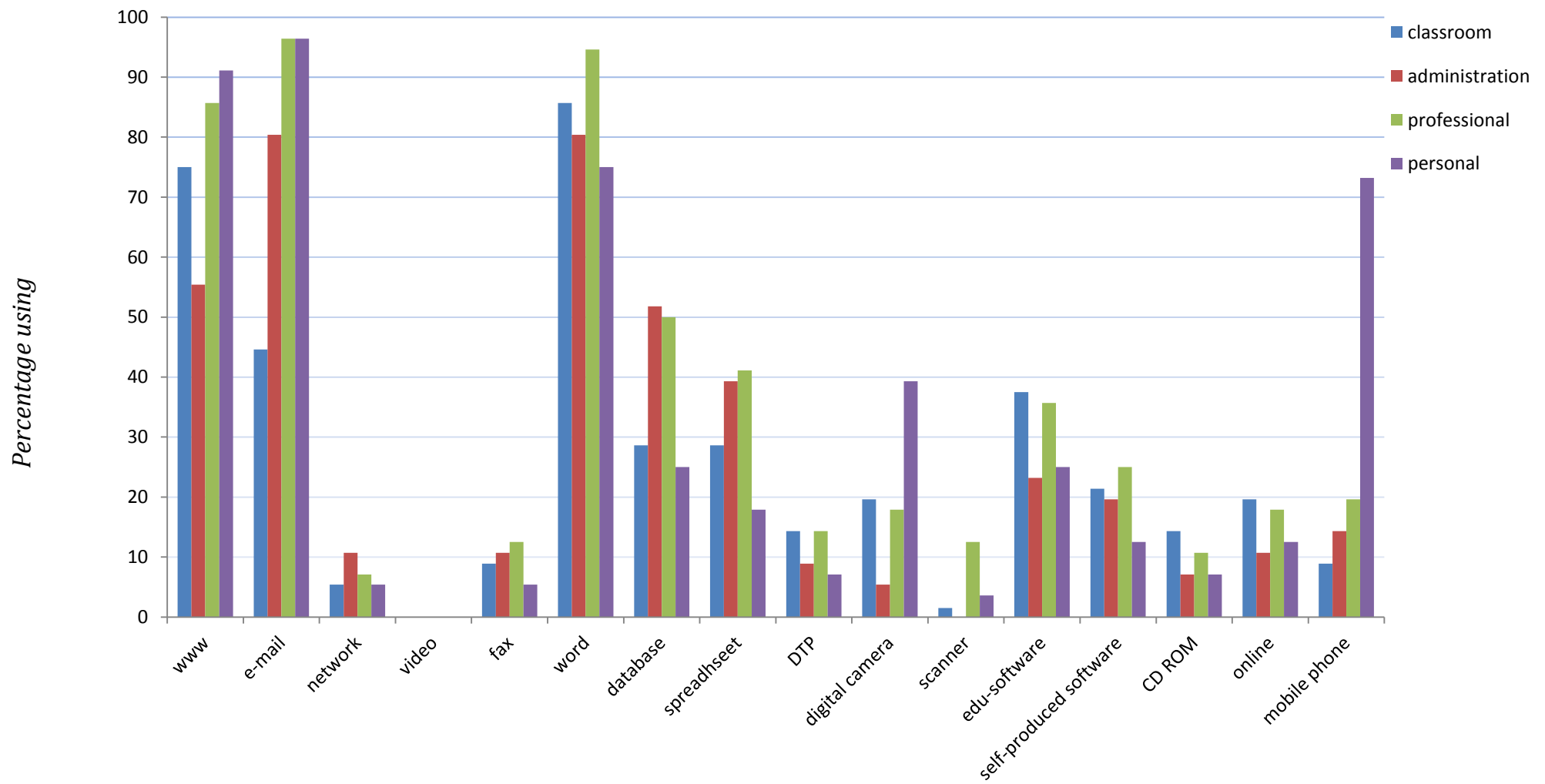


Figure 4.13 Percentage of teachers using nominated technologies frequently (weekly, daily) in classroom, for administration, professional development or for personal use ( $N=56$ )

The most frequently used technologies by teachers across all four domains (see Figure 4.13 and Table 4.8) were associated with the use of the internet (WWW and email) together with the use of a word processor. Whilst productivity tools, such as desktop publishing software, scanners and video conferencing were rarely used across any of the four domains. Teachers' used mobile phones more in their personal lives than they did for school related activities, in contrast databases were used more for school activities than for personal use.

In using the above technologies for classroom, administrative and professional development purposes the majority (93%,  $n=52$ ) of teachers reported that they used the technology in their classrooms. Just under half (45%,  $n=25$ ) used the technology in a computer lab, or school library (36%,  $n=20$ ). Furthermore, most teachers (80%,  $n=44$ ) used their home ICT equipment for school related purposes. In relation to the mode of technology use (for teaching, administration, professional development or personal use) the usage data were collapsed into the four modes. This revealed that teachers used ICT more for professional development compared to personal uses, administration and classroom use, which was the least reported ICT mode. In terms of the most frequently used technology word processing, email and the internet were consistently used across all four domains. Video conferencing, desktop publishing, and using educational CD-ROMs were the least used of the listed technologies.

### Reasons for teachers not using specific forms of technology

In addition to finding out what technologies the responding teachers were using the current study also sought to understand the reasons why some teachers did not use a range of readily available technologies. In ascertaining why the selected forms of technology were not being utilised participating teachers were able to select one of eight set responses (Not available at all, Not accessible when needed, Not familiar with it, Lack of skills, Not appropriate, Cost of buying/using, Lack of technical support, Lack of time) for not using each of the 16 technologies referred to in the previous section. To simplify reporting each of these choices and the teachers'

responses are presented in a set of eight figures in Appendix 7 (Figures 7.1 to 7.8), and only significant findings are reported below.

Significant reasons for participating teachers not to use the 16 nominated technologies ranged from (least cited reason) *cost to purchase or use* which was only cited twice across all 16 technologies, through to, *it was not an appropriate technology* (most cited explanation) to use for teaching, administration or for professional development. This was cited 123 times across the 16 nominated technologies. Table 4.9 reports the means and standard deviations for the reasons cited by teachers for the non-use of the listed technologies, using an eight-point scale. Video-conferencing was the least used and this suggests it is an availability issue as well as a teachers' competency issue.

Potential responses included no response (score=0), not available (score=1), not available when needed (score=2), not familiar with (score=3), lack of skill (score=4), not appropriate (score=5), cost (score=6), lack of technical support (score=7), and lack of time (score=8). Items in the table are ordered according to means. As shown in Table 4.9, the average level of agreement for items in the reasons for technology not to be used ranged from not available when needed through to teachers not being familiar with the technology. Response category, for example, not available, lack of skill were consolidated across the 16 nominated technologies and compiled as Figure 4.14.



Table 4.9.

*Means and standard deviations for teachers' non-use of technology (N=56)*

<b>Items</b>	<b>Mean</b>	<b>Std. Deviation</b>
Word not used	0	0
WWW not used	0.27	0.94
Email not used	0.36	1.3
Digital camera not used	0.75	2.1
Databases not used	0.86	1.78
Spreadsheets not used	0.96	2.04
Scanner not used	1.2	2.28
Educational software not used	1.32	2.33
Mobile phone not used	1.36	2.23
Fax not used	1.61	2.36
Internet not used	1.63	2.28
Internally produced software not used	1.64	2.51
CDRom not used	1.8	2.62
Desk top publishing not used	1.86	2.42
Networking facilities not used	2.73	1.96
Videoconferencing not used	2.91	2.23

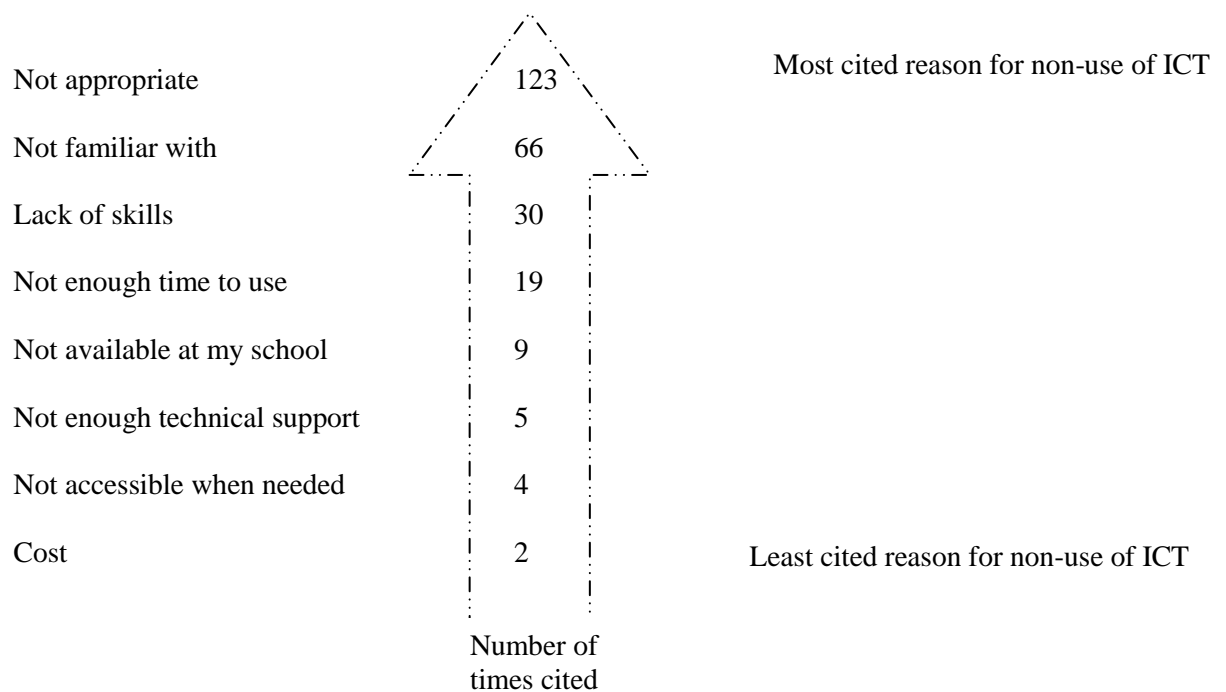


Figure 4.14 Reasons for technology being under used or not-used by teachers

Across all 16 nominated technologies the classroom teachers cited that they did not use the nominated technology because they felt that it was not appropriate or available but this was also reflected by them responding that they did not have adequate skills to use the technology, nor the time to do so (see Appendix 7).

### Teachers' perceptions of ICT

Ascertaining when and how teachers were using, or not using, ICT is affected and influenced by their perceptions about digital technologies. In order to better understand participating teachers' ICT perceptions, a number of teachers' survey questions were asked and subsequently analysed. Table 4.10 summarises the findings to teachers' survey question 5, which asked *What do you think about ICT* questions, that used a five-point Likert scale of definitely disagree (1) though to definitely agree (5), with a score of 3 representing a neutral value. Items in the accompanying table are ordered by the mean response value, from highest to lowest.

Table 4.10.

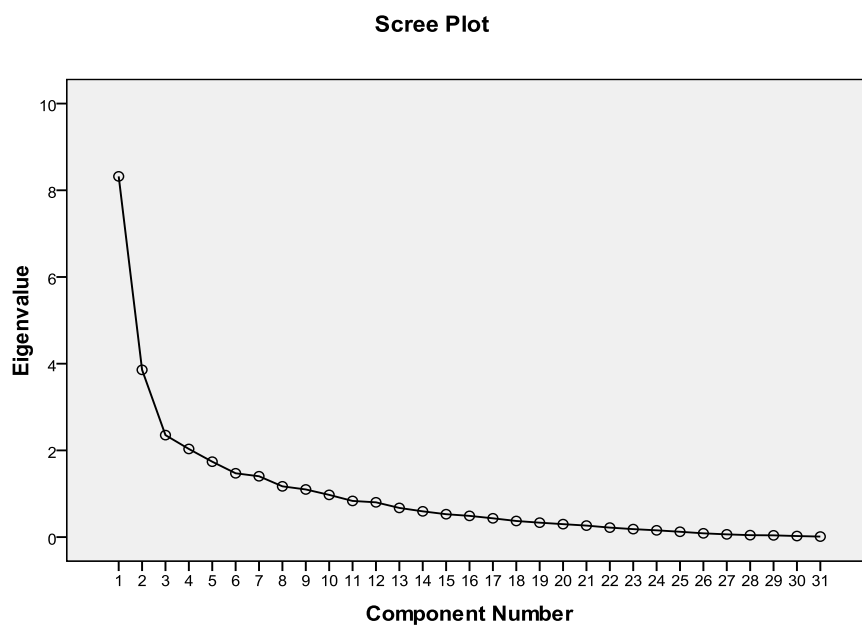
*Descriptive statistics for teachers' attitudes to ICT survey (N=56)*

<i>Question</i>	<i>Mean</i>	<i>SD</i>
Current school has positive attitude to ICT	4.61	0.62
ICT supports communication.	4.52	0.60
ICT helps me	4.41	0.89
ICT increases knowledge	4.29	0.76
Like to know more about ICT	4.27	0.80
Use for non-work	4.11	1.00
Supported in ICT use	4.09	0.84
ICT is effective	4.05	0.98
ICT makes life easier	4.02	1.07
ICT motivates students	3.89	0.89
Can't do without ICT	3.86	1.31
Students are ahead of me	3.64	1.26
Students distracted	3.52	1.18
Reduces prep time	3.39	1.12
ICT time consuming	3.36	1.34
Easy to select ICT	3.30	1.01
Increases collaboration	3.13	1.03
ICT swamps students with information	3.00	0.95
I've got info overload	2.88	1.31
Can't cope jargon	2.73	1.31
ICT moving too fast	2.71	1.16
I know the basics	2.55	1.35
Unsure how to teach its use	2.36	1.03
I don't have skills	2.36	1.21
Use it on my own	2.05	1.07
ICT too slow	2.05	0.82
Students scared	2.00	1.06
Lost in ICT world	1.80	0.80
Can't find things	1.75	0.69
ICT scares me	1.32	0.69
Wish ICT never invented	1.27	0.62

The responses for teachers' technology use reflects a belief that it is part of the educational environment and it has a positive impact on students' learning. Even so the teachers were aware that ICT had its limitations - it could both motivate and distract students.

## Factor structure of the teachers' survey

To investigate the internal cluster pattern associated with the above findings an exploratory factor analysis (EFA) was conducted using Principal Components Analysis, with a Varimax Rotation, and Loadings below 0.25 not visible. The Eigenvalues scree plot identified that the 31 teachers' attitude items formed three strong factors but suggest that there are up to seven factors in all (see Figure 4.15) which explained 68% of the sample variance. Rather than just collapsing the data into these three factors there was interest in reporting all seven (see Table 4.11).



*Figure 4.15* Scree Plot of teacher attitudes towards ICT ( $N=56$ )

As indicated in Table 4.11 after excluding 10 items with high loadings on more than one factor, a seven factor solution was obtained. The seven factor solution was retained as it offered a broad picture of these teachers' attitudes towards the use of ICT, rather than recalculating factors down to a smaller number.

Table 4.11.

*Seven-factor solution for 21 level-of-agreement items about teachers' attitudes to ICT*

<i>items</i>	<i>Negative Teacher issues</i>	<i>Useful</i>	<i>Negative Student issues</i>	<i>School attitude</i>	<i>More Knowledge</i>	<i>ICT communic ation</i>	<i>Ease of use</i>
Can't cope with jargon	0.80		0.27				
Prefer using it on my own	0.79						
I don't have skills	0.75						-0.41
I only know the basics	0.74	-0.37					
ICT moving too fast	0.64				-0.30	-0.40	
ICT is effective		0.79				0.38	
Makes life easier		0.74		0.29			0.25
Can't do without		0.74					
Reduces prep time		0.66		0.43			
Motivates students		0.65	-0.36				
Students distracted			0.89				
ICT swamps stdts with info			0.68		-0.26	-0.32	
Students scared	0.39		0.63		0.34		
School positive about ICT				0.81		0.27	
Supported in ICT use		0.29		0.79			
Helpful for non-work tasks	-0.27				0.81		
Like to know more about ICT					0.80		
ICT supports comm.						0.82	0.25
Happy that ICT invented		0.35		0.27		0.57	
Easy to select ICT		0.29					0.77
Ahead of students	-0.36		-0.32				0.61

Table 4.11 shows that five items related to the factor called *Negative Teacher Issues*. The second factor, related to ICT being *useful* whilst the third factor dealt with issues relate to *Negative Student Issues*. The fourth factor is *School Attitude* and the fifth factor five was *More knowledge*. The final two factors were *ICT Communication* and *Ease of Use*.

The Cronbach's Alpha value for the 31 items of the *What I think about ICT* scale was 0.68, which approximates the 0.7 threshold that is considered to demonstrate a moderate level of internal consistency (Nunnally, 1978).

Teachers' perceptions of ICT impact on their teaching practice and upon students' learning, as demonstrated in Figure 4.16, indicated that more than 80% of teachers felt that ICT had positive impacts on their teaching, with less than 2% responding that it had negative impacts. These teachers were also very likely (77%) to state that ICT had positive impacts on students' learning, with less than 4% responding that it had negative impacts (see Figure 4.17).

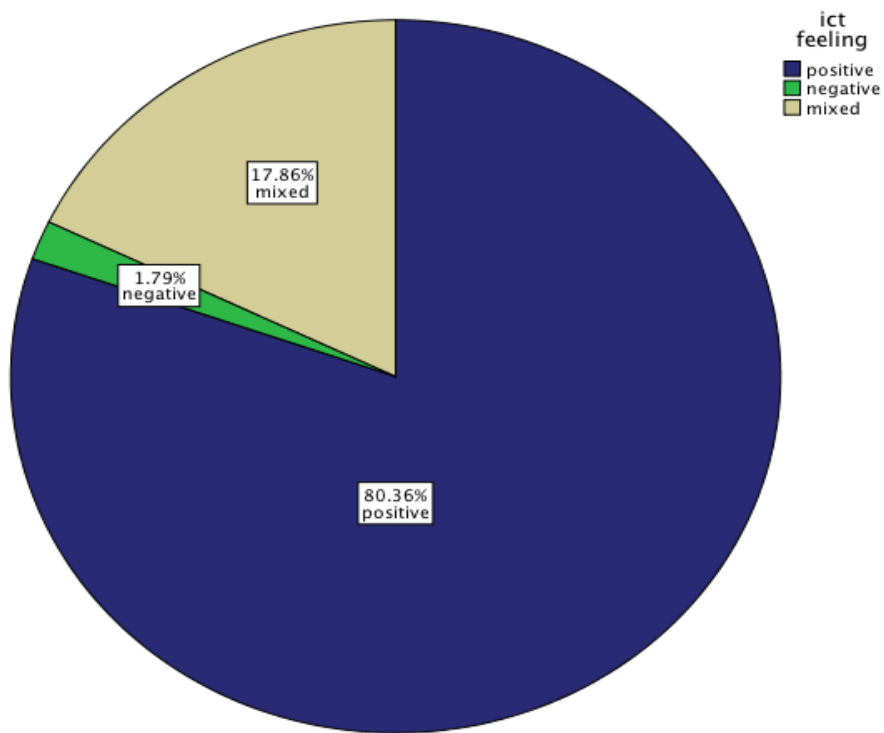


Figure 4.16 Percent of teachers indicating that ICT has had positive, negative, or mixed impacts on their teaching ( $N=56$ )

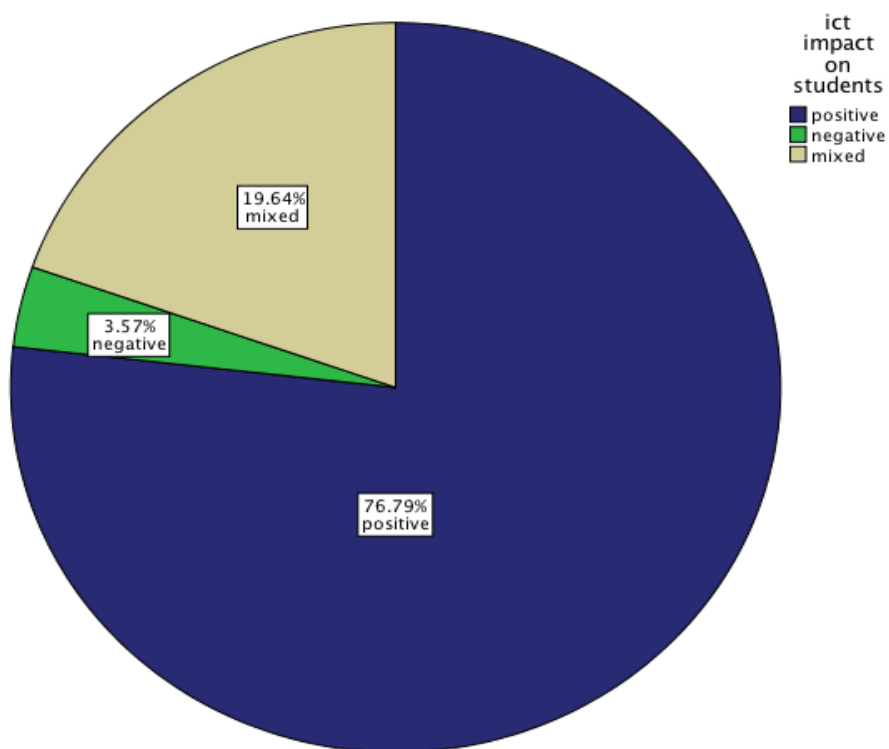


Figure 4.17 Percent of teachers indicating that ICT has had positive, negative, or mixed impacts on their students' learning ( $N=56$ )

## Teachers' ICT professional development and ICT attitudes

Within the past 12 months of completing the survey the majority (69.6%,  $n=39$ ) of teachers had undertaken some form of ICT-based training or professional development (PD). However, only half (53.6%,  $n=30$ ) of these teachers found that training to be useful or beneficial to their teaching. Overwhelmingly past ICT-based training was on specific software (i.e. Inspiration or FileMaker Pro) or hardware (i.e. interactive white boards) that the school was considering purchasing-but did not currently have in their school.

Despite only half of the teachers finding their past ICT training useful, when asked to nominate future training needs all of the teachers indicated further software training (i.e. Tinker Plots, advanced Excel) and useful websites (i.e. Mathletics) which they could go away and use immediately in their current teaching. Table 4.12 lists the means and standard deviations for teachers' survey questions relating to past and future ICT professional development using a five-point scale. Potential responses included definitely disagree (score=1), tend to disagree (score=2), neutral (score=3), tend to agree (score=4), and definitely agree (score=5). Items in the accompanying table are ordered in terms of mean response values from lowest to highest.



Table 4.12.

*Teachers and further ICT professional development (N=56)*

<i>Items</i>	<i>Mean</i>	<i>SD</i>
Interest ICT development	0.91	0.29
No need for me to use ICT	1.38	0.65
Not necessary	1.39	0.56
ICT not required in my teaching	1.55	0.83
ICT not appropriate for me	1.59	0.68
ICT not required for career progression	1.64	0.77
Not interested in ICT but should be	1.80	0.94
Interested in ICT but not appropriate for teaching	1.80	0.94
Interested in ICT but no access	1.89	0.89
ICT training not useful	1.95	0.84
Interested in ICT but no training	2.07	0.95
ICT training isn't a priority	2.39	1.14
Interested in ICT but no time	2.77	1.10
ICT skills adequate	3.23	0.99
ICT training a priority	3.61	1.14
Like to develop ICT skills and knowledge	3.66	0.69
Want to know more about ICT	3.96	0.91
ICT training useful	4.05	0.84
Need skill to be up to date	4.18	0.94
ICT appropriate for my teaching	4.20	0.94
Need skill for professional development	4.21	0.76
Develop skills for my students	4.25	0.84
ICT required for career development	4.36	0.77
ICT appropriate for me	4.41	0.68
Interested in ICT but ICT skills development inappropriate	4.57	0.60

As can be seen from Table 4.12, the average agreement for the five-point scale ranges from some disagreement (1.00), though these were negatively worded questions, through to strong agreement, the lower responses occurring to negatively worded questions, which when rephrased to be positively worded result in participant responses showing a great deal of agreement. The overwhelming majority (95%,  $n=53$ ) of responding teachers indicated a desire

to learn more about how to use ICT in their teaching practice and in using ICT more generally (96%,  $n=54$ ). Though the majority of teachers 73.2% ( $n=41$ , definitely agree or agree) believed that they had adequate access to further training. Despite this teachers felt ‘pressure’ or potential barriers to their further ICT-based training needs, with the most common reasons given related to a lack of time with 32% ( $n=18$ ) reporting that they did not have enough time; importantly, only 5.4% ( $n=3$ ) of surveyed teachers thought that the use of ICT was not required in their future teaching practices.

Associated with undertaking ICT professional development is the realization that teachers need further education and professional development to maintain their contemporary practice and to keep up to date with the latest technologies and pedagogies. As such, surveyed teachers were asked to indicate their level of ICT competence, using a Likert scale with four response categories: (1) Don’t know/missing value; (2) Not competent; (3) Competent; and (4) Very competent, across the four ICT usage domains (classroom practice; administration, professional development and personal use). The teachers’ responses are summarised in Table 4.13. Across the four domains of: (1) classroom practice; (2) administration, (3) professional development and (4) personal use, the teachers’ self-rated themselves at the above competency level.

Table 4.13.

*Descriptive statistics for teachers’ level of competence in four contexts (N=56)*

<i>Level of ICT competence</i>	<i>Mean</i>	<i>SD</i>
Personal use	3.20	0.44
Classroom practice	3.07	0.50
Administration	3.07	0.47
Professional development	3.00	0.49

As indicated in Table 4.13, these teachers on average rated themselves as competent (3) to very competent (4), with the highest rating for personal use and the lowest rating for professional development. It is worth noting that the context of professional development received the lowest ratings (on average) and the largest number of missing responses ( $n=4$ ). One conclusion is that teachers felt more uncertain about responses in this context than others.

Teachers were also asked to rate how they felt about a number of ICT professional development and training questions, using a five-point Likert scale with response categories ranging from: definitely disagree (1) to definitely agree (5), with neutral being 3. As reported in Table 4.14, responses are ordered in terms of loading from the highest to the lowest. In general these teachers were interested in using ICT and recognized the need for their ICT skills to be constantly updated via regular professional development so that they were able to use the technology in their teaching practice. These teachers also recognized the importance of using ICT in their teaching and administrative roles and as such believed that having appropriate levels of ICT skills were a requirement for career progression and promotion.

Table 4.14.

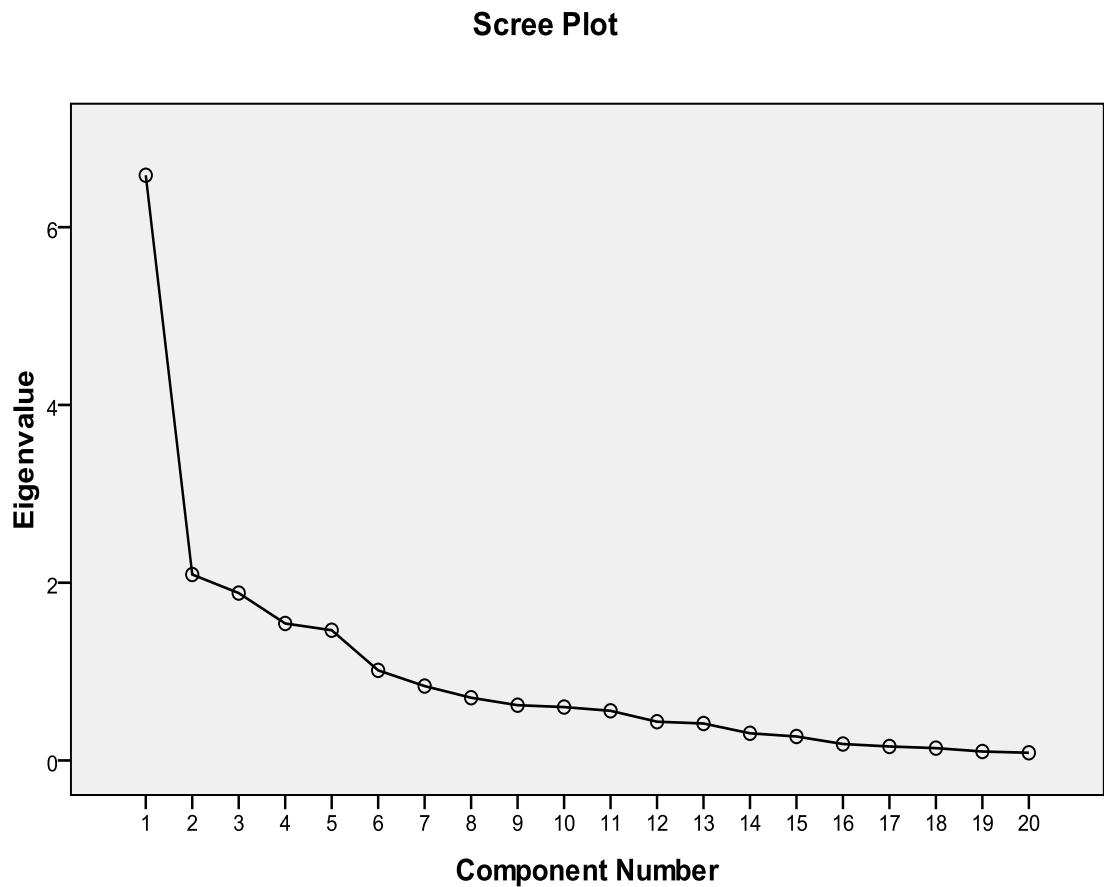
*Descriptive statistics for level of agreement regarding ICT training (N=56)*

<i>ICT training items</i>	<i>Mean</i>	<i>SD</i>
Interested in ICT	4.57	0.60
Develop skills for my students	4.25	0.84
Need skill for professional development	4.21	0.76
Need skill to be up to date	4.18	0.94
ICT training useful	4.05	0.84
Want to know more about ICT	3.96	0.91
Like to develop ICT skills and knowledge	3.66	0.70
ICT skills adequate	3.23	0.99
Interested in ICT but no time	2.77	1.10
ICT training isn't a priority	2.39	1.14
Interested in ICT but no training	2.07	0.95
Interested in ICT but no access	1.89	0.89
Not interested in ICT but should be	1.80	0.94
Interested in ICT but not appropriate for my teaching	1.80	0.94
ICT not required for career progression	1.64	0.77
ICT not appropriate for me	1.59	0.68
ICT not required in my teaching	1.55	0.83
Not necessary	1.39	0.56
No need for me to use ICT	1.38	0.65

## Factor structure of the teachers' survey

Further interrogation of these findings was undertaken using exploratory factor analysis (EFA) (Principal Components Analysis, Varimax Rotation, Loadings below 0.25 not visible) to identify the themes and factors in the teachers responses.

While the scree plot suggests a strong two factor solution (see Figure 4.18) there are up to five possible factors identified in the scree plot and in this case all five are reported (see Table 4.15).



*Figure 4.18* Scree Plot of factors for teachers' attitudes towards ICT in their teaching practice (N=56)

Table 4.15.

*Five-factor solution for future teachers' ICT training*

<i>Components</i>	<i>Career</i>	<i>Skills</i>	<i>Professional disinterest</i>	<i>Personal interest</i>	<i>Self efficacy</i>
Need skill for PD	0.91				
ICT required for career development	0.83				
Develop skills for my students	0.70	0.43			
ICT appropriate for me	0.64	0.39	-0.38		
Need skill to be up to date		0.84			
ICT training a priority	0.29	0.79			
ICT appropriate for my teaching		0.70		-0.31	0.28
Interested in ICT but no time	0.25		0.82		
Interested in ICT but no access			0.74	0.39	
ICT training not useful			0.72		
Interested in ICT but no training		-0.30		0.75	0.26
Want to know more about ICT		0.36		0.74	-0.25
ICT skills adequate					0.93

The five factors were:

- That ICT skills development and knowledge was required for career progression That ICT Skills development was required to keep teaching practice contemporary;
- ICT use and ongoing training was difficult due to time and access issues, this factor was called Disinterest;
- That teachers were interested in furthering their ICT knowledge, factor called Personal interest, and
- That ICT was required in their teaching practice but many thought their present skill level was adequate; this factor was called Self-efficacy. This item was significant in itself in that it resulted in a factor rating of 0.93 for a single item.

The five factors resulted in a Cronbach's Alpha of 0.69, which approximates the 0.7 threshold that is considered to demonstrate a moderate level of internal consistency (Nunnally, 1978); therefore, the factor solution was considered statistically reliable.

## Teachers' interview qualitative findings

From the 56 teachers who took part in the teachers' survey, 10 (18%) volunteered to be interviewed. In this qualitative analysis, the core issue being investigated was how teachers used technology in their classroom. The questions asked are shown in Appendix 3.

The teacher interview data were transcribed verbatim, and checked by interviewees. This qualitative data were prepared for analysis by collecting each answer provided by the ten teachers together into one block of text. It is possible to analyse individual teacher's responses but for the purpose of this research, it was the responses from the cohort of 10 teachers as a group that was of interest. This block of text collected from each teacher on the same question was analysed by a text program called Leximancer (Smith & Humphreys, 2006). This program allowed each word to be reviewed within the context of the sentence that the word was located within. The outcome is that while the unit of analysis is the word, it is understanding how that word relates to other words and sentences that is important.
































Leximancer thus provides the researcher with a frequency of words used in the block of text being reviewed, and output tables and figures that report on how these words relate together as themes and these themes are linked together to form a concept map. (Krupenia, 2006; Smith & Humphreys, 2006). The reliability, stability and face validity of Leximancer has been demonstrated in previous research studies that used Leximancer and other comparable techniques to produce similar concept maps for the same texts (Smith, Grech, & Horberry, 2002; Smith & Humphreys, 2006).

As indicated, Leximancer (see <https://www.leximancer.com/>) was used to identify main concepts of the overall teacher transcript content. During the analysis, such words as "the" and "and" known to have no research relevance, were discarded; while pairs of words with similar meanings, such as "feel" and "feelings", were merged. Looking first at the vocabulary Table

4.16 reports the most common words teachers said when talking about how they use technology in their classroom.

Table 4.16.

*Frequency of vocabulary used when teachers talked about ICT in their classroom*

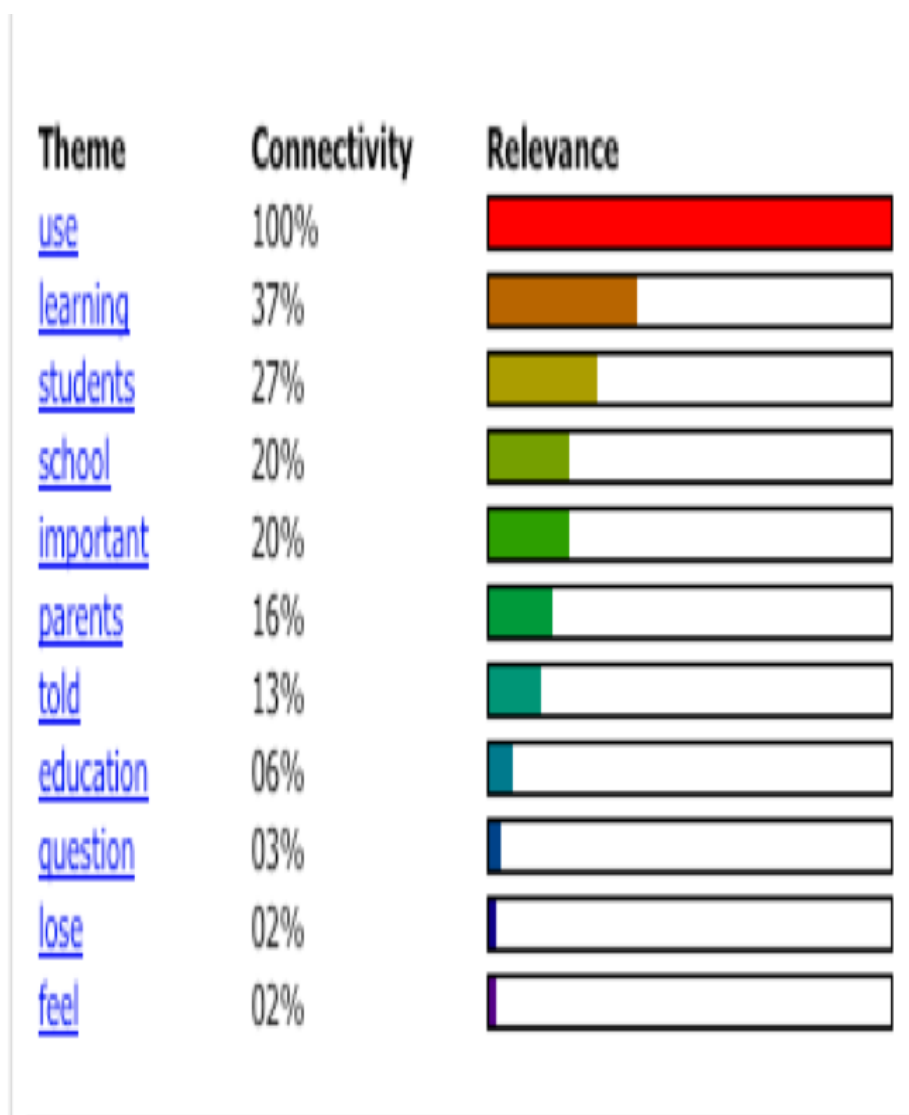
Word-Like	Count	Relevance	
use	39	100%	
technology	23	59%	
important	23	59%	
learning	20	51%	
technologies	15	38%	
students	11	28%	
teacher	9	23%	
school	9	23%	
staff	8	21%	
suppose	7	18%	
used	7	18%	
education	7	18%	
time	6	15%	
teachers	6	15%	
extent	6	15%	
work	5	13%	
guess	5	13%	
told	5	13%	
needs	5	13%	
using	5	13%	
probably	5	13%	
question	5	13%	
feel	5	13%	
parents	4	10%	
pressure	4	10%	
doing	4	10%	
teaching	4	10%	
reasons	3	08%	
girls	3	08%	
year	3	08%	
lose	3	08%	

As reported above there were some 30 words that regularly appeared when teachers were talking about how they used technology. For example, all teachers talked about the use of technology (word count 39). The high frequency words also act as common linked to other words in the text, and as such, they form connections within the text, that the designers of Leximancer call themes. The level of connection by each of the high frequent word themes is reported in Table 4 17. For example, the word/theme “use” is at the most connected word in the text.



Table 4.17.

*High frequency and connection points in the text on how teachers used ICT in the classroom*



As reported in the above table five main themes are: (1) use, (2) learning (3) students (4) schools and (5) important. Leximancer is able to draw a map of how the high frequency words or theme words relates to the other words (as shown in Table 4.16). This concept map is shown in Figure 4.19.

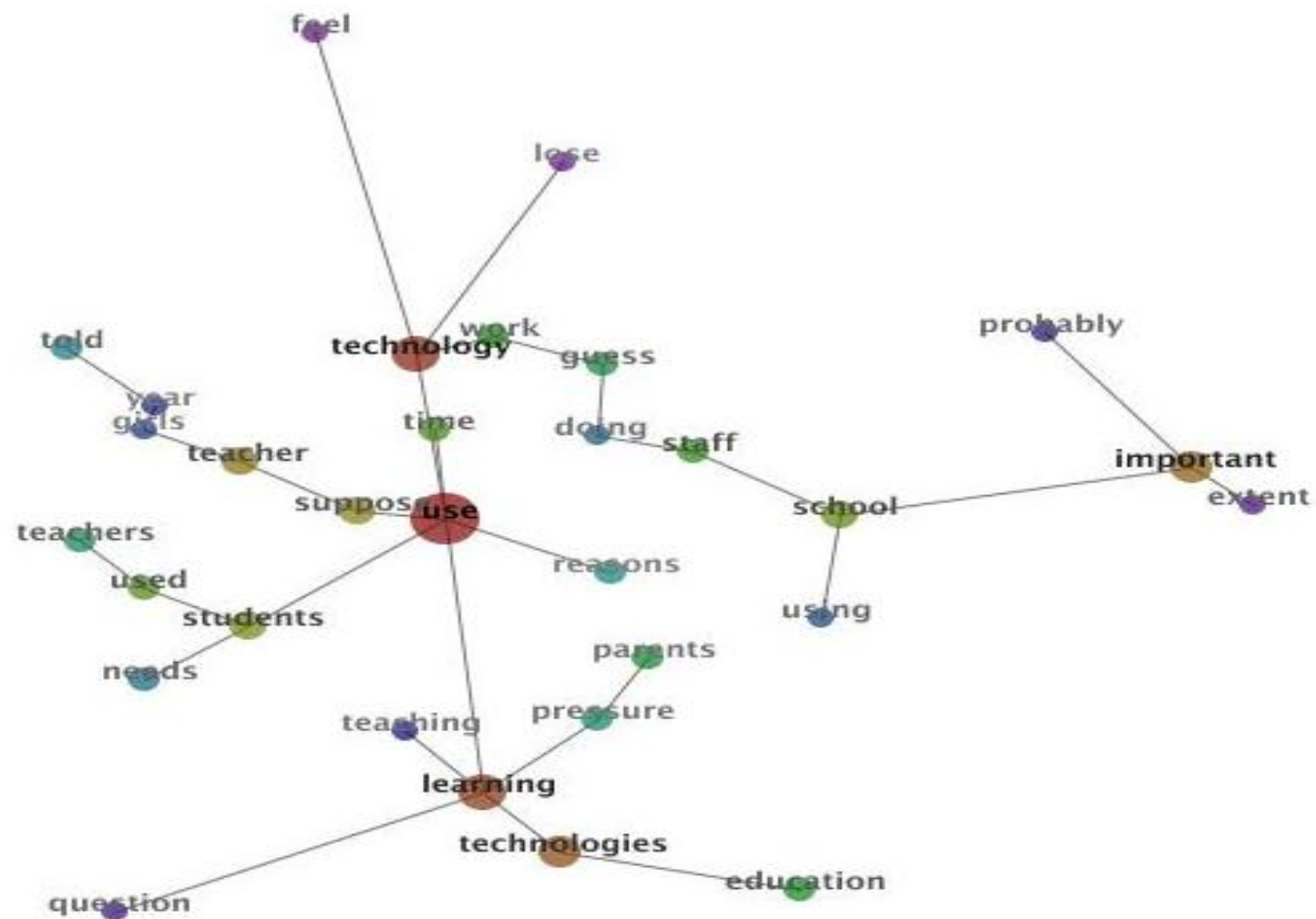


Figure 4.19 Concept map of how teachers' relate ICT issues together

This concept map can also be drawn to identify the level of overlap between a theme, that is what words and concepts “fit” close together and which do not. The theme concept map is shown in Figure 4.20.

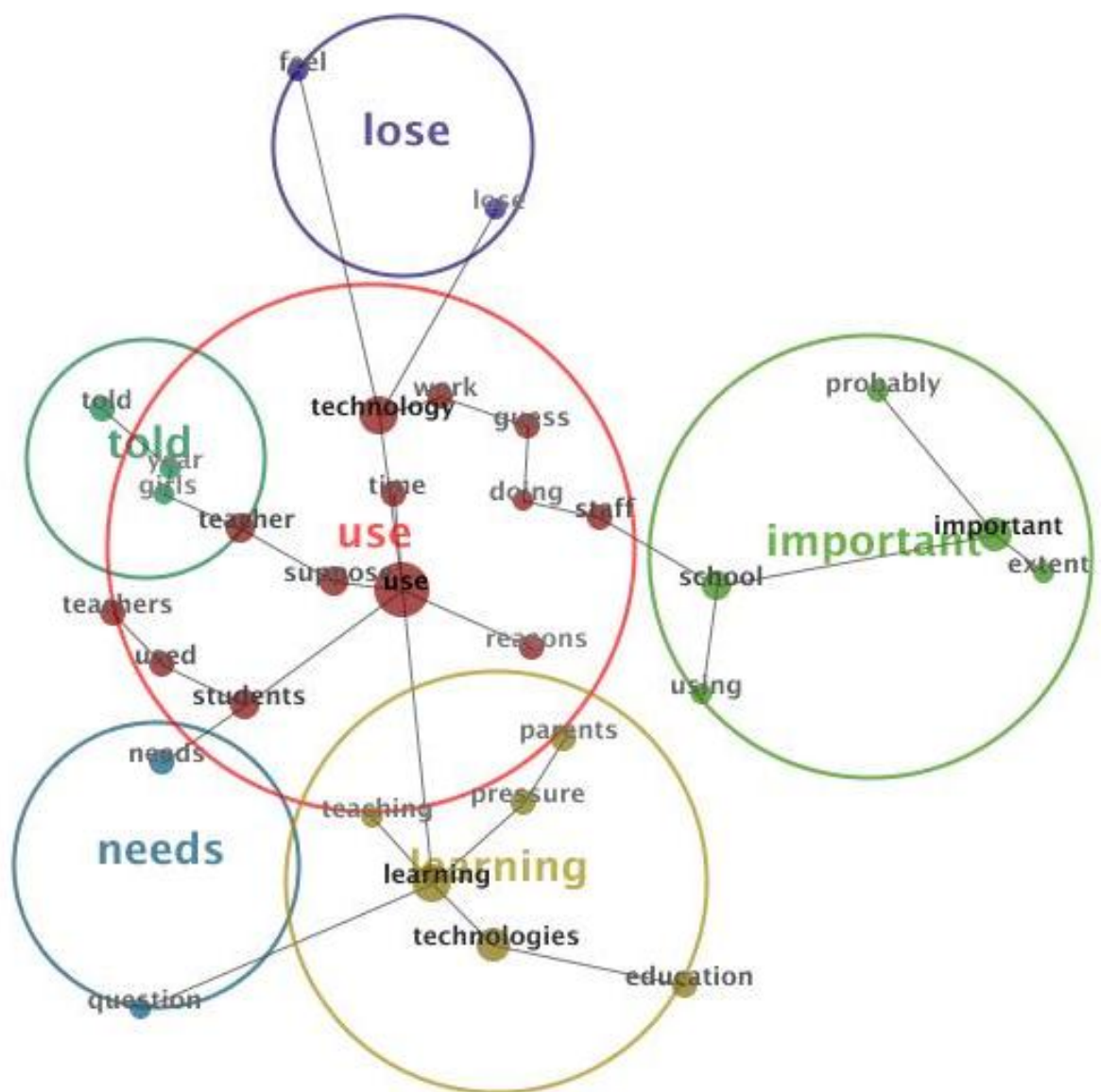


Figure 4.20 Teachers ‘concept map of how they use ICT in their classroom with theme “bubbles

Interpreting the concept map, (Figures 4.19 and 4.20) the use of technology is the core issue, and it is seen as important, and related to students' learning and their needs. The learning theme is close to the student learning need and it is interesting that *parents* are linked to the *students* via the word *pressure* suggesting that teachers see pressure to use technology related to parent expectations. The importance of the ICT is more at the school level and it is linked into classroom use via the branch line of staff and work. The main link related to the use of technology is the concept *time*. This suggests that teachers see technology as *important* but time is an important consideration. There is a branch line from the centre concept "use" that links use to telling or instruction and for this cohort girls are linked concept. The word *feel* and emotion is away from the learning and suggests that feelings about technology are still connected to its *use* but it is not directly influencing its use or its relationship with the students learning and needs. The word *teaching* in the lower end of the diagram is linked with *learning*, and *education* and *parents*, and *students need*. While this is in the lower section of the concept map the fact that they are all clustered together suggest that teachers are linking technologies, teaching and learning together and as one way of meeting students educational needs.

### Teachers' survey summary

Results from the teachers' survey and interviews revealed that all responding teachers used ICT to some extent in their teaching practice, and this finding was identified using both qualitative and quantitative analysis. The teachers reported that technology was important and related to the students' learning and their needs, although issues about time and external parental pressure and the importance at the school level were concerns. Teachers with postgraduate teaching qualifications and those teachers who rated their ICT competency as high were more positive towards the use of ICT in their teaching than those teachers who held lower level qualifications or rated themselves as being less confident. The results also indicate that younger teachers are more positive towards ICT in their teaching practice than older teachers. Female teachers and

those who had taught in four or more schools were more confident and positive towards the use of ICT than male teachers and those who had taught in fewer schools.

### Principals' Survey

To determine the characteristics of the six participating schools, principals were asked 68 questions, organised into ten sections, to ascertain their views on a range of school related ICT factors. Of the six schools, two were from Tasmania and the remaining four from Victoria, Australia. Two of the six schools were in a capital city, three in other major urban areas, and one in a small rural community (see Table 3.3). Participating principals worked with very diverse student populations (Early learning centres [4 year olds] though to grade 12 [18 year olds], kinder [5 year olds] to grade 12, kinder to grade 6 [12 year olds], Preschool [3 year olds] to grade 6, preparatory [5 year olds] to grade 12, grade 7 [13 year olds] to grade 12). One of the six worked in a government (public) school, the other five in independent (Anglican, Catholic and independent) schools. Three of the six schools had been in operation for more than 100 years, and the other three for between 21 to 50 years.

The number of students at the schools ranged from 50 or less, through to 1301-1400, with no two schools reporting the same ranges. Three of the six schools reported employing 91-100 staff; two had a range extending from 5 staff or less, through to 30 staff, and another more than 100 staff.

### Mission and general ICT aspects

To determine the importance of ICT within the school, principals were asked eight questions relating to ICT within the school's mission and philosophy, and to rate the level as Not at all, Low, Moderate, or High; with Not at all, numerically coded as 1 and High coded as 4 (see Figure 4.21).

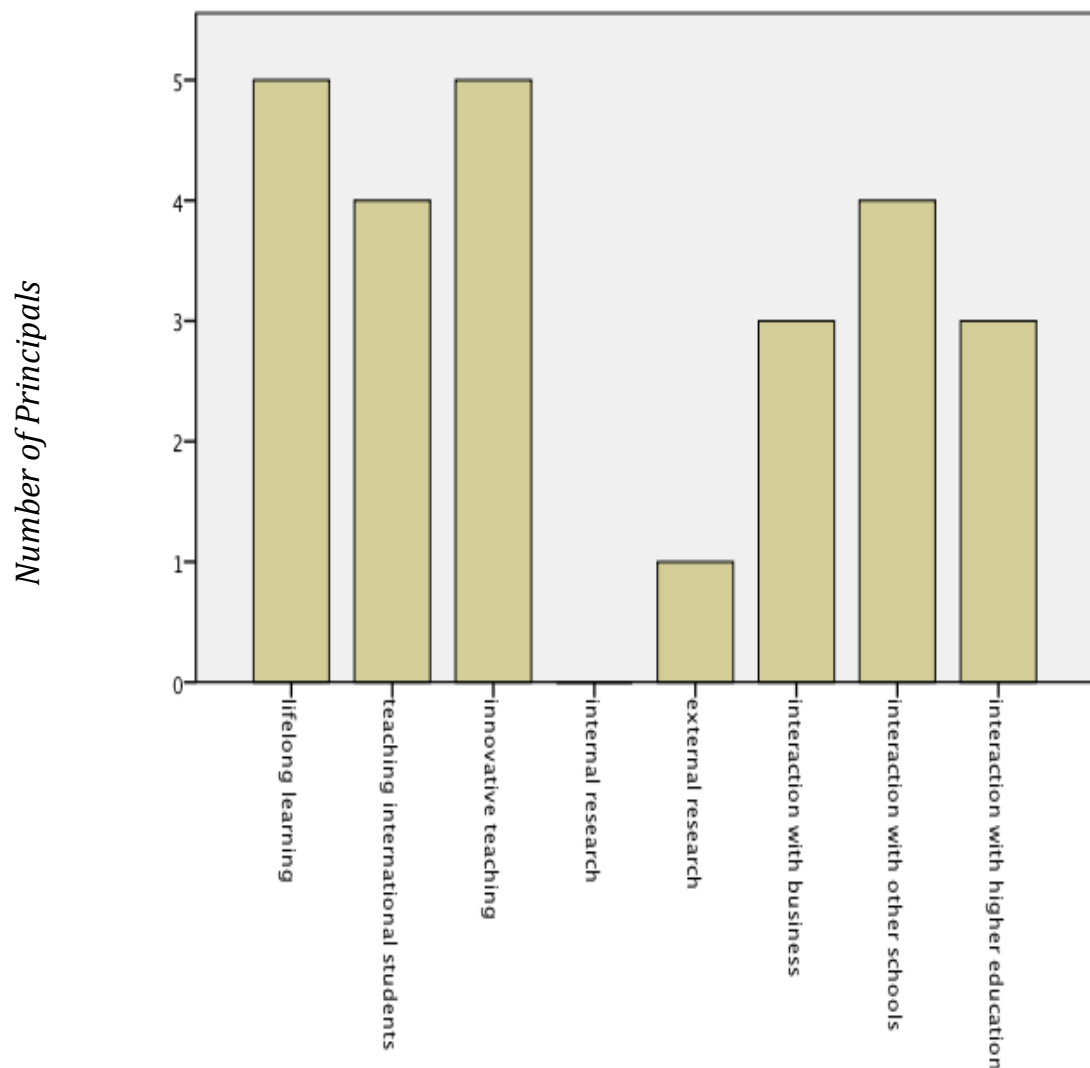


Figure 4.21 Importance of ICT in school's mission statement (N=6)

As shown in Figure 4.21, principals were most likely to list the importance of ICT to provide for students' life-long learning (83%) and using ICT to provide for innovative teaching (83%) as moderately or highly important. They were less likely to list internally funded research (0%) or externally funded research (17%) as being important reasons for the school to purchase or use ICT.

Associated with principals' view of ICT within their schools' overall mission or philosophy, was how they viewed the educational practices within their school. As demonstrated in Figure 4.22, these six principals were most likely to list face-to-face contact (100%) and contact with

teacher when needed by the students (100%) as occurring widely within their schools. They were less likely to list students being allowed to choose the time and place of learning (independent learning: 50%) as occurring within their schools, though in general the majority of these principals reported that an appropriate level of ICT was used in their schools.

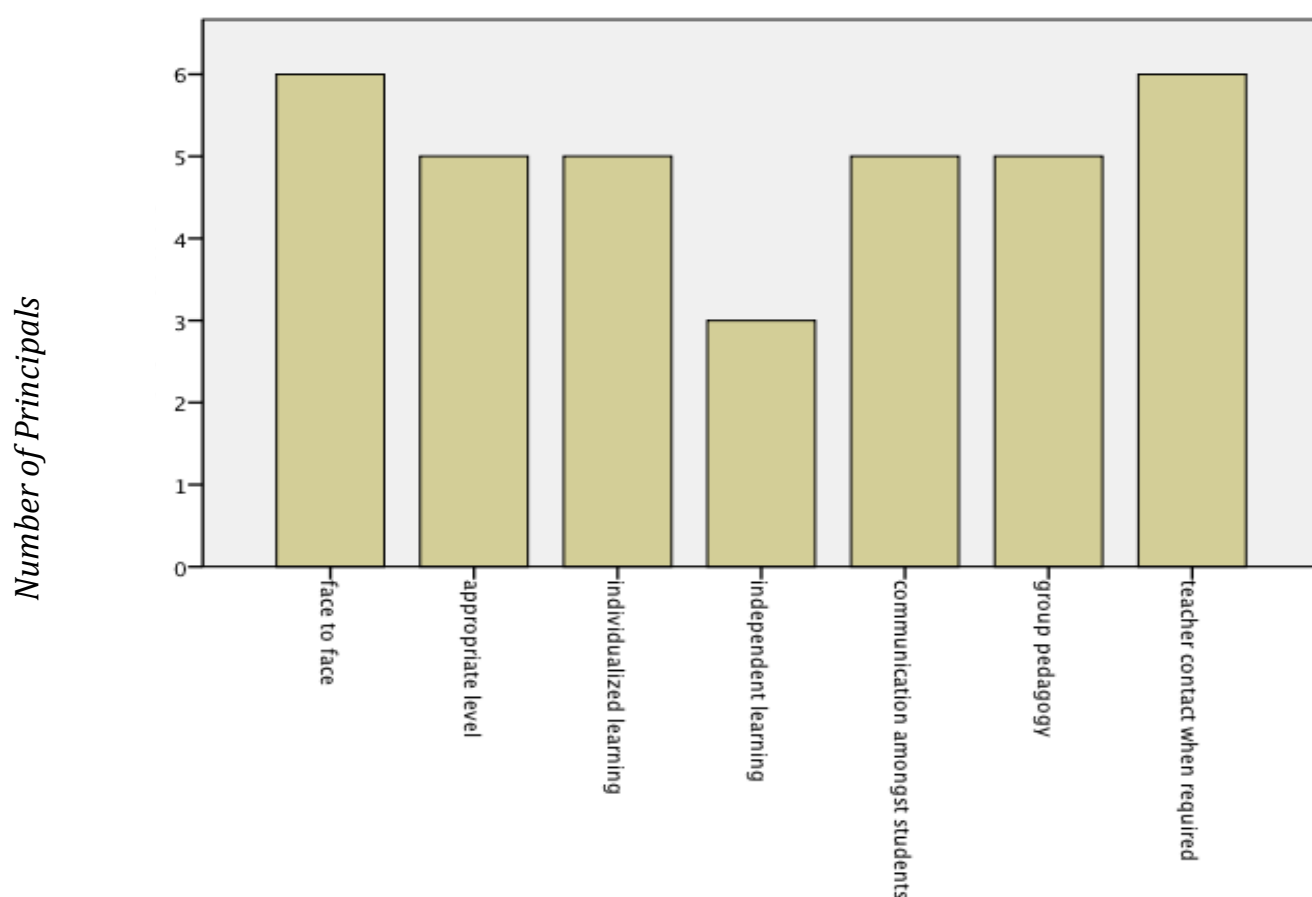


Figure 4.22 Principals' beliefs of good education (N=6)

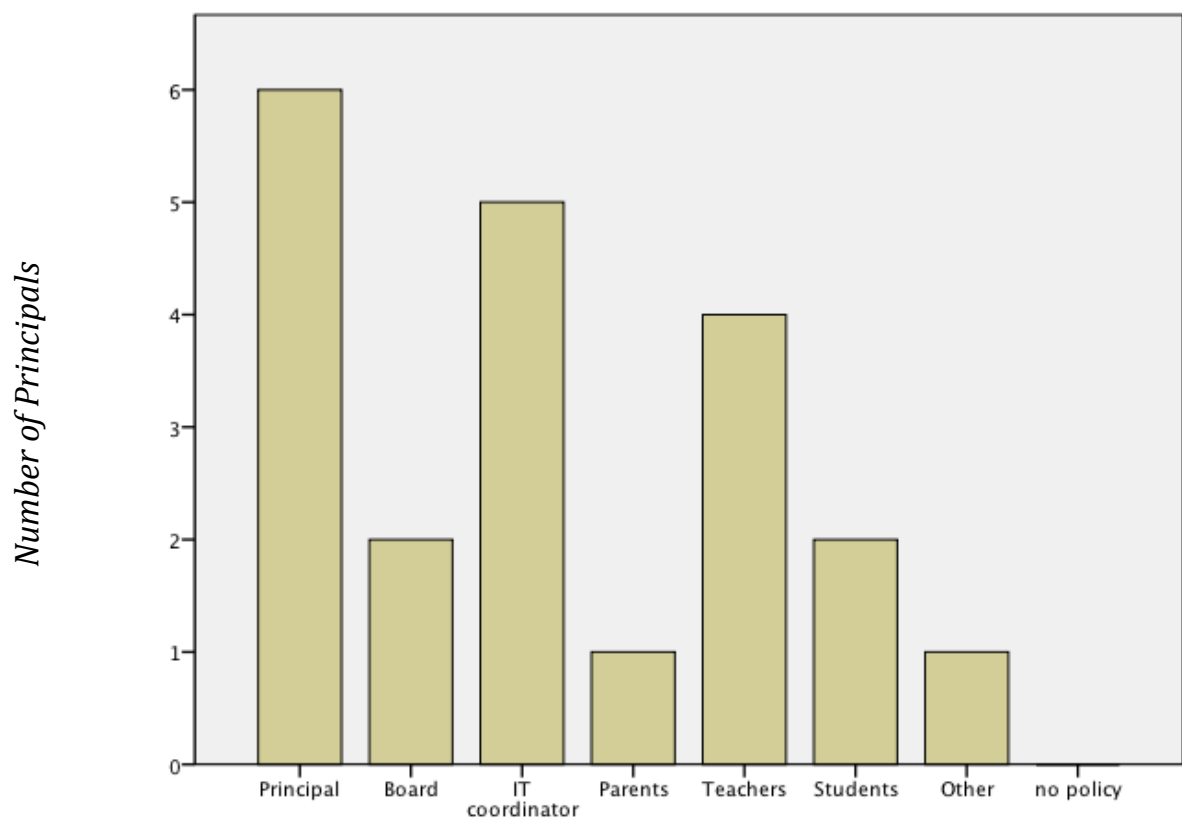
Of the six principals, when asked to assess the current balance in their schools between face-to-face and via-the-internet for teacher administrative procedures, 50% selected face-to-face and the other 50% reported that their use was balanced, with both being used in their schools. Overall the principals regarded their school's overall success in relation to using ICT for teaching and students' learning as average to strong, using a three point scale of Weak (score=1), Average (score=2) or Strong (score=3). One principal selected weak, and the other four selected strong.

## Policy and leadership processes

The principals were further asked to indicate which individuals or positions were responsible for the creation of ICT related policies and procedures within their school. All six principals reported that their school had specific ICT related teaching and learning policies and all six principals reported that they had the primary and formal responsibility for ICT related policies in their school. Five (84%) also selected the IT coordinator, three (50%) District Management or Board of Governors. Only one principal (17%) thought that parents had a say in or had some responsibility for the school's ICT policy.

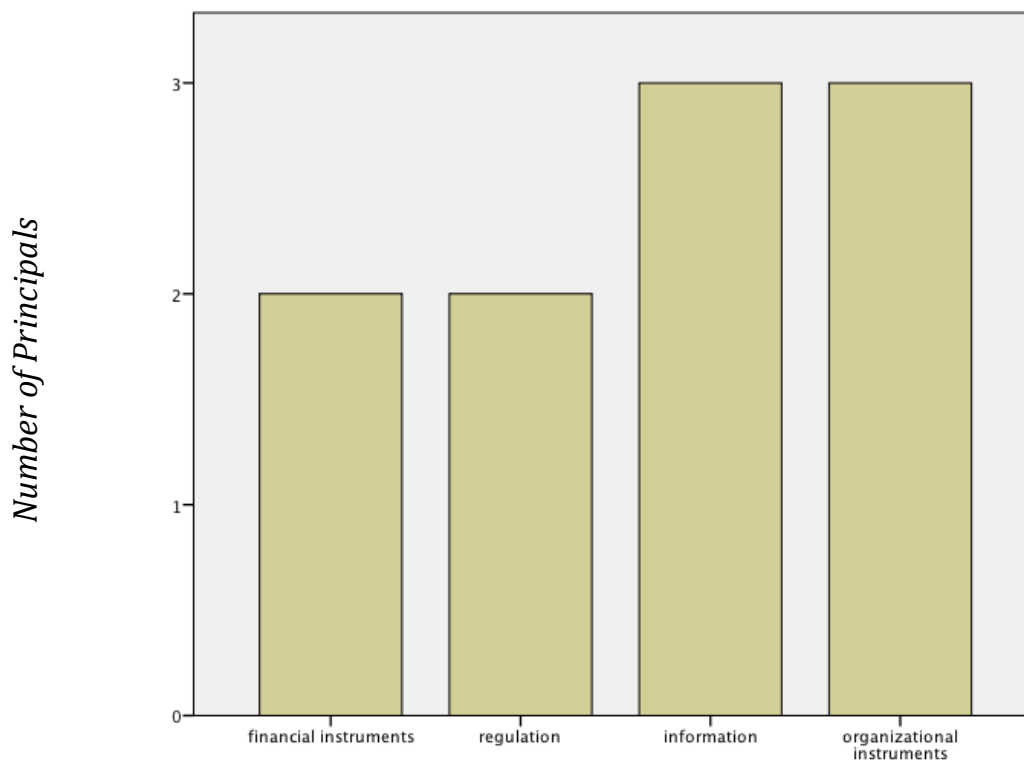
When it came to the actual implementation of and use of ICT resources and policies within the school (see Figure 4.23) all six principals identified the principal as important in implementing the policies in the school. The principals in this study were also likely to identify the IT coordinator as having an important role (83%). They were less likely to identify a board of management (33%), parents (17%) or students (33%) as having an important role in the creation and implementation of ICT policies. None reported that they did not have an ICT policy.





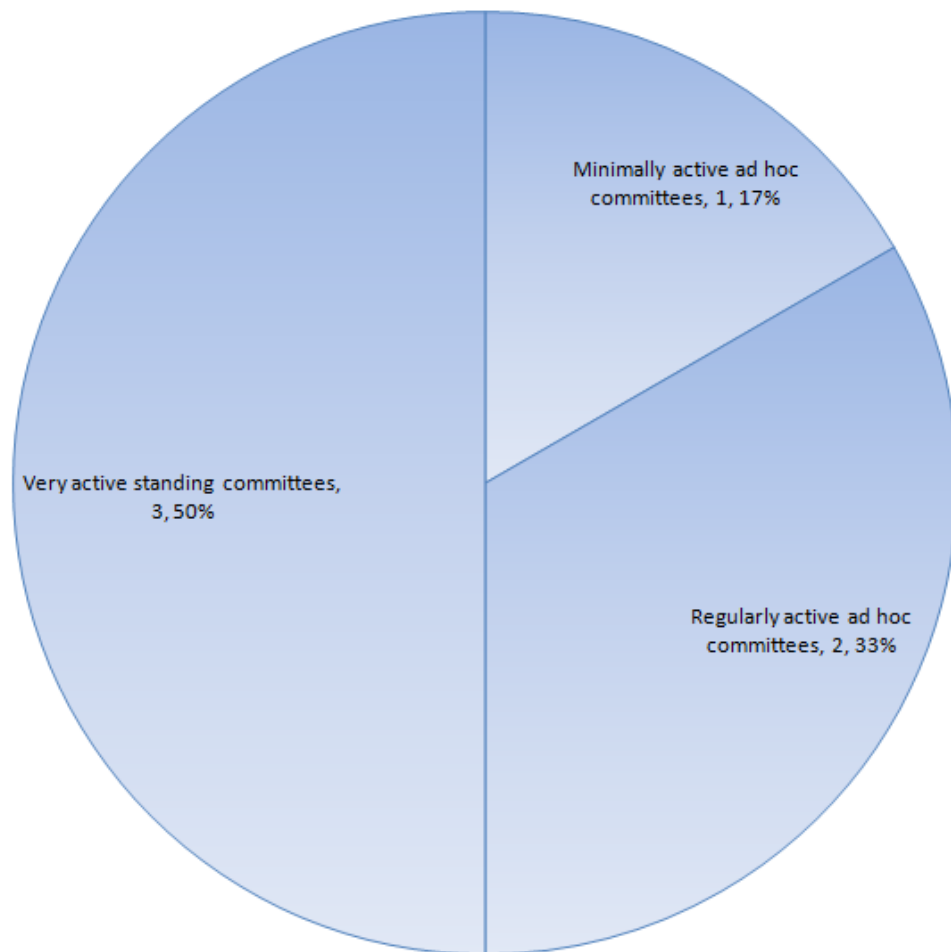
*Figure 4.23* Important individuals/groups in the schools' implementation of ICT policy ( $N=6$ )

When asked to identify how their schools' ICT policy information was disseminated amongst staff, students and the school community, as illustrated in Figure 4.24, the principals were most likely to identify information (50%) and organisational instruments (50%) as the most common mechanisms for organizing and dissemination information on the school's ICT policies, and less likely to identify using financial instruments (33%), such as budget papers or regulation or 'rules' (33%) as used for this purpose.



*Figure 4.24* Important policy instruments in relation to the implementation of learning related technology policy ( $N=6$ )

In disseminating information about ICT use within the schools these principals were most likely to identify the principal (57%) or IT coordinator (57%) as the actor (person) most responsible and likely to disseminate the information. They were least likely to identify parents (0%) or students (0%) as involved in this way. These six principals were also most likely to identify the IT coordinator (83%) as showing high level of leadership in implementing the ICT policy and its subsequent on-going development. They were less likely to identify a board of management (17%), parents (17%), teachers (17%), or students (17%) as doing so. In disseminating information about ICT within the school the six principals were most likely to use very active standing committees (50%) and least likely to identify minimally active, ad hoc committees (17%) as the most common communication mechanism for discussing ICT related issues within the school (see Figure 4.25).



*Figure 4.25 School communication mechanisms for discussing IT policy (N=6)*

In terms of using ICT for teaching and students' learning (also referred to by some of the schools as learning technologies or LT) related activities, five of the six principals agreed that the systematic adoption of new technologies and up skilling staff were an on-going part of their institutional planning, and four agreed that learning technology purchases were one of the top three budget priorities for the current year (the other two disagreed).

In terms of ICT use for teaching and students' learning related activities (see Figure 4.26), these six principals were most likely to agree (83%) that the school's technology was used today by teachers and students and that teachers regularly planned for and used the available technology with their students. They were less likely to agree that students have daily planned technology

access (50%) or daily planned access with learning technologies as the goal of instruction (33%), that is learning about the specific technology (i.e. learning how to use presentation software such as MS PowerPoint to create a presentation).

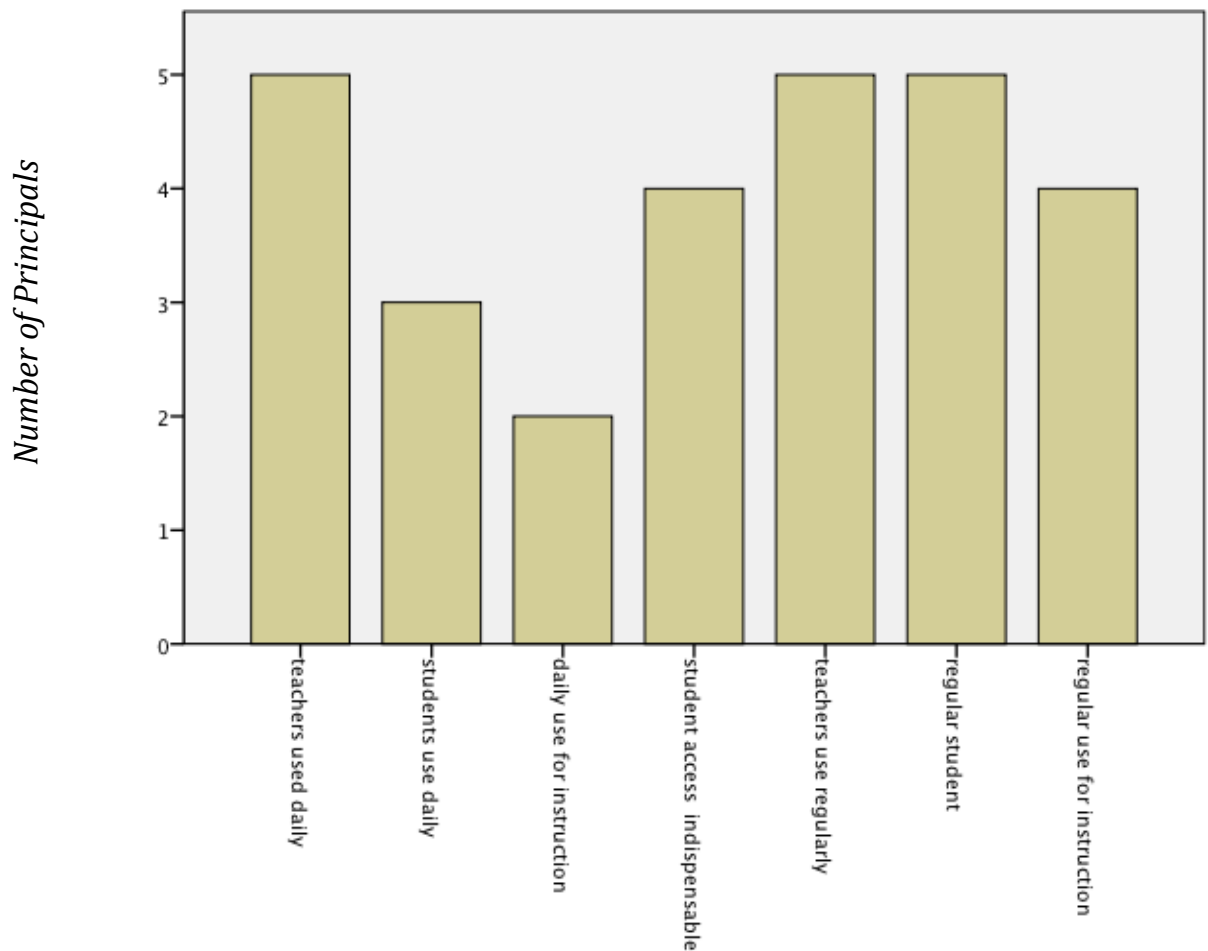


Figure 4.26 ICT use in schools as viewed by Principals (N=6)

By using the school's available technology (see Figure 4.27) these six principals were most likely (83%) to report that it increased teaching efficiency; enhanced the quality of students' learning and teaching, and created opportunities for students' self-directed learning. They were least likely to report that generating institutional income (0%) was an objective for using the available schools' technology.

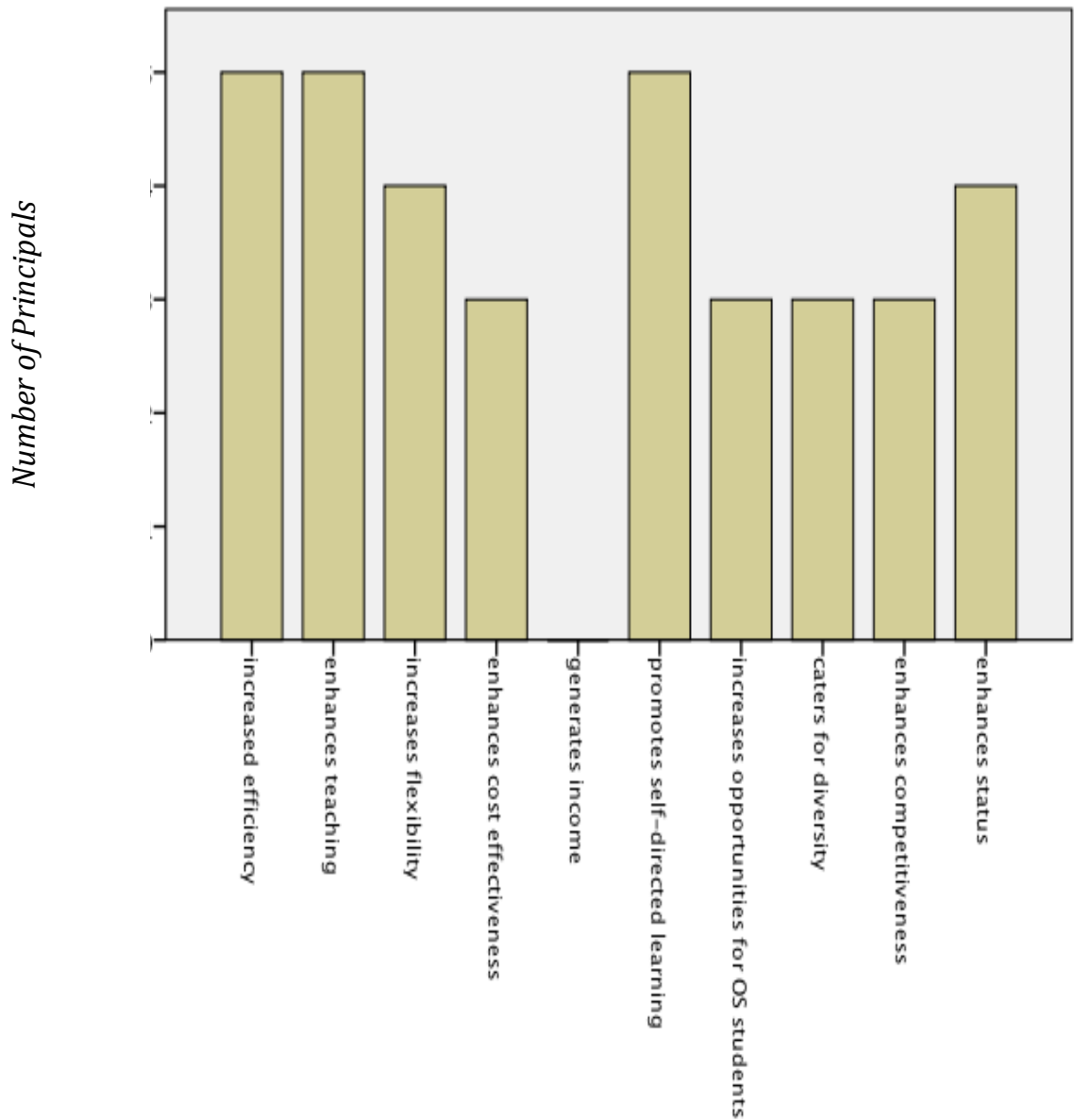


Figure 4.27 ICT importance in schools productivity (N=6)

When asked what were the barriers or problems confronting the school's implementation of the ICT policy and subsequent use of ICT, as shown in Figure 4.28, these six principals were more likely to identify lack of financial resources (67%), and a lack of skilled staff (67%). They were less likely to identify inadequate national and/or state regulations (17%) as problems in implementing the IT policy or in using ICT in their schools.

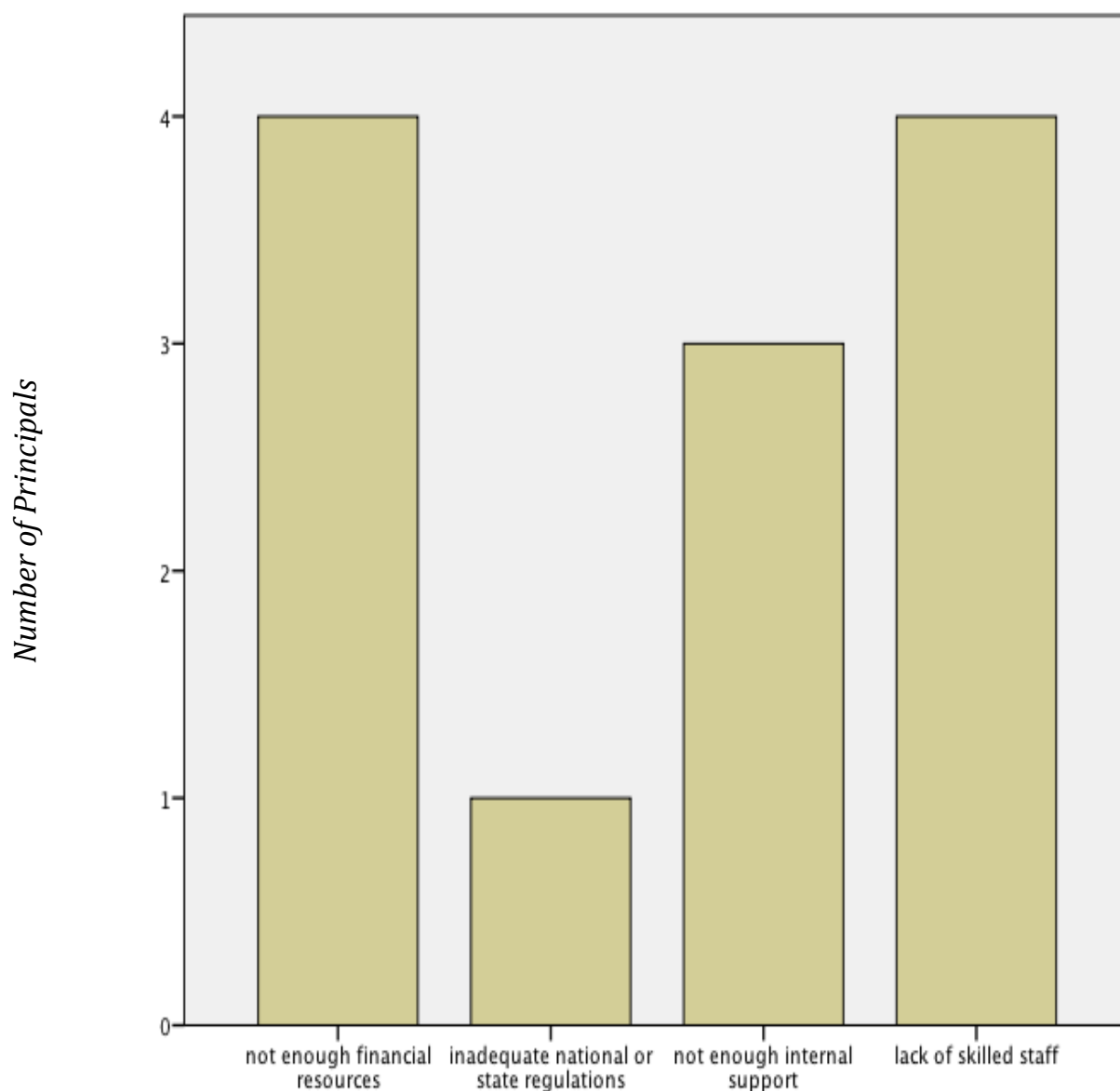


Figure 4.28 Problems in implementing ICT policy in the school (N=6)

### Funding and support

Of the six schools 50% ( $n=3$ ) allocated between 10 to 15% of their annual budgets on providing and maintaining the school's learning technologies. Of the remaining three schools, one spent less than 5% of its budget on learning technologies, with the other two (33%) spending 5 to 10% and >15% respectively. Two schools did not rank expenditure on learning technologies as one of the top three school budget priorities for the coming year. Of these two schools, one

principal wrote on his/her survey form that it was not in the top three because of an expansion in building works and sporting facilities for that year and the next two years.

A third of the schools did not charge a specific fee or levy to parents for the on-going maintenance and procurement of ICT, though half did with another school considering charging a fee in future years.

In reference to the technology and support available in the six participating schools, Figure 4.29 shows that most (66%) had the services of a network manager, ICT technician and an ICT coordinator. Sharing of resources with other schools, businesses or the local community was something that was generally not undertaken.

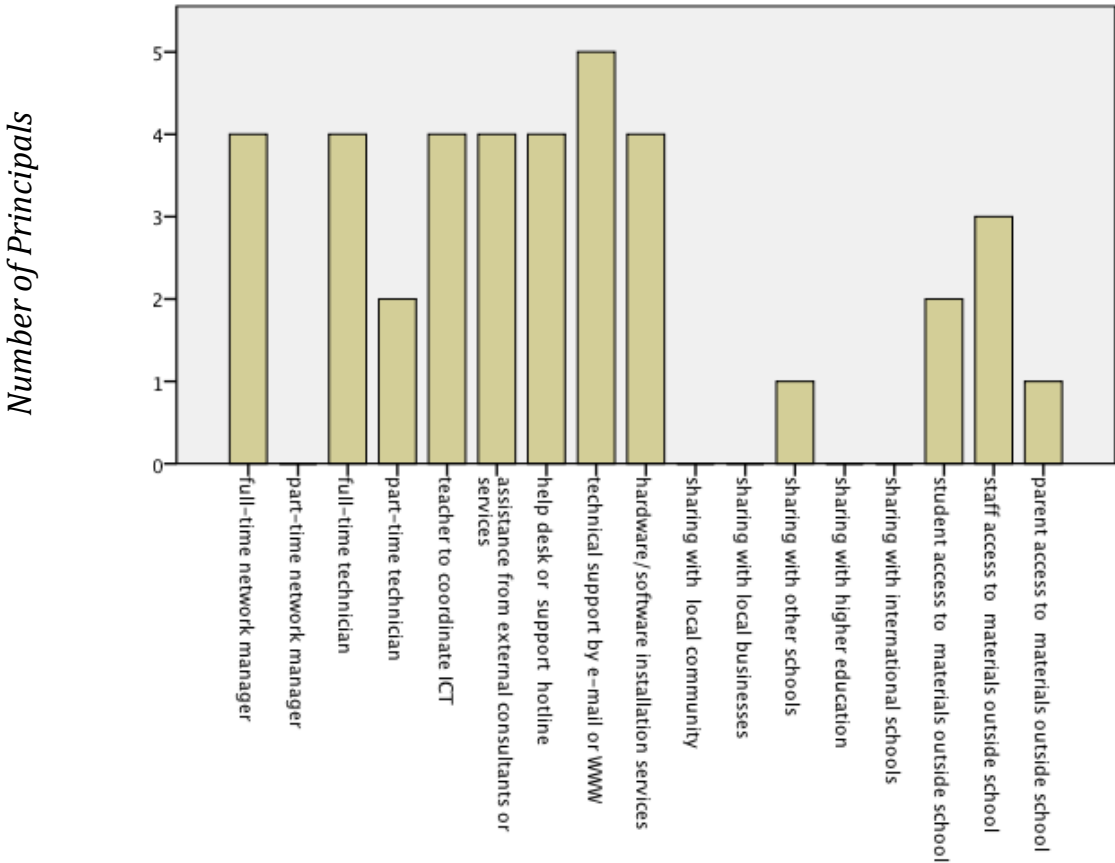


Figure 4.29 Current ICT school options (N=6)

Closely associated with the above ICT support functions is the specific teaching, planning and administrative software available to teachers. As demonstrated in Figure 4.30, all schools provide their teachers with access to an email account, whilst only half of the principals allowed teachers in their school to assess, grade and write students' reports online. In terms of how principals viewed their schools' overall level of support for teachers' use of ICT those schools which provided 2 out of the 5 technical support functions (see Figure 4.34) viewed their level of support to be average, whilst the school which supplied 3 out of the 5 features rated themselves as high. Not surprising the three schools which supplied all five technical support features rated themselves as very high.

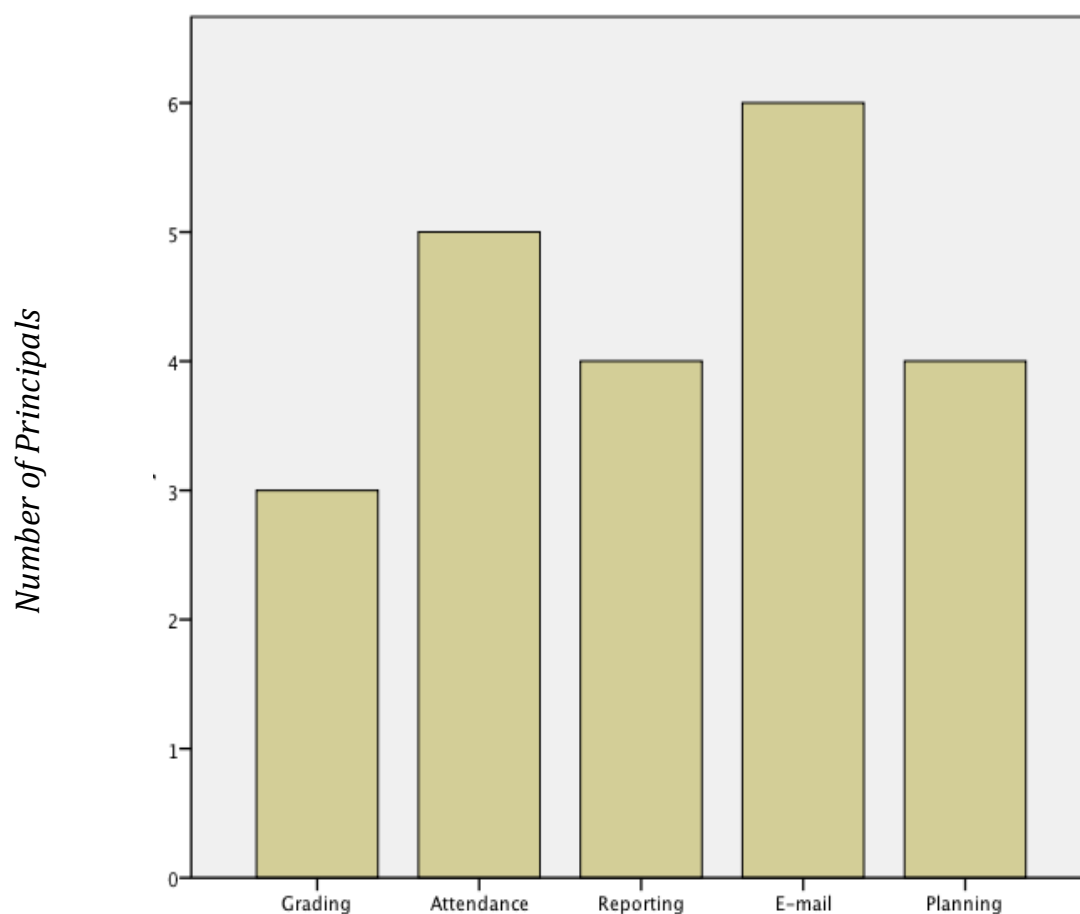


Figure 4.30 Current school IT supporting systems (N=6)



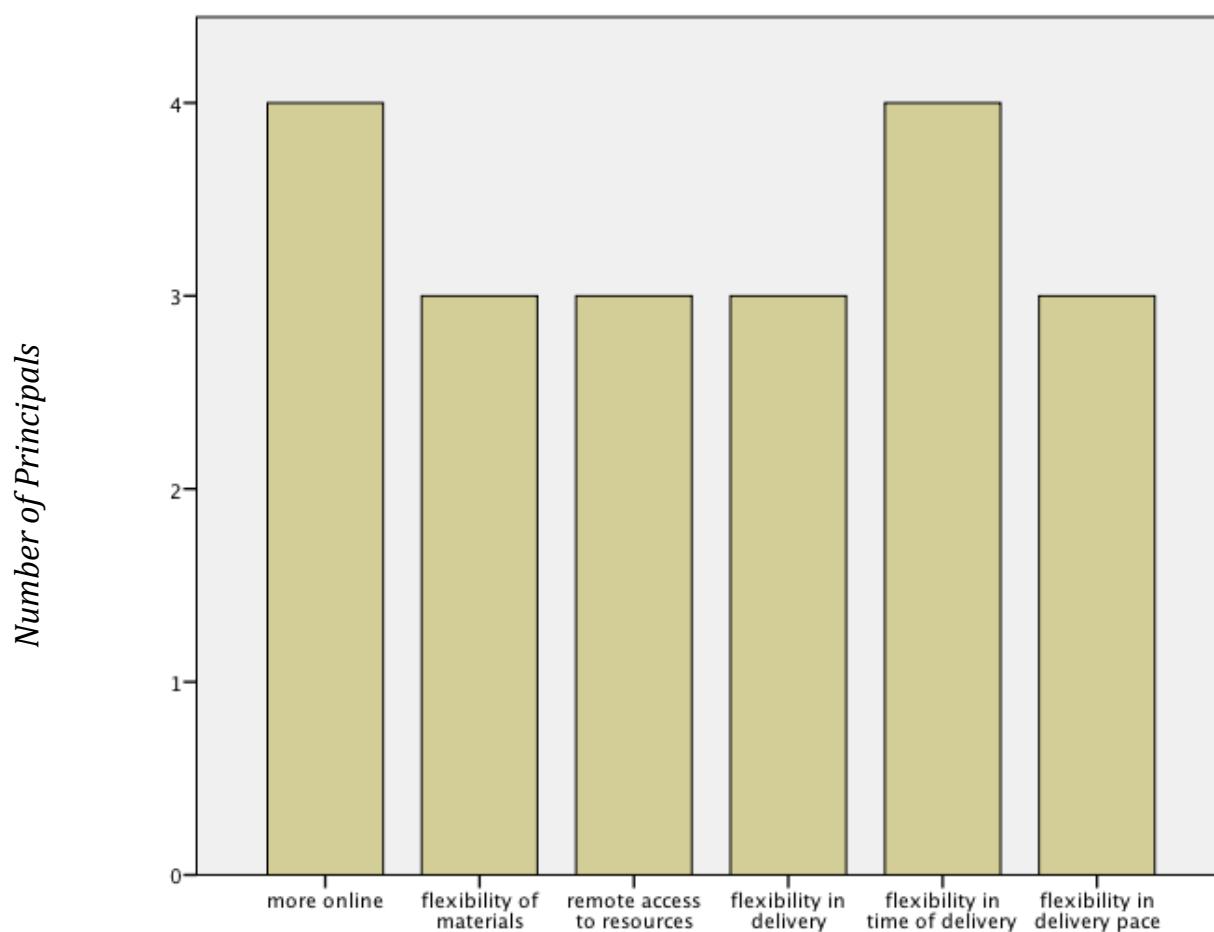
### School ICT related student aspects

The majority (84%) of schools reported having a student to computer ratio of five-to-one or less, with only one school having a greater ratio:

Students to computer ratio	Number of schools (percentage)
10 +:1	1 (16%)
5:1	1 (16%)
3:1	2 (33%)
1:1	2 (33%)

Of these six schools, 3 (50%) provided their students with laptops and two had done so for over a decade, 1997 and 1998 respectively.

In terms of how the schools' ICT policy and subsequent technology use were influenced, the principals were asked to indicate their level of agreement for a number of influences and drivers for ICT change in their schools. As demonstrated in Figure 4.31, the six principals were most likely to report that their ICT policy and subsequent technology use was influenced to some extent by students' demand for access to more online resources and for the provision of more flexible learning options. However, at present all six schools reported that teaching course content and instruction was only delivered on site at school.



*Figure 4.31* Current student IT policy influences ( $N=6$ )

### School ICT staff aspects

All six principals agreed that teaching staff received professional development support to acquire basic ICT skills and also to acquire advanced skills in relation to using and implementing ICT in the curriculum and in their classrooms. Furthermore, none of the schools used ICT as a reward or incentive in their transfer procedures the exception though was for ICT specific position requirements such as an IT specialist teacher. A third of the principals did believe that teachers had appropriate levels of ICT skills and that teachers' knowledge did play a factor in their teacher recruitment practices and in the schools' promotion practices, even if these was not formally written down (see Figure 4.32).

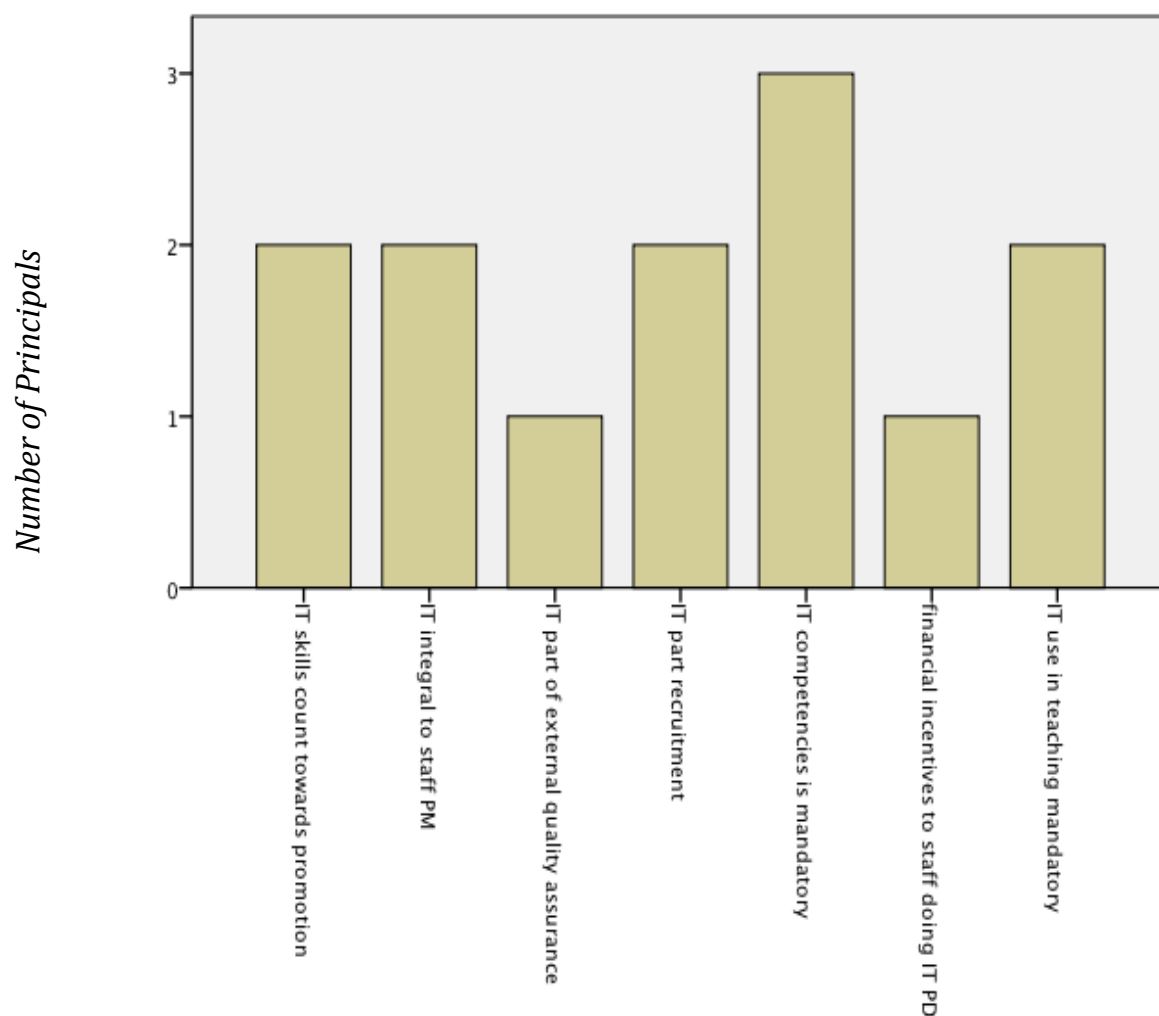


Figure 4.32 Current principals perceptions of ICT for teaching staff (N=6)

When asked to nominate the top five IT professional development needs for their teaching staff over the next 12 months, these principals listed site specific administrative software (100%), such as SARIS (student attendance and reporting information system) which is used to monitor, record and report on student attendance, marks and subsequent student reports. This was followed by specific curriculum software training (83%,  $n=5$ ), for example Dreamweaver, Studio 8 and Study Wiz. The next most anticipated ICT training need in their school centred around the use of interactive white boards (IWB's) or smart boards (66%,  $n=4$ ), followed by greater general knowledge and skills in the use of the internet (66%,  $n=4$ ) to assist teachers with finding and preparing class teaching materials. This was followed by understanding how to

use portable devices including tablet PCs (33%,  $n=2$ ), game players and mobile phones (16%,  $n=1$ ) in the classroom for student learning centred activities.

In addition to these software specific training requirements, principals also indicated their school's planning was increasingly being influenced by the internet, use of email and increasingly mobile communication technologies which utilise wireless networks, with less perceived influence coming from IWB's and PDA's (see Figure 4.33).

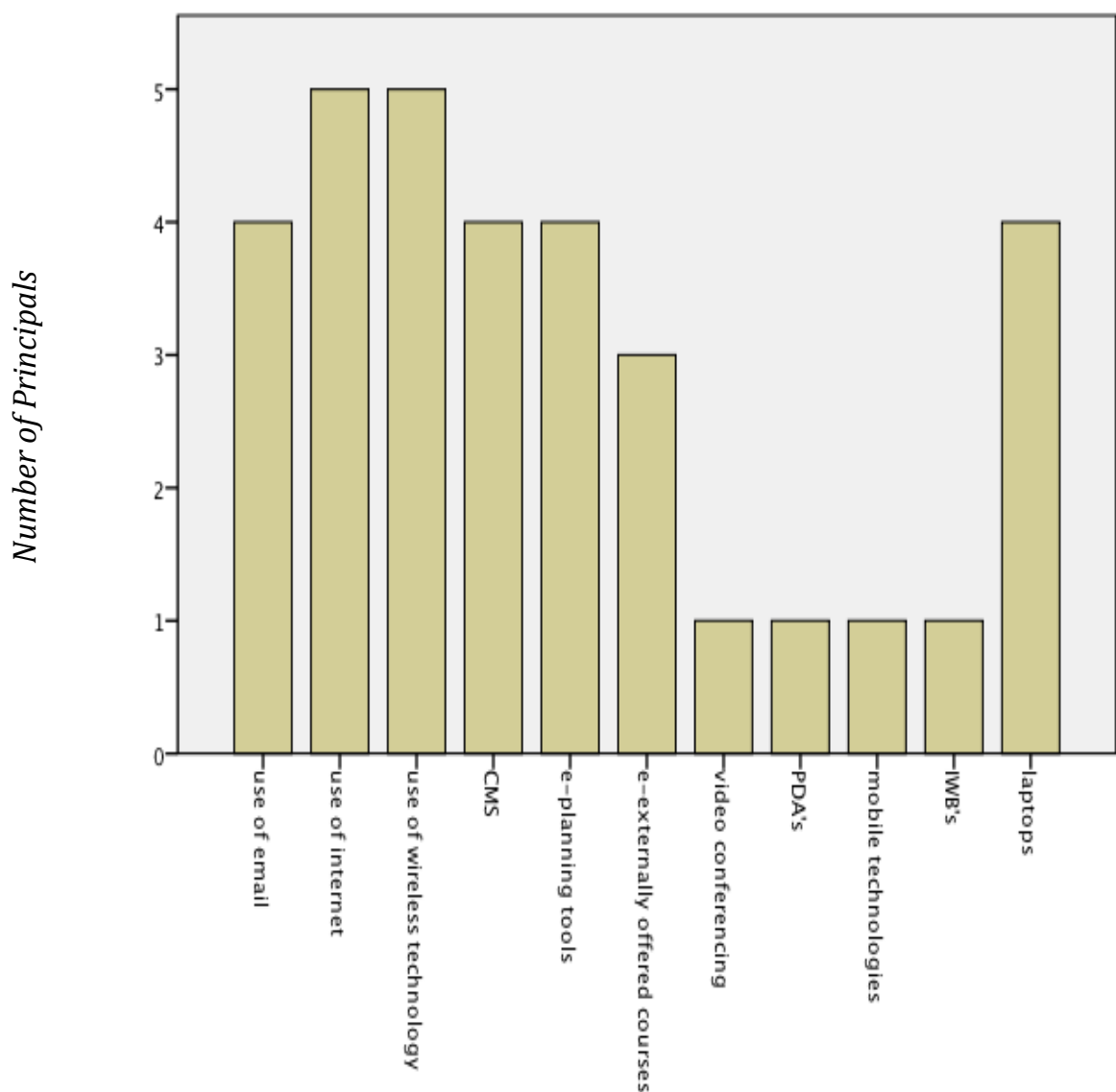


Figure 4.33 Current extent of influence of specific IT on learning ( $N=6$ )

In addition to future teachers' professional development requirements principals were asked how they believed their teachers used the available technology for teaching specific activities. In response this, these six principals reported that teachers used the available technology to prepare their course content materials (66%,  $n=4$ ), but did not (0%,  $n=0$ ) use the internet for the creation and delivery of out of class activities. In using the available technology, as demonstrated in Figure 4.34, these principals were most likely to rate that the technology was used to enable students to practice specific skills or to locate information, and for enabling students to use ICT for project or group work as being a common use for technology. They did not believe that the students in their school were studying via web-based content and learning environments at present in their schools ( $n=0$ ).

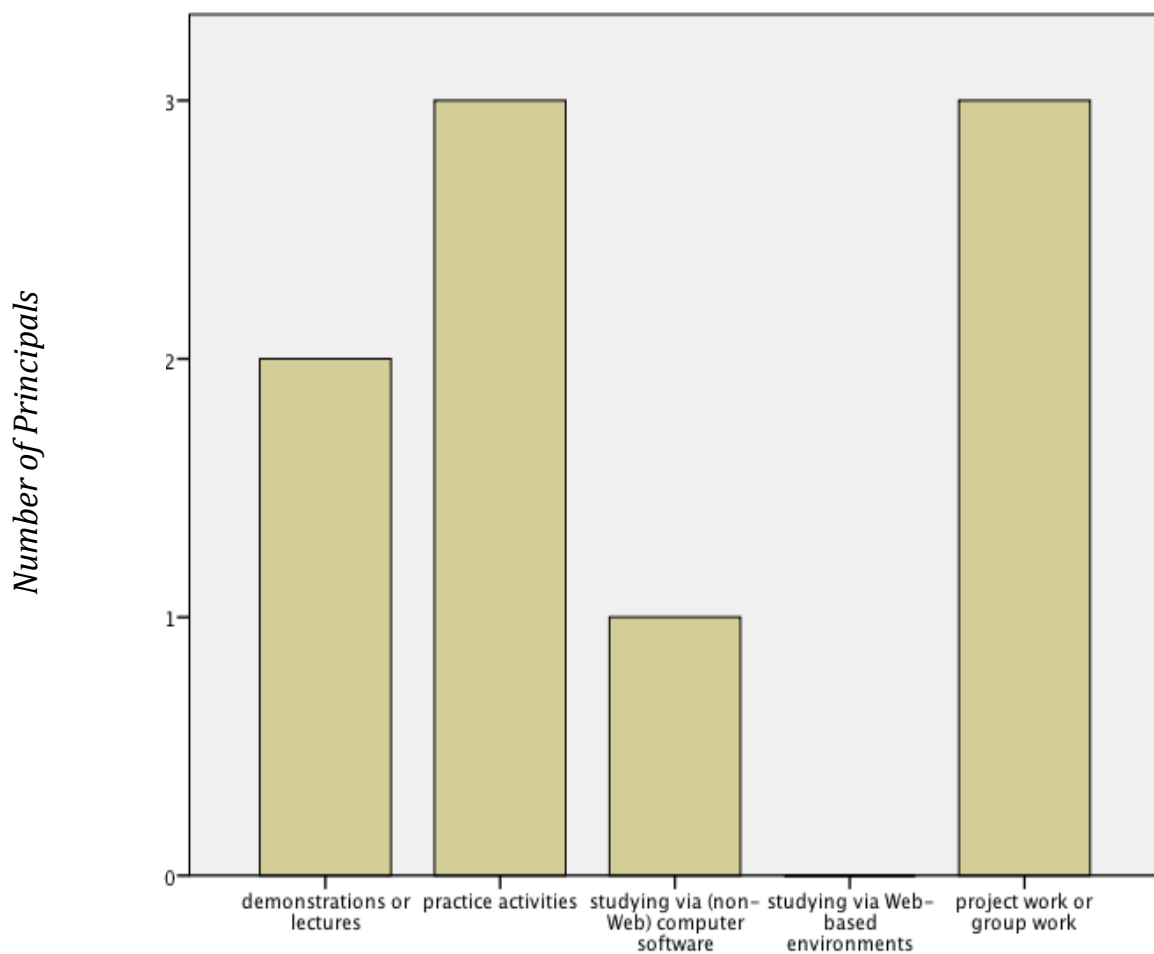


Figure 4.34 Current specific teaching practices ( $N=6$ )

## External influences on schools' ICT policy

External influences on the schools' ICT policy and technology use came less from technology providers, industry and universities, as demonstrated in Figure 4.35, and more from National and State education authorities and school specific parent groups.

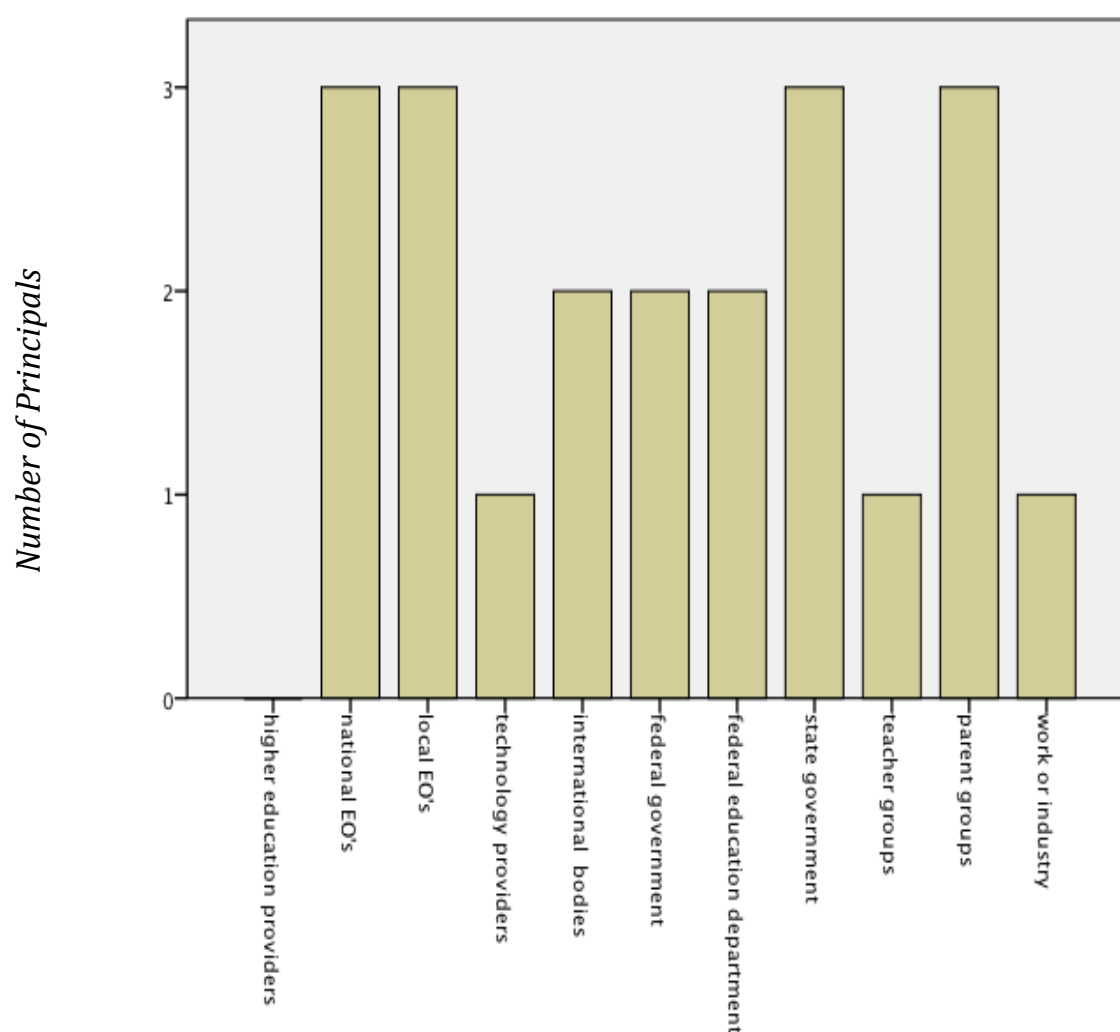


Figure 4.35 Current external influences on ICT policy (N=6)

## Future predictions

In looking towards the future these principals felt that technology would improve teaching practices (83%,  $n=5$ ) and would be used to teach some students off-campus or via distance learning methods (66%,  $n=4$ ). As exemplified in Figure 4.36, these principals believed that in

the near future their schools' application of ICT would increase their interaction with businesses and be used to foster internal and external research projects, which could be completed by the students and their teachers.

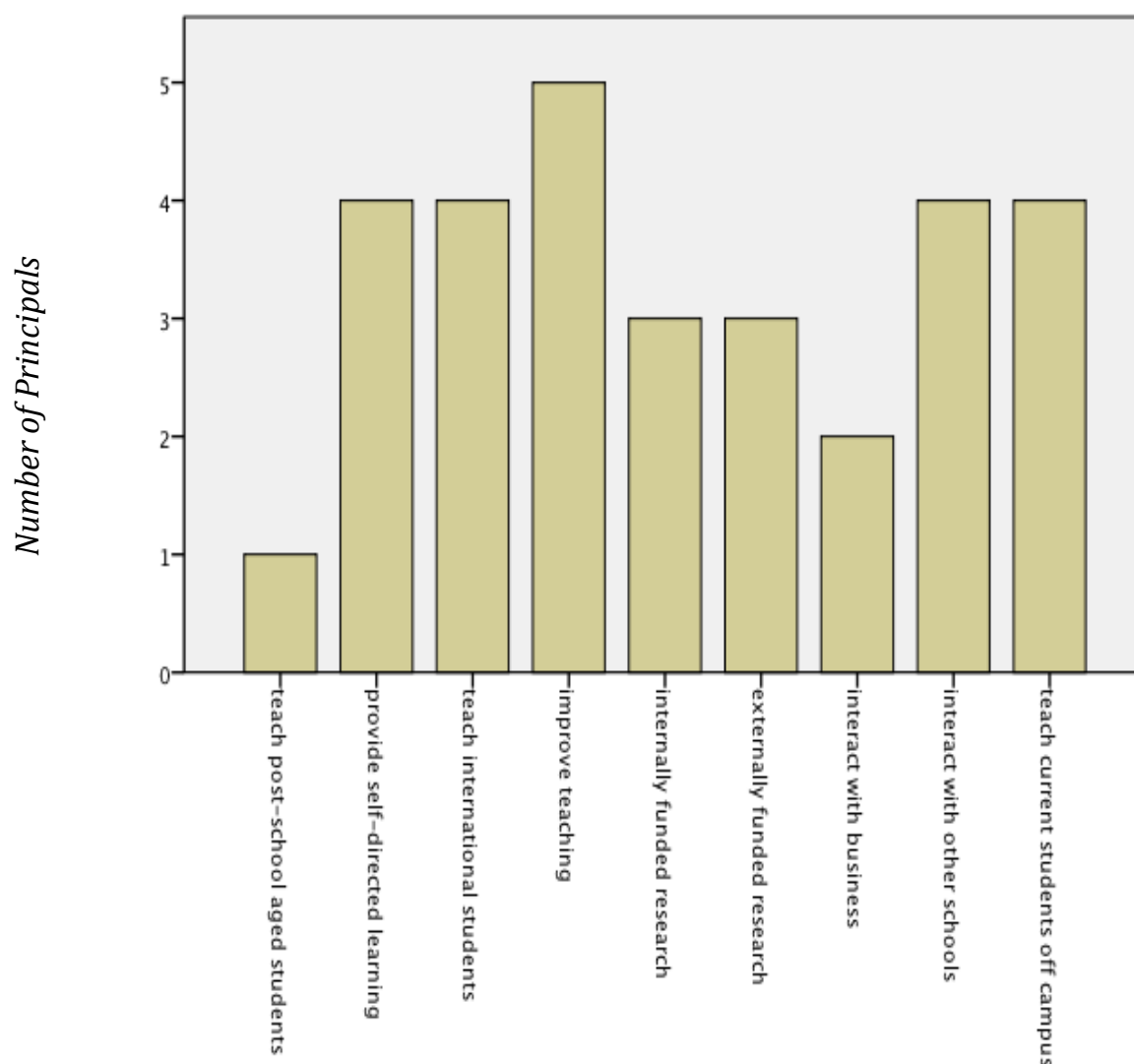
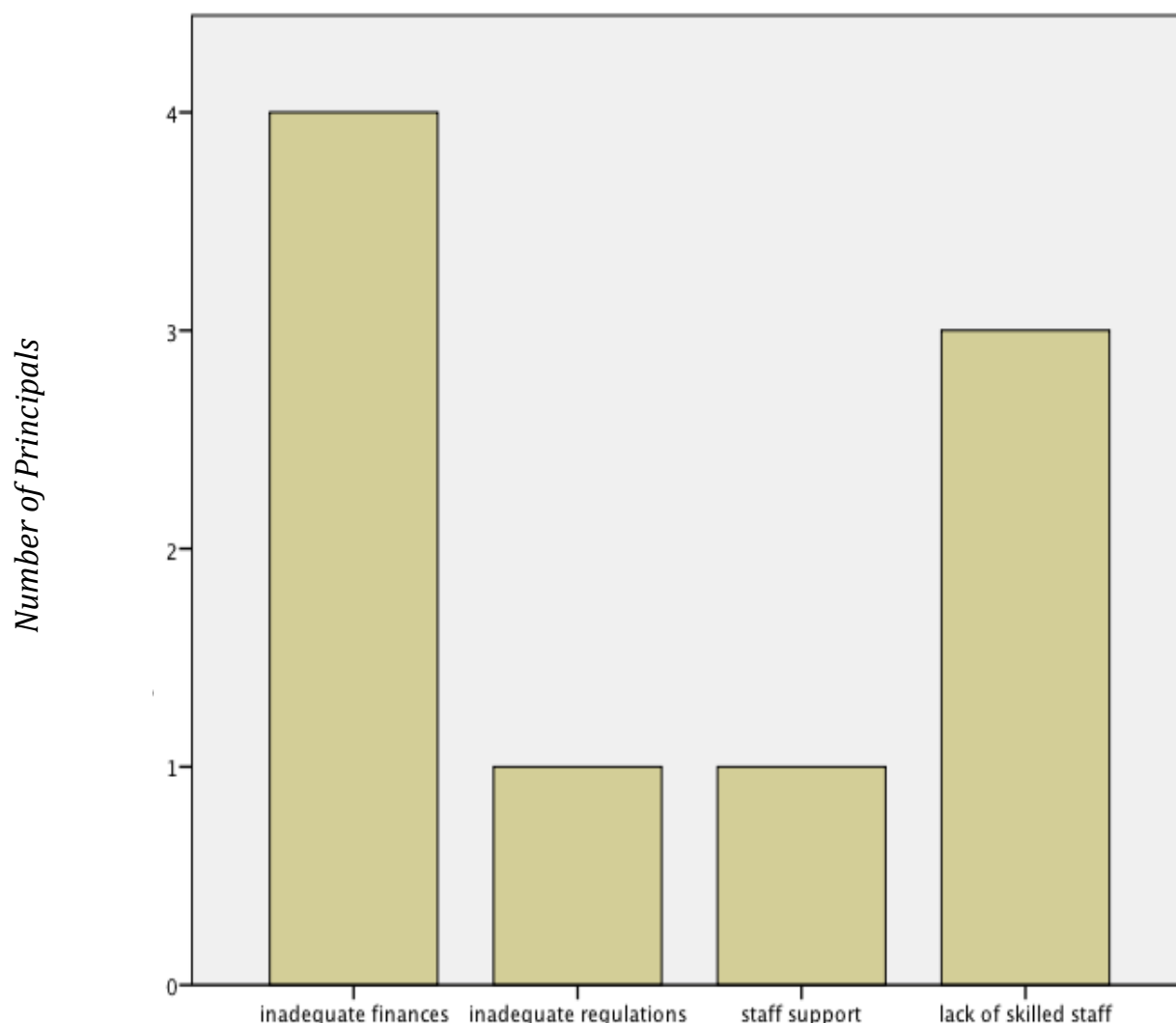


Figure 4.36 Future role of ICT in the school (N=6)

The principals in this study were most likely to rate access to online resources (100%, N=6) to be driven and affected by increased demand by students for this in the near future. However, in the near future these principals believed that the on-campus setting would be the main site for students' learning and teaching (100%, N=6) and that like now (when the study was conducted)

inadequate finances and a lack of skilled staff (see Figure 4.37) would affect how ICT was used in their schools in the near future.



*Figure 4.37* Future perceived problems in the implementation of ICT in the near future ( $N=6$ )

In the near future these principals, as denoted in Figure 4.38, reported that the schools use of ICT would lead to an increase in teaching efficiency, whilst also enhancing the quality of teaching and students' learning in addition to increasing students' self-directed learning. They were least likely to rate generating institutional income or enhancing competitiveness highly (33%,  $n=2$ ) as a result of their use of ICT.



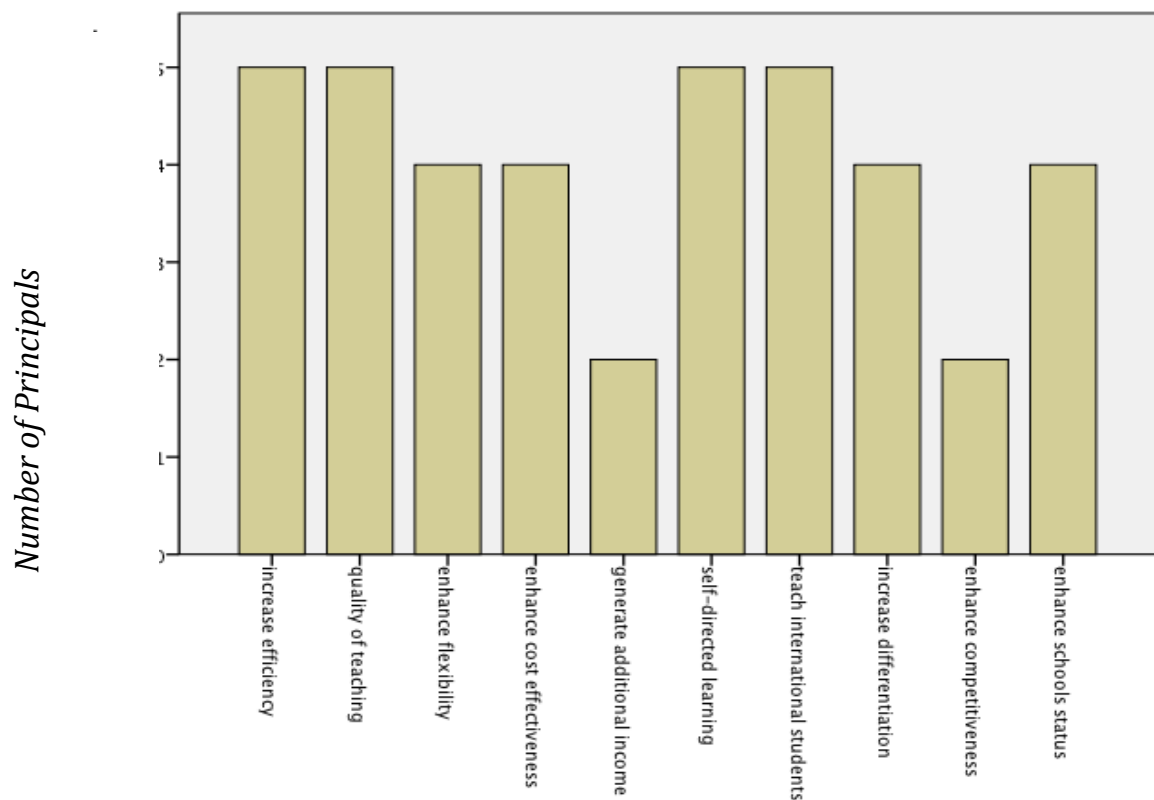


Figure 4.38 Future role of ICT in schools (N=6)

#### Teacher interview comments

Finally, the principals were asked about how technology might be used in their school communities in the near future and their responses related to the use of more portable devices in their schools and a greater level of seamless connection between the students' classrooms and teachers and students' home lives. Comments on this are reported below:

- As our school is a remote school and in a rural farming/timber industry, parents want their children to be literate and numerate. ICT plays little function in most of the families now and unless infrastructure improves and costs for computers and internet decrease I can see IT having a big influence.
- Each child has wireless access to own computer linked to home. Interactive whiteboards.
- Small hand held PDA's with convergent technologies (phone/video/tablet/slate) allowing instantaneous intranet/internet access.

- Students and staff will have access to learning material and be able to submit assignments electronically from home via a secured intranet, using their own ISP. We will be using leading edge technologies to teach, assess and monitor learning across our curriculum.
- The use of technology in classrooms will be seamless. We won't talk about integrating learning technologies anymore; we will simply talk about learning. New technologies will be the focus.
- How can we harness the technologies that students' use so effortlessly?

### Principals' survey summary

Overall the Principals' Survey findings revealed that principals were supportive both in terms of providing equipment, technical support and professional development opportunities for their staff to use ICT. Further principals could see that in the future how their schools use ICT for teaching and students' learning practices may change, with more flexible study choices being offered. One concern is that schools appear to be relying on a limited number of individuals to guide and promote continuing ICT developments or transformations within their schools.

### Chapter overview

In this chapter the major results pertaining to the four surveys and teachers' interviews have been presented and analysed using a range of techniques. As a brief summary the results indicate that guardians who were more involved in their child's access and use of ICT were more positive towards ICT use than guardians who were not as involved. In relation to students, the data indicated that the more frequently a student uses a particular technology the more self-confident they become in the use of that technology. Furthermore students' technology use and self-reported competency of that use may be predicted by a number of factors including their:

- use of presentation tools at school;
- use of communication tools both at school and outside of school, and

- use of productivity tools at school

In terms of teachers' use of ICT the data revealed that many were unfamiliar or uncertain about the effectiveness or functionality of a large range and number of ICT tools which could be used in their teaching practice. Indeed the data obtained from the teachers' surveys indicated that "office" based technologies, such as word processing packages together with research and communication technologies such as the internet and email were the predominant forms of technology used by teachers for classroom, administrative, professional development and personal use. When surveyed and later interviewed about the other forms of technology indicated on the survey, teachers overwhelmingly indicated that those forms of technology were either not well known or were not appropriate for their particular teaching requirements. Exemplifying this finding were the responses from two teachers "... *not appropriate as it is too complicated for the children to use*" (Teacher Interview-School D-001-Greg, Line 30) and "*the technology itself it needs to be compatible with the students learning needs and for this to occur the technology needs to be specifically developed or adapted to the students and their particular learning needs*" (Teacher Interview-School E-004 Marsha, Lines 45-47).

The issues raised by both Greg and Marsha (both full-time classroom teachers) indicate that "generic" based applications may need to be adapted for education environments if teachers are to take more advantage of the technologies available. Compounding the teachers' familiarity of the technology is the related issue of reliability and performance. Whilst Marsha indicated that the technology needs to match students learning needs, Petra a senior subject head indicated during her interview the importance of the school having support facilities were:

Extremely important. No point in all the learning technologies if you get stuck at any point and you are unable to move forward. It is also very frustrating to have all the latest gadgets fail in the middle of a lesson, or even worse just as you are about to begin-and you have to redesign what it was you were to teach. If we are to have the technology being used in the classroom it needs to be reliable and we need to

have the resources in terms of people and money to fix the problem there and then- otherwise the teachers and students lose faith in the technology. (Teacher Interview-School C-005-Petra, Lines 20-27).

As Greg, Marsha and Petra indicate not only does the technology need to be tailored to each unique learning situation, staff need to have the confidence and reassurance to use the technology, knowing that if (and we all know from our own experiences that it is not if but when) the technology fails, appropriate measures can be put in place to minimise the disruption to the learning experience and “*the teachers and students lose faith in the technology*” (Teacher Interview-School C-005-Petra, Line 27). Despite the issues teachers have raised about their knowledge of what technologies are available for teaching and students’ learning and their concerns regarding reliability, the overwhelming majority of surveyed teachers (94.4%,  $n=51$ ) were interested in undertaking further professional development in the use of ICT for teaching and were using ICT in their current practice (100%).

Finally school principals when asked to indicate who or what has influenced their ICT plans, policies and practices tended to focus on local actors such as parents and local education authorities, and less on technology providers or universities. Principals were also overwhelmingly positive and supportive, both in terms of financial practices and on-going training opportunities, in how ICT was used within their schools. Many believed that ICT would increase or improve teaching and students’ learning practices in the future and that the technology may be used to deliver more flexible students’ learning options in which the school may not be the only site for that learning.

In the next chapter (Chapter Five Conclusion), the major issues and themes emerging from this study will be explored further. Where possible recommendations will be made and suggestions for further research investigations will be offered.

## **Chapter 5 Discussions and Conclusions**

### **Introduction**

The previous chapter reported and analysed the data from the six case study schools selected for this study. This chapter revisits and provides answers to the research questions posed at the beginning of the study. The chapter begins with a brief overview of the current study, followed by a discussion of the major findings. Implications about ICT use in schools as it applies to the surveyed groups (Guardians, Students, Teachers and Principals) are identified. The application of these, in relation to ICT use within schools is also addressed, together with the limitations and strengths of the current study. The chapter then concludes by identifying other areas for education-based ICT research and action that would be beneficial.

### **Summary of research study**

The ubiquitous nature of technology in modern society has led many to conclude that to live, work and learn in a technological world we have to “utilise technology effectively” (UNESCO, 2008, p. 1). For schools this means teachers and students effectively using the available technologies (DOE-Tasmania, 2000, 2002a/b; Grabe & Grabe, 2001; Kumar, 2002; Milis & Mercken, 2004; Sherman, 2000). The initial enthusiasm with which governments, schools and individuals have embraced ICT in the education sector have been based upon rosy predictions about how technology would make teachers’ jobs easier, allowing more time for individualised one-to-one teaching. For students, technology was meant to change what, how and when they learnt; making their learning more personal and lifelong. However the reality may be that over the last thirty years in Australian schools a different new perspective can be offered, in-as-much as those rosy ideals may be considered to be naïve today (O’Rourke, 2003). Studies of educational uses of ICT have concluded that technology use is highly dependent on teachers’ ICT attitudes and prior ICT experiences (Bigum, 2001) and the internal conditions of the school (Meredyith et al., 1999). Although some notable researchers have concluded that technology use

makes no significance difference (Russell, T., 1999) as compared to non-technology based ways of teaching and students' learning.

An important step to understanding technology use, or non-use, in schools is to ascertain the school community attitudes or perceptions towards that technology and their influence on its subsequent usage. From such an approach belief factors around the use of ICT for teaching and students' learning, together with factors, which inhibit or support use can be identified. Therefore, the current study employed a survey questionnaire (and teacher interviews) to collect the required data from guardians (parents), students, teachers and principals from six schools across Tasmania and Victoria, Australia. Each participant group, called an actor, was administered a specific questionnaire at the same time. The respondents included 84 guardians, 120 students, 56 teachers (10 interviewed) and 6 principals. The collected data were then analysed using a mixed methods approach, including:

- Both exploratory and confirmatory analyses to test validity and reliability of measures;
- Regression analyses to examine connections between variables;
- Structural equation modeling to explain and predict paths, and
- Thematic analysis of interviews to explore themes and concepts.

The computer software for statistical analyses, Statistical Package for Social Science (SPSS) version 16.0; Analysis of Moment Structures (AMOS) version 18.0, and Leximancer qualitative analytics software version 3.0 were used to analyse the data from the current study.

## Major findings

The major findings discussed in this section are based on the three research questions posed by the study. Subsidiary question 2 and 3 are addressed before answering the main research question (RQ1).

*RQ 2 How are schools utilising digital technologies for teaching and students' learning?*

In response to this research question the present study found schools were utilising a limited range of technologies, specifically computers, for teaching related activities on a weekly basis. Study data found that teachers used ICT for instruction at levels below what others perceived its use to be. For instance principals and parents thought that teachers used ICT for instruction daily but teachers reported use every few days. This perception of teachers' use of ICT for classroom instruction was not located in the examined literature and indicates viable future research and also the assumption that teachers should be using ICT more frequently than they do, especially given the technical infrastructure and ready access to ICT.

When compared to earlier investigations of teachers' use of technology (i.e. Cowley, 2002; Meredyth et al., 1999) the present study found that all responding teachers reported using ICT in their teaching practice; a finding not found in previous studies that tended to find groups of teachers who were non-users, occasional users or frequent users (typically defined as weekly or more often). The majority of teachers ( $n=52$ , 93%) reported having technology in their classrooms as opposed to in specialist computer labs or general use computers in a library. The classroom being the dominant site for ICT, specifically computers and the internet, is significantly different from earlier studies (Meredyth et al., 1999; Yelland & Swaminathan, 2003) which found that specialised computer suites, or the library, were the 'norm' in the 1990's and the early part of the 21<sup>st</sup> century, suggesting that ICT is becoming a more 'mainstream' classroom tool rather than a tool of specialists. This higher access to technology in the classroom did not correspond with high usage for teaching related tasks, such as using ICT for instruction, administration and professional development.

Low levels of technology use for teaching specific activities, despite high levels of available

technology, had been reported previously by two large scale American studies (Barron et al., 2003; U.S. Department of Education National Centre of Educational Statistics, 2000). Scottish studies (Conlon & Simpson, 2003; Williams et al., 2000) reported slightly more than half of the teachers surveyed had access to ICT and of those who did have access, less than half used that technology for teaching or instruction. This finding of high access but low usage has been reflected in the literature more broadly (Cuban, 1999, 2001; Cuban et al., 2001; Mathews, 1998; Meredyth et al., 1999), suggesting that variables other than access to technology may be responsible for technology under use or non-use.

The current study's access and usage findings refuted several previous studies (Hardy, 1998; Hoffman, 1997; Kook, 1997) which concluded that providing teachers with more technology resources would equate to use of that technology. The findings from the six case study schools indicated that all had near universal ICT access, but technology use was not a daily occurrence for teaching, administration or professional development by teachers; nor was student use of ICT a daily occurrence, suggesting that other factors besides access to equipment may contribute to technology underuse.

To understand how schools are using ICT for teaching and students' learning, and the reasons for its underuse, teachers and students were asked to report on how often they used a range of listed technologies, and their self-reported confidence with those technologies. If the technology was not used teachers were asked the reasons for non-use. The results suggest that of the listed technologies less than 20% were used to any extent on a weekly to daily basis, with the others rarely used, if at all. For example, the internet, email and word processors were the predominantly used technology by teachers and students though the use was 2 to 3 times a week. Although many teachers reported that they used these three 'office' type applications and they did so more for administration, professional learning and personal use rather than as a tool for instruction.



When compared to earlier investigations teacher's use of 'office' applications replicated similar findings (Becker, 2001) which reported on low use for instruction as compared to planning and professional development (Kozma, 2003; Meredyth et al., 1999; Williams et al., 2000).

Although the use of ICT by teachers and students seems to have increased throughout the previous ten years, the current study found little evidence to suggest that ICT is being used in ways that are entirely consistent with definitions associated with the Australian Commonwealth Department of Education, Training, and Youth Affairs (DETYA) *Learning for the Knowledge Society: An Education and Training Action Plan for the Information Economy* (DETYA, 2000), nor with similar overseas visions such as New Zealand's ICT education vision (MOE-NZ, 2001) or the United States Department of Education national ICT plan (USA-DoE, 2000).

The results from the current study suggest that although ICT usage by teachers and students has increased in the last decade, teachers were still not daily users of the technology for instruction; nor were students daily users of ICT for their own learning; this is despite increases in available ICT related infrastructure, school and national regulatory frameworks or policies and almost universal school and home access to ICT, specifically an internet connected computer.

In the current study teachers were asked why they did not use the listed forms of technology, or use them more frequently if they did use them. Results concerning underuse or non-use replicated previous study findings in that teachers reported that they did not have the time, skill and/or knowledge to search out extended uses of current technologies or to find newer technologies (Blease & Cohen, 1990; Russell & Bradley, 1997; Mahmood, 2000; Mumtaz, 2000; Pelgrum, 2001; Scrimshaw, 2004; Somekh, 1989; Stephenson, 2001). These inhibitors to ICT use will be further analysed and discussed under research question 3.

The current study's findings revealed that schools were using the available technologies to a limited extent as ICT use was not a daily teaching or students' learning experience. To ascertain

the level of support for the continued use of ICT, the school principals were asked how ICT may be used in 3-4 years time within their schools. The study's findings concluded that principals, like the other surveyed groups, were supportive of technology use in the school and they could see the benefits technology provided for teaching practices and students' learning. In general principals believed that in the near future their schools would offer students, and hence teachers, a greater choice in when, and how, they could access learning material. Despite this assertion principals still report that teaching and students' learning would predominantly occur within the classroom but they could see in the future students could study some course material via a distance electronic mode where they could also access that material from home.

These findings support the trend that ICT in schools is gaining momentum in the educational context (Bonk, 2002; Bonk et al., 2000; Bonk & Wisher, 2000; Byrnes & Ellis, 2006). These findings support the premise that ICT will change how teaching and students' learning will occur, something that the literature at least has been suggesting for some time (Cox et al., 2003; Gillard, 2008; Meredyth et al., 1999; OTA, 1995; Reinen & Plomp, 1997). The literature and the current study's 'findings add support for the continued roll-out of ICT in schools and in Australia support the Federal Government's \$2.4 billion Digital Education Revolution (Gillard, 2008). This additional technology funding may in effect provide a technological 'push' for the increase in technology use by teachers, at least those teaching grades 9 through to 12, as it will no longer be a case of not having access, at least to computers, that is a barrier to ICT usage, but how to use the technology in meaningful and productive ways to justify the investment.

Such improvements in access to technology whilst important in that they mitigate previous inhibitors to technology use (i.e. access, see Albion, 1999; Czerniak et al., 1999; Hardy, 1998; Pelgrum, 2001; Reiser & Dick, 1990) do not in themselves guarantee the technology will be used. The literature on change management (Collis & Moonen, 2001; Fullan, 1982, 1991, 1993a, 1993b; Fullan & Stiegelbauer, 1991), in particular educational change (Cuban, 2001; Moersch, 1995; Newhouse, Trinidad, & Clarkson, 2002; Surry & Land, 2000), indicates that for

long lasting and substantial change to occur the organisation must enrol key individuals within and outside of the business to formulate and implement change whilst at the same time putting into place measures to support staff in learning to work with the proposed changes.

The current study noted that when developing ICT policies, the schools relied on a small number of individuals, a finding that was in contrast to the examined change literature. Whilst school principals were aware of national and state based ICT educational reform agendas, neither of these were mentioned as being important in the formulation of school ICT visions or policies. This finding was surprising given that the educational change literature (Cuban, 2001; Moersch, 1995; Newhouse, Trinidad, & Clarkson, 2002; Surry & Land, 2000) highlighted the importance of external actors or agencies in school based reforms. This being the case, principals' visions for the use of technology in terms of students' learning mirrored national and state reform agenda (i.e., Australia's learning for the knowledge society-DETYA, 2000; NZ vision of ICT-MOE-NZ, 2001; Tasmania's ICT in education strategic plan-Department of Education, Tasmania, 2002a; US National ICT plan, USA-DoE, 2000) in that ICT is seen as a mechanism to promote lifelong learning and to prepare students for the knowledge economy. This limited involvement of outside groups (i.e. funding agencies, business groups, and higher education technology experts) in the planning and formulation of the school's ICT vision and policy may have led these schools to adopt a narrower view of educational technologies, a finding supported by the literature (Riffel & Levin, 1997; Simpson & Payne, 2002). Such a haphazard and serendipitous approach to planning is heavily reliant on the technological expertise and practice of the limited few who in turn become 'powerful' controllers for change (McClure, 2000).

The current study found that schools in their planning to use ICT relied heavily on a select few but when it came to the actual implementation of those planning policies even fewer groups or individuals were consulted.

The limited experience and variety of school ICT policy formulators and staff exposure to instructional uses of ICT in turn has an impact on ICT use within the classroom. Again the principal and IT coordinator were seen by principals as being the predominate initiators for promoting ICT use, followed by the end users of the decisions and the actual uses of the technology such as teachers ( $n=4$ , 66%) and students ( $n=2$ , 33%). The literature indicated that these end-users should be key stakeholders in the decision-making process (Fullan, 1982; Manson, 2000; Tytler et al., 1999; Watson, 2001). In particular the literature (Aviram, 2001; Barone, 2001; Dede, 1989; Schiff & Solmon, 1999; Trotter, 1999; Watson, 2001) indicated that teachers should be key informants and 'drivers' of educational change in schools. Despite the limited involvement of some groups the current study found that 3 out of 5 parents (60%) were satisfied with their level of involvement in the school's ICT decision-making processes. Nearly 4 out of every 5 students (77%) and teachers (75%) were similarly satisfied, perhaps suggesting passive acceptance.

Another aspect of the case study schools self-limiting their use of external actors, or the knowledge that these external actors may possess, was in how teachers kept themselves up-to-date with the latest technology and its subsequent use. For a large part of their on-going technology knowledge teachers relied on internal school based resources and associations. For instance, teachers relied on colleagues, family and students to inform their ICT practices.

Such systemic disregard for external actors contradicts the examined literature which suggests external actors have a determining influence on the internal workings of schools (Barrone, 2001; Mahmood, 2000; Riffel & Levin, 1997). Several leading researchers have also indicated that external actors may have a short-lived or limiting influence on schools. Indeed Caldwell (2006) indicated that government influence in terms of more funding have not resulted in greater gains in technology use nor in technological "expectations being achieved to any great extent" (p. 5). Furthermore some researchers have concluded that top-down initiatives or incentive schemes may not work because they undermine the confidence of those who are at the coalface of the

change and cause them to lose “confidence in their own abilities” (Benabou & Tirole, 2003, p. 516).

In answering the question of how schools are using ICT for teaching and students’ learning the current study found that technology, specifically internet connected computers, were widely available and accessible in schools, but ICT use was limited. When technology was used in schools it was mainly ‘office’ type applications suggesting that schools were using technology that was reflected in the wider business and knowledge economy sectors. In making that technology available schools were on average allocating 15% or more of their operational budgets on providing equipment, software and technical support services, a finding slightly higher than the decade old Real Time Study (Meredyth et al., 1999). In order to understand the ‘oversold and underused’ notion of technology in the current study the next section examines factors which may hinder or promote ICT usage.

*RQ 3 What are the inter relationships between teachers’ and students’  
background, access to technology, and attitude towards technology?*

To address this question, teachers and students were asked to identify the extent to which they used or didn’t use a range of listed technologies; together with providing access, usage and demographic information on themselves. As stated in the previous chapter and shown in appendix 6, surveyed teachers were representative of the general Australian teaching population in that they were female, aged 35 years or older and had been teaching for more than a decade. These demographic findings were compatible with previous Australian (Cowley, 2002; Meredyth et al., 1999) and international studies (Conlon & Simpson, 2003; Sallimah, 2007) and consistent with Australian teacher demographic data (Australian Bureau of Statistics, 2001; Tasmanian Teachers Registration Board, 2007; Victorian Institute of Teachers, 2009). These teachers were found to be all using ICT in their teaching careers and reported being confident

users of technology. These data seem to contradict earlier studies of teachers' confidence (Blease & Cohen, 1990; Russell & Bradley, 1997; Somekh, 1989); though the finding was not as statistically significant when compared to the decade old Meredyth et al. (1999) study. Even so some words of caution are required. First, previous studies did not report on teachers' confidence across the same four domains, often reporting personal operational confidence with ICT; second, of the 16 indicated technologies in the survey only four were frequently used (internet, email, word processing and students' management databases) and of the remaining tools, the majority of teachers were unsure of their competency levels because they either didn't use the tool or weren't familiar with it. These findings suggest that teachers overall were confident users of a selected repertoire of technology and were able to recognise that they were not confident with other technologies which in turn limited their use of those technologies. As a word of caution it must also be acknowledged that as newer technologies become available all of us are exposed to the benefits these forms of technology offer though marketing and personal use. Therefore, as technologies become more common their use in schools may increase as users become more adept in their use.

The current study results contradict an earlier study (Ertmer et al., 1999) that concluded that the presence of technology in a classroom leads to an increased usage and confidence with that technology. These findings could be interpreted several ways. First, it indicates a need for professional development on the use of the unfamiliar tools; second, it brings into question the limited repertoire of used technologies as compared to what is available. Lastly, over reliance on "office centric" technology which may be seen as a focus solely on preparing students for the knowledge economy (Gibbons et al., 1994). However, these were skills parents believed should be taught at school, for example *"Frankly, I believe that the computers (programs) should reflect what's out there outside of school"* (School C, Guardian Survey 005).

In relation to the used technologies, teachers in this study predominantly utilised ICT for administrative purposes on a weekly basis and in providing materials for students-as opposed to

directly using the technology for instruction. Teachers' use of ICT for administration as opposed to instruction mimic previous findings (Baron et al., 2003; Becker, 2001; Conlon & Simpson, 2003; Cuban, 2001; U.S. Department of Education National Centre of Educational Statistics, 2000; Williams et al., 2000). This quantitative finding was consistent with the teachers' interview interpretations which revealed that teachers were supportive of using ICT in their teaching careers but they felt time and workload pressures in doing so. This pressure may be increased by their over reliance on a limited repertoire of technologies and approaches for keeping-up-to date with ICT. These aspects may help to explain why despite widespread access to ICT, its use was not a daily teaching occurrence, even in the two schools which provided a laptop to every student and teacher.

The teachers' data denoted that teachers believed their students enjoyed using the available technology and in using the technology it promoted positive students' learning benefits. Furthermore, participating teachers were using the available technology in more places (i.e. classroom, library and home) but were not necessarily using the available technology for longer or more frequently than in earlier studies (Baron et al., 2003; Conlon & Simpson, 2003; Meredyth et al., 1999; U.S. Department of Education National Centre of Educational Statistics, 2000; Williams et al., 2000). Data from the current study found that the issues confronting teachers a decade ago were persistent in the current study. The current study identified that teachers predominantly used ICT for supportive activities, such as lesson planning, as opposed to using the technology for instruction. Teachers reported it was not a question of if, but when technology would fail in the classroom. Teachers' experiences of technology failing resulted in them not using the technology or having to have a 'back up plan' just in case the technology failed. For example Mike a senior teacher said *"Over time I have found that I need a plan B because the technology is not always working or available when I want it"* (Teacher Interview-School A-Mike, Lines 5-6).

In order to indicate factors and reasons for technology use and/or under use, including non-use,

the results of the present investigation suggest factors which contribute to teachers' use or non-use of technology, in particular teachers' confidence, teachers' attitudes and the relevance of the ICT. For example, the factors which contribute to teachers' use of ICT are related to having a *positive attitude* towards the continued use of technology; this necessitates understanding how to use the technology both professionally and personally. Professional attitudes are increased by understanding how continued ICT professional development is required in one's teaching career, whilst personal attitudes are increased by teachers' use of technology within their personal lives in which the technology can have a flow on effect into their teaching practice. Associated with the factor *positive attitude* is the attitude of the school towards ICT. Again a positive school attitude towards ICT which is manifested by staff and students having access to a range of technologies, technical support and opportunities to both have time to learn to use the technology and an opportunity to observe others-which might be called 'good practice'. For example, one of the case study schools used a peer mentoring program which had an associated number of teaching release hours in order for both parties to work on learning and sharing their ICT expertise within school operating hours. Since the study data did not indicate that this school used ICT more than the other schools, nor did it show that attitudes were more positive, a further investigation with a larger number of participants and sites is required. The literature does, however, indicate that a community of practice (see Lave & Wenger, 1991) approach does promote collegial learning and that such collegiality helps to mitigate the limiting factors of fear and uncertainty of how to apply the available technologies.

Overwhelmingly the results from the present study indicated that teachers were willing to use technology and believed that it had beneficial outcomes on students' learning. These findings support earlier studies (e.g. Cox et al., 2003; 2004; O'Hara, 2004; O'Rourke & Harrison, 2004) which found that having a positive attitude towards ICT resulted in teachers using that technology.



In understanding why the listed technologies were not used, the main cited reasons were that teachers' reported that the listed technology was not appropriate; and they were not familiar with it. These data suggests that teachers by not being familiar with the technology may be making a judgement call not to use the technology as they do not know how to use it within their own teaching practice. Similar findings were not found in the reported literature indicating that unfamiliarity may be a reason for underuse. Ertmer et al. (1999) reported, however, that teachers' lack of technological skills, which may be the result of non-existing or inappropriate professional development, inhibited teachers' integration of ICT. These findings suggest a need to 'expose' teachers to a wider range of technologies that could be used within their teaching practice.

Also noteworthy was what teachers did not identify ICT was an obstacle to students' learning. For example, the Leximancer concept map linked students' learning, students' needs, and teaching together and identified technology use as important. All teachers reported using ICT in their practice and that most thought ICT supported communication. The teachers also reported that ICT motivated students' learning, and that their school supported their use of ICT in the classroom. These finding, in part contrast, the results of several previous studies (Baron et al., 2003; Conlon & Simpson, 2003; Cowley, 20002; Ertmer et al., 1999), and the current findings suggest that teachers are perhaps now more engaging with ICT and supportive of ICT use in the classroom than was the case in the past decade.

In relation to teachers' technology use the current study found that teachers used ICT more for personal reasons, as compared to teaching related activities and that older teachers were more negative towards the use of ICT for teaching and student related learning than their younger counterparts. In terms of teaching backgrounds, the study found those teachers who had taught in four or more schools or in regional schools were more positive towards the use of ICT for teaching activities than other teachers. Finally, teachers who had higher self-efficacy (self-reported competence) ratings were more likely to use ICT for teaching instruction. These data

suggest that teachers' attitude towards ICT and their perceptions of personal and teacher use of that technology were major predictors of ICT use. These findings provide several implications which will be further explored in research question one, from which a number of recommendations will be made.

From the six case study schools 120 students participated in this study; of these 99% ( $n=119$ ) reported having a computer and internet connection at home. This near universal home access was substantially higher than previous studies; in particular the Real Time Study (Meredyth et al., 1999) which found that home ICT access was 79%, whilst a Tasmanian study (Cowley, 2002) found that 75% of students had a computer at home. A possible explanation for this increase in home technology is that in the intervening years the cost of computer ownership has decreased. Of note, the current research findings are less supportive of previous studies which have claimed:

- that ICT had detrimental effects on students' learning (Alliance for Children, 2000; Dunn & Ridgway, 1991; Healy, 1998);
- that ICT teaching in school makes no significant difference to students' ICT competencies (Russell, T., 1999), or
- that students' being 'digital natives' learn their ICT skills outside of school (Palfrey & Gasser, 2008; Prensky, 2001)

Using exploratory and confirmatory factor analysis to underpin subsequent pathway analysis the current study produced a structural equation model (SEM) which had a Goodness-of-Fit Index of 0.95, indicating a sound and robust model. The structural equation model, as demonstrated in Figure 4.11, indicated that students learnt to use presentation tools such as digital scanners, desk top publishing and web conferencing technologies at school and then used this school based application knowledge to use those technologies outside of school for personal uses.

The students' structural equation model also indicated that students' personal use of productivity tools, such as word processing, spreadsheets, databases and CDs/DVDs, had positive effects on their school use of those technologies. That is, students' who used productivity tools at home and were confident in their use of those forms of technology were more willing and confident to use those same forms of technology at school. This technology transition from home to school had been identified in the literature previously but only in so far as indicating that having access to technology, especially at home and school should help open the door for new and innovative ways for learners to learn (Bates, 2000; Hoffmann, 2002; Van Scoter & Boss, 2002).

Figure 4.11 also indicated that students' use and are confident with communication tools, such as mobile phones, World Wide Web and email, and that this familiarity predominantly occurred outside of school with application knowledge being taken from personal usage to student use of similar technologies at school. This from 'home to school' and 'home use altering school use' had been identified in the literature (Barker, 2000; Hopson, Simms, & Knezek, 2002; Marina, 2001; Smith, 2002) but not quantified in a predicative manner as was done in the current study through SEM.

Of note from the students' structural equation model in Figure 4.11 is that personal use of communication tools resulted in students being confident and skilful with those forms of technology. Whilst at school usage of presentation tools and communication tools resulted in students being confident and skilful users of productivity and presentation tools. In other words at school use of technology resulted in students being more confident and skilful technology users than they would have if they were just using those forms of technology at home. This finding was not encountered in the literature review. For instance many researchers (Bonk & King, 1998; Cashman et al., 2003; Cuban, 2001; Hoffmann, 2002; Kuh & Vesper, 2001) have reported on students' use of technology at school or at home but have not identified a link between which domain (home or school) is more effective in contributing to technology use,

skill development or technology confidence. Understanding students' use of technology and where they predominantly learnt to use that technology and which domain (home or school) has the greatest influence in developing confident and skilful technology users enables educators, curriculum bodies and policy makers to make better connections between home and school technology uses.

A key finding of this research that was identified using structural equation modeling is that there was a iterative interaction between ICT and home and school use, particularly in terms of ICT that is used for producing an assessable assignment or an output that is linked to the students' writing of text, use of visual and digital media and multiliteracies, seeking new information, and using software to solve problems. Schools played a major role in enhancing students' confidence about ICT while home provide opportunities to practice with that technology and facilitate communication. Both home and school enhanced students' ICT skills and had the effect of making the student a more independent learner and user of ICT. This finding has application in how teachers consider teaching ICT and integrating it into the students learning experiences. It also identified technology as having a major role in motivating students to engage with learning and to connect with others and their wider digital environment. In other words, school is where the expectations and purposes for ICT are introduced and homes are where the skills are developed and practices (honed) for a majority of technologies.

Guardians were supportive of after school ICT access and would support an after-school ICT class, particularly used to teach students how to use the internet for searching for information and using "office" type applications such as touch typing using a word processor and using databases to store information. In relation to the actual forms of technology used, or the applications (tools) this study found that students were more likely to use office type applications more at school as compared to at home, whilst their use of web-based applications between home and school were similar.

Overall the current study found students and teachers had almost universal access to an internet

connected computer at home and school. Students and teachers believed they were confident users of a similar range of technologies, specifically the internet and office type application such as word processing. The current study reported that both teachers and students were higher users of technology at home as compared to school and were similarly more confident in their home use of technology compared to similar use at school. In terms of teacher and student attitudes towards ICT both cohorts believed that ICT improved their teaching and learning. Subsequent data modeling analysis of the student data revealed that students, who used communication and presentation software, were more confident and frequent users of technology as compared to those students who did not use the same software. In order of significance was the use of presentation tools (i.e. scanners, conferencing facilities, DTP) followed by communication tools (sms, www and email) then tools for productivity (word processing, spreadsheets and databases, and CD/DVDs). These groups of tools in turn may become indicators for ICT use and confidence and so provide an insight into how to increase ICT use at school, as will be discussed next.

*RQ 1 How can schools successfully embed digital technologies for teaching and students' learning?*

Attitudes towards mandated change are dependent upon how change affects us personally and professionally and this is clearly the case in school adoption of ICT. Based on the findings to research questions two and three a number of implications arise for the continued use of ICT for teaching and students' learning.

The most notable reported finding in the current study was that ICT, specifically an internet connected computer in the classroom or home, was highly accessible yet underused, findings supported by Cuban and others (Cuban, 2001; Cuban et al., 2001). Accordingly ICT success in schools has been measured in terms of student to computer ratios but as this study has found,

high levels of technology do not equate to corresponding levels of use. This finding indicates that access, as in previous studies (Baron et al., 2003; Conlon & Simpson, 2003; Mathews, 1998; Meredyth et al., 1999; U.S. Department of Education National Centre of Educational Statistics, 2000; Williams et al., 2000), is no longer an issue but that technology use is dependent on other variables. Further, the current study identified overwhelming support for teaching and students' learning with ICT by guardians, principals, teachers and students. This finding indicates that community and end user support for school ICT is not a significant factor in the relative underuse of technology in schools. Despite the limited use by schools of National and State based ICT policies in their planning to use ICT, this again was refuted as a significant hindrance to ICT use in the case study schools. This leads to the conclusion that ICT underuse is being driven by factors more specific to the classroom. As discussed in Chapter Two, research has shown that teachers have been slow in their uptake of ICT into their teaching practices. It was shown that this was mainly due to access (now not a factor), technical support (now not a factor), appropriate professional development (available but not meeting needs) and confidence to use that technology. Confidence to use ICT has a number of associated issues which will be discussed.

Throughout the reviewed literature it was indicated that teachers were the key actors, if not the most influential actors, for school change (Goodlad, 1984; Gross, Giacquinta, & Brenstein, 1971; Guri-Rosenblit, 1998; Hargreaves & Fullan, 1992; Hyman, 1981) and particularly for technology use (Watson, 2001; Salaman & Storey, 2002; CEO Forum, 2001). The current study found that this was not particularly the case; with principals infrequently using teachers to plan and implement ICT based reforms. None the less many teachers in the study were satisfied with their current level of involvement; these findings may be indicating passive acceptance as the school change literature clearly indicated that teachers as the end users of curriculum and school reform have a significant impact on the success or otherwise of those reforms.

McKenize (1999) described an effective teacher as one who has a toolkit of strategies they use to modify student performance and choose the best tool to fit the requirements. The current study found that teachers are using ICT as a tool for teaching and students' learning but are not using the full range of available technologies because they are unfamiliar with their use, in particular for students' learning. These reasons can be extrapolated into factors which relate to:

- the perceived relative advantage of the technology, particularly over non-technology mechanisms;
- the relationship of the technology with the teacher's current practice, with technology and teaching style (pedagogy), and
- outcomes or a benefit that is what are the benefits for teaching practice and students' learning in using technology versus non-technology use.

To maximise technology use within a school a series of related measures can be implemented within and outside of the school. As the current study found, one of the most influential factors in the successful integration and implementation of ICT is the personal motivation of end users, namely teachers and students. Whilst it needs to be acknowledged that not all teachers have such a strong personal motivation to use ICT, respondents in the current study found that they all did, though some were more frequent and confident users than others. The current study also found that principals looked favourably to the benefits that ICT could offer in terms of students' learning experiences now and into the future. However juxtaposed to this positive support was that principals did not rely to any great extent on teachers or students in the planning and ICT implementation phases. Nor were teachers given rewards, financial or motivational, to improve their ICT usage. This low level of involvement of these key stakeholders is contrary to established change management practice. For example McIntire and Fressenden (1994) and Fullan (1991) suggested that administrators or school leaders encourage active participation by stakeholders when implementing new ideas and concepts. Active involvement by teachers and

students in ICT decision-making may be a crucial mechanism to improve and increase ICT use. The current study found with little involvement teachers and students were happy with their level of decision-making. This being the case they were at best only weekly users of the available technology, whilst indifferent in searching out new technologies or innovative approaches to current technologies.

In line with the last large scale school ICT study by Meredyth et al. (1999) and congruent with the examined literature, teachers in the current study expressed many concerns which have been evident to users and researchers since the introduction of ICT into schools. Concerns related to *reliability, time, and professional development*. The previous issue of access appears to have been addressed by teachers now having their own school laptop and students having on average one computer for every four students.

Concerns of teachers relating to reliability largely related to having the technology working when required. All of the case study schools have made significant financial and technical outlays to support teachers through the provision of technical support and equipment. Such infrastructure commitment by schools was uncommon a decade ago (Meredyth et al., 1999) and whilst not being a guarantee for equipment 'up-time' (functioning) does support the notion that the technology should be more reliable than in may have been the case in earlier studies. Despite this, teachers still felt uneasy with technology. For instance Mike, a 31-40 year old primary music teacher who has taught for over ten years, stated that:

I use technology a lot at school though most of the use is probably in getting materials developed for the class to use rather than for the students to actually use- though with the older children I do use music manipulation software- ... Over time I have found that I need a plan B because the technology is not always working or available when I want it and for this reason I tend to take a lot of work home with me to do on my home computer. (Teacher Interview-School A-Mike, Lines 1-3 & 4-6).



Mike's comments were typical of participating teachers in that they were keen to use technology but highlight the old saying 'once bitten, twice shy' in that they were still fearful of technology failing to work when they required it. This type of response, or reasoning, may be indicative of participating teachers being older (medium age 35) and having taught on average for 10 or more years. This highlights teachers being digital immigrants; so still learning how to use the available technology. Second, earlier on in their careers, the technology they were using may have indeed not have been as reliable as it is currently. Technical support was much more of a rarity compared to now. To address this reliability concern, schools must view technical assistance and support as an essential, often hidden (until needed), requirement for the continued progress of using ICT for teaching and students' learning. As discussed in relation to professional development, the best way to enhance teacher's use and confidence with technology is to have just-in-time support, which McKenzie (1998) referred to as the best way to win widespread support for an innovation. Without this timely, as required, support, schools run the risk of teachers relying more on non-technical forms to impart the curriculum (Killion, 2000). It needs to be acknowledged, however, that such support would be at an additional cost to the school.

Time to use and time to learn to use the technology were significant issues affecting teachers' ability and confidence with using ICT in their classes and for their own purposes. It could be said that time can be used as an excuse for not starting or doing something. This was not perceived within the case study schools in that teachers and students were all using ICT to some extent at home and school. For teachers, time related to having enough of it to learn, to practice, to plan with and to experiment with the nominated technologies which in turn increase confidence levels. Although all of this has workload implications.

Overall, the current study data suggest that ICT usage has increased since "The Real Time" (Meredyth et al., 1999) and Cowley (2002) studies and that there has been a threefold increase in the number of computers in schools. Despite these promising findings teachers still are not

regularly using many available technologies in their daily teaching practices. It would appear that despite the enthusiasm by governments, schools and parents for the continued procurement of more ICT equipment and associated infrastructure in schools, teachers themselves maybe contributing to the underuse of ICT. For example the results from the current study indicated that “office” applications were the predominant technologies being used by teachers and that when it comes to other readily available technologies such as portable devices (i.e. PDAs) and web conferencing applications teachers showed an apparent lack of understanding of what these technologies were and how they might be embedded into their teaching practice. This finding was further compounded by teachers requesting further professional development on technologies they were already using.

The apparent lack of use and understanding of many of the surveyed technologies suggests teachers and policy makers may need to strive for changes in teacher education programs and teacher professional development in order for transformations in teaching ICT practices to occur. Furthermore, the study findings suggest that teachers may need to shift their understanding of how to use ICT and to make space in their teaching not only for emerging uses of technology, but perhaps more importantly for new ways of learning and teaching, and using the currently available technologies. To understand how this may occur the following section presents some suggestions for theory and practice.

### Significance of the study: theoretical and recommendations for practice

The current investigation of ICT use in schools was prompted by the observation that a prominent gap exists between government initiatives to implement information and communication technology in schools and the marginal level of usage in schools, particularly by teachers. This gap prompted three research questions: *How can schools successfully embed digital technologies for teaching and students’ learning? (RQ1)*, *How are schools utilising digital technologies for teaching and students’ learning? (RQ2)*, and *What are the inter*

*relationships between teachers' and students' background, access to technology, and attitude towards technology? (RQ3).* In providing answers to these questions, the present study sought to contribute to other studies in ICT use in schools, with its theoretical and practical implications.

Chapter Two (Literature Review) of this thesis presented and examined the literature using a triumvirate model: (a) the macro perspective or a societal look at ICT; (b) the micro level which examined ICT within schools and, (c) the meso level which looked at how school and society influenced teachers use of ICT. Similarly, study findings revealed that teachers' use of ICT was influenced by how ICT was perceived in the broader society (i.e. the knowledge economy and life-long learning) and within the school itself (i.e. provision of professional development and expectations to use the available technology). Current study findings revealed that for meaningful and transformative change to occur solutions need to be presented which address the macro, micro and meso levels. As such the study findings support a model which looks at the technology, the social structures, the culture and the interrelationship of these three elements (networks) in order to suggest recommendations for ICT plans, training, policy and measurement of progress.

### Implications for theory

Findings from this study have at least two implications for theory. First this study complements the body of knowledge with regards to the measurement of ICT usage in schools, and the attitudes of school staff, students and parents facilitating the conceptualisation and measurement of ICT use, attitudes and competency.

Second, this study examined ICT usage and attitudes across a range of stakeholder groups, using these instruments. The present study concluded that ICT in schools and homes has reached almost universal access levels; the use of ICT for students' learning is supported by principals, parents, students and teachers; yet its use remains at levels lower than would be expected given the levels of ICT access.

Having conducted the present study and associated literature review there is still a paucity of empirical research examining how teachers can use ICT for students' learning related teaching activities. Although, the results of the present study inform the potential content of professional development aimed at increasing the use and integration of ICT into daily teaching and students' learning practices. The current study found overwhelming support for the continued use of ICT for teaching and students' learning and found that teachers who were younger and had worked in four or more schools and held postgraduate qualifications were more positive towards ICT than those with different demographic characteristics. Moreover, this study found that teachers surveyed believed that improving their ICT skills was required to further their careers. Despite this only half thought that current ICT professional development opportunities were beneficial or useful. This suggests a need for specific guidelines for teachers and PD trainers about what ICT training is required and how to effectively integrate ICT into the curriculum so that teachers are able to implement the new found skills immediately into their practice, as this is something the current study found teachers most wanted to do from PD sessions.

### Recommendations for practice

The most notable reported characteristic of ICT use in schools found by the current study was that it is highly accessible yet underused. Accordingly, relevant school and educational authorities should endeavour to focus upon identifying factors encouraging teachers to use the available technology, particularly computers and the internet (i.e. during the time that this study was undertaken web 2.0 technologies such as blogs, wikis and social communication sites such as Facebook and Twitter have gained momentum) in their teaching. The current study has gone some way to providing schools and education authorities with some of these factors, for teachers and students' use of ICT. For instance the students' structural equation model, Figure 4.11, indicated that students do learn to use some forms of ICT at school (Presentation Tools) and that they also bring what they know about others forms of technology (Communication

Tools and Productivity Tools) from their home lives to school. Further the student SEM (Figure 4.11) indicated that using ICT at school resulted in higher levels of student technology confidence and skills than purely learning to use the technology at home. To take advantage of this school-to-home and home-to-school technology relationship, linkages need to be made on how to use the available technologies for learning and personal pursuits. To assist in the dissemination of study findings and to ultimately improve how ICT is used in schools the study suggests the adoption of the *cyclic process for implementing continuing change* model (see Figure 5.1).

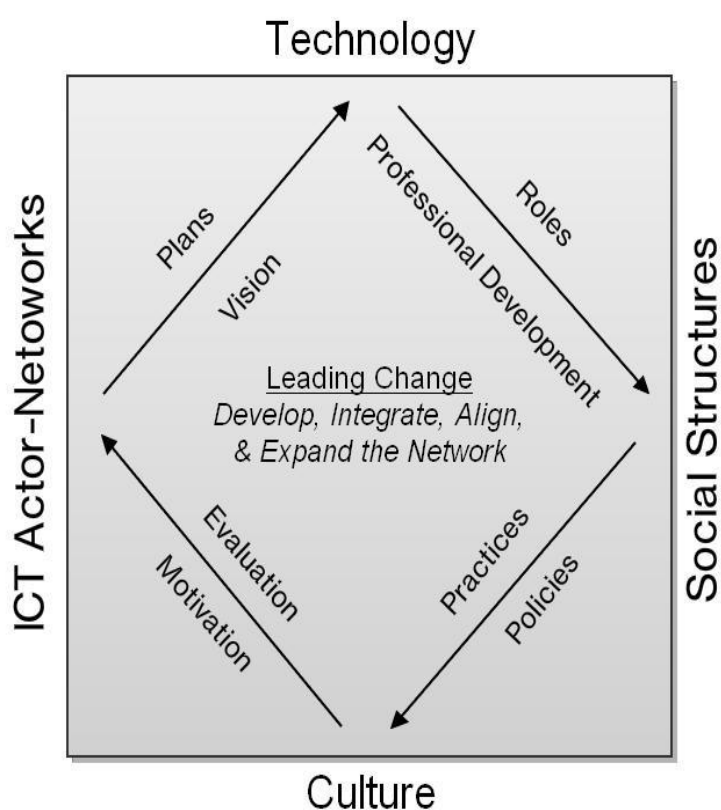


Figure 5.1 Cyclic process for implementing continuing change

The above model can be used at the macro level for education authorities and teacher training institutions to formulate policy. Simultaneously, the *cyclic process for implementing continuing*

*change model* can be used at the micro level for school wide planning and at the meso level by teachers in understanding how to use ICT in the classroom.

In using the above model study findings revealed that ICT use by teachers was contextual in that use was shaped by societal influences such as parents wanting their child to use ‘office’ type applications and broader government and societal influences to prepare students who are able to be productive workers in the knowledge economy. Whilst, at the school level ICT policy and visions were apparent there appeared to be a mismatch between ICT use expectations (i.e. daily use) and reality (i.e. every few days). This discrepancy between current study findings of ICT use and expectations perhaps indicates that teachers lack the time, professional development, and materials to seamlessly integrate ICT into their classroom practice. Whatever is the case, teachers, school administrators, policy formulators, teacher training institutions and regulatory bodies need to work in unison to plan and deliver substantial ICT-based school change. In doing so, each group needs to work across numerous other groups (see Figure 5.2) and within groups in order to plan for this school transformation.

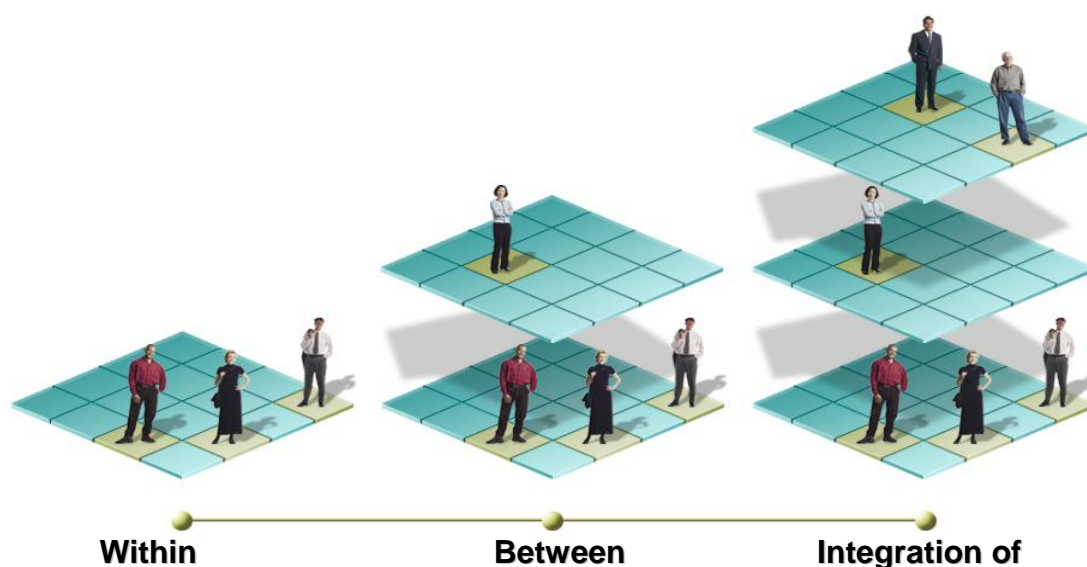


Figure 5.2 Facilitating innovation and change

In working within and across these networks the *cyclic process for implementing continuing change model* can be used to focus attention on the specific change attributes. As such the findings from the current study have several implications for practice which are now discussed with reference to Figure 5.1. It is worth noting that Figure 5.2 and the three level of changes described below (System, School and Teacher level changes) have synergy with the triumvirate model that was used in the literature review (see Figure 2.1). This is not surprising given that ICT changes are dependent upon the wider organisational and political system in which the change is situated (Macro or System level), the internal characteristics of the organisation, school or classroom (Micro or School level) and the interception of these two levels is how the users of the technology or proposed changes implement the technology (Meso or Teacher level). In managing or reviewing such changes it is proposed that the *cyclic process of implementing continuing change model* (Figure 5.1) is used.

### System level change

At the macro or system level government funding and national education policies have resulted in an increase in available technology, specifically computers, in schools. Associated with this infrastructure governments have provided ICT embedded curriculum material such as the Australian Government's Learning Federation site (<http://www.thelearningfederation.edu.au/default.asp>). Unfortunately, such financial and support material has not resulted in a similar increase in ICT usage. At this level, there seems to be a need for a clearer understanding of what it means to use ICT for teaching and students' learning and the goals associated with ICT use. Education authorities, and perhaps schools, may need to articulate clearer goals regarding ICT use. For example, Australia through the *Learning for the knowledge society: An education and training action plan for the information economy* (DETYA, 2000) has formulated a national ICT education vision and action plan, yet the plan, at least in the current study, appears to have no direct impact on the actual use of ICT in schools. What may be required is for education authorities and regulatory bodies to mandate clear

articulated goals and definitions of what it means to use ICT for students' learning and teaching practice (Plans/Vision). In doing so regulatory bodies would prescribe minimum acceptable standards for ICT competency for graduating teachers, ensuring that all new graduates have a minimum common standard of ICT proficiency (Evaluation/Motivation), which some Australian states i.e. New South Wales have already implemented. In providing minimum teacher standards, regulatory bodies should also encourage the sharing of good examples of ICT practice across all curriculum areas. In doing so minimum curriculum, standards for ICT may be developed to guide current and future use of technology in schools (Practices/Policies). Such models then help define the roles and associated training (Professional Development) that needs to be undertaken in teacher training institutions, whilst also defining initial ICT standards of proficiency for teacher registration or accreditation bodies.

### School level change

At the school level, such regulatory standards and minimum competency levels for ICT use and curriculum integration are enacted by schools taking stock of their teachers' current use of ICT and benchmarking this against the minimum standards (Evaluation/Motivation), resulting in the identification of potential professional development initiatives (Roles/ Professional Development). In planning for the ICT use and subsequent ongoing training and support, schools need to develop ICT committees (Plans/Vision). These committees should include stakeholders from within the school (principal, teachers, students, guardians, IT technicians and library staff) and external representatives (other school personnel, industry and university experts, IT development companies) in order to have a broad overview of ICT and specifics for how to support school and teacher use of readily available and emerging technologies (Practices/Policies). To achieve these aims committees need to:

- Identify obstacles and opportunities to innovation & change;
- Determine the needs, interests, and requirements of all ICT users (networks);



- Develop interactions and relationships via communication;
- Resolve resistances of inhibitors through negotiation;
- Translate interests into visions, objectives, roles, plans, and examples of good practice;
- Create and disseminate examples of good practice, and
- Identify and implement strategies for strengthening the work already undertaken.

By enacting the above suggestions, schools may then be able to facilitate change and not be the recipients of others' agendas. Schools need to work on a number of areas in order to have an ICT Vision/Policy that is reflective of not only internal ICT requirements but also reflective of National/State and industry requirements. The current study found that ICT was being used more frequently and for longer time periods by both teachers and students than was found in previous studies, in particular the last ICT usage study by Meredyth et al. (1997) and Jamieson-Proctor, et al. (2006). Findings from the current study are unable to suggest a minimum number of hours nor frequency of use for technology. However, the study can offer regulatory bodies and schools a number of recommendations that support use and frequency:

- Scheduled time for teachers to work with colleagues;
- Opportunities for teachers to observe classroom procedures and teaching practices;
- Discussion time for curriculum planning;
- Opportunities for teachers to design lessons with colleagues;
- Opportunities for teachers to model technology-supported lessons;
- Opportunities for teachers to observe each other teaching with ICT;
- Provision of feedback on lessons taught;
- Active support for teachers to help and learn from each other;
- Provide reward or recognition for on-going and exemplary ICT usage;
- Linking ICT training so that personal and professional uses of the technology are given, and

- Encourage staff and students to demonstrate personal uses of technology which may have school applications.

By developing a vision for ICT use and empowering technology use for teaching, students' learning and personal usage, schools are building up networks of skills and knowledge that can then be shared and distributed to others, by way of 'exemplary practice' or 'good news' stories (see Figure 5.2).

### Teachers' level change

Associated with system wide and school level changes there is also a need for an ICT led transformation of the roles of teaching and students' learning (Plans/Vision). For example, with the computer to student ratio becoming almost 1:1 in Australian schools teachers may need to change the way they deliver and assess students' learning (Roles/Professional Development). Schools, education authorities and policy-makers can facilitate such change using standards, guidelines and examples of good practice, but ultimately it is the teachers who will decide when and how to use the technology (Practices/Policies) and to date there are no models or guidelines to indicate what type or for how long students should be using technology for.

The current study found that teachers were supportive of ICT use for teaching and students' learning but were using a relatively small repertoire of available technologies a few times a week. This was associated with them receiving professional development that may not be fully addressing their needs, indicating a need for a new variety of PD related to ICT. ICT professional development has often focused on how to use ICT but data from this study suggest that teachers assess themselves as being confident users of ICT and believe that using ICT promotes students' learning. It appears that the majority of teachers do not use technology on a daily basis, despite its availability. Thus, there is a need for PD that focuses on ways to better integrate ICT into the current curriculum and to definitions of 21<sup>st</sup> century life-long learning

skills. Furthermore, teachers in the current study indicated a need for more time and examples of how to embed ICT into their teaching practice. Providing teachers with time and giving them incentives to use ICT in their practice may help reduce the existing gaps between teachers' use of ICT and the expectation that the technology be used more frequently than was the case in the current study (Evaluation/Motivation). Additionally allowing time and encouraging IT technicians and teaching staff time to work and train together may help both parties understand why teachers are uncertain about using ICT given their perceived issues around reliability.

This study suggests that teachers have favourable attitudes towards ICT and a willingness to learn more about its use but lack guidance and assistance to increase their level of usage. Thus, professional development may need to also focus on informing teachers about where they can seek assistance within and outside of their schools as well as how to use old and newer technologies in their practice.

### Recommendations summary

Using the *cyclic process for implementing continuing change model* regulatory bodies; teacher-training institutions, schools and teachers are able to identify how a change in say vision needs an associated change in training, policy and evaluation. Furthermore, such changes need to be considered in terms of the available technology, societal expectations, the culture of the group expected to enact the vision; all of which occurs across several networks i.e. classroom, school, community and nation. At the policymaking and national level, the findings of this study suggest that further development of ICT in schools should promote a view of ICT as a tool for enriching the teaching and students' learning experience. Decisions about how to use this tool should be consistent with the principles, strands, and goals outlined in national and state curriculums. Further ICT development within schools could be connected to areas already valued in schools, for example, its role in the new national English curriculum, the use of multimedia to document and share students' learning, strengthen relationships between educators and families, and forge

stronger connections between the school setting and students' homes and other learning environments.

Teachers need to understand and make good use of ICT to support students' learning, to communicate with others, and for their own professional learning. Effective initial teacher education and on-going teacher professional development should be considered as key tools for supporting the development of teachers' understanding of how to use ICT. In enacting these ideas state and national education bodies need to prescribe a minimum acceptable ICT skill set for teacher training institutions, together with a mandated requirement for pre-service teaching training programs to target skill development together with pedagogical applications of ICT. Such programs may then mitigate current study findings of positive attitudes towards ICT, but low usage and an over reliance on a limited range of technologies.

To assist future studies and school personnel Table 5.1 summarises the practical recommendations and strategies that can be employed to improve the current usage of ICT in schools.

It should be noted that the Australian Curriculum, Assessment and Reporting Authority (ACARA-the Australian Federal government's new curriculum authority) are currently enacting several of these recommendations, particularly those concerning the embedding of ICT standards into the curriculum for release in 2011 (see <http://www.acara.edu.au/curriculum.html>). ACARA's sister organisation the Australian Institute for Teaching and School Leadership (AITSL) is also working on minimum ICT standards for teaching graduates (see <http://www.aitsl.edu.au/ta/go/home>).

Table 5.1.

*Summary of study recommendations*

Directed to	Requirement	Strategies
Education authorities, Teacher training institutions, teaching employers and registration boards	<ul style="list-style-type: none"> <li>• Skilled teacher workforce</li> <li>• Minimum ICT standards</li> </ul>	<ul style="list-style-type: none"> <li>• ICT skills addressed in teacher training and registration board requirements</li> <li>• Minimum teacher graduate ICT skill level</li> <li>• Minimum standards for ICT embedding across the curriculum</li> </ul>
School	<ul style="list-style-type: none"> <li>• Supported and maintained ICT infrastructure and professional development</li> </ul>	<ul style="list-style-type: none"> <li>• On-going commitment to maintain, upgrade and replace infrastructure on a regular basis</li> <li>• Continued provision of on-site technical support</li> <li>• Development of minimum infrastructure requirements</li> <li>• “Just-in-time” technical assistance and training</li> <li>• Adaption or development of hard/software specifically suited to schools and curriculum requirements</li> <li>• Needs to be determined by the whole school community</li> <li>• Incorporates National/State ICT documents</li> <li>• Committee incorporates in-school and external actors, as well as education, industry and business actors</li> <li>• One on one PD to meet individual learning requirements</li> <li>• Incentives for continuing PD and sharing of practices</li> <li>• Whole school/staff PD on ICT vision</li> <li>• ICT staff skills register</li> <li>• Team/pair/CoP ICT-based learning teams</li> <li>• Reward and recognition of staff and students’ exemplary use of ICT and willingness to share ICT knowledge and practices</li> </ul>
Teachers	<ul style="list-style-type: none"> <li>• Willingness to continue to develop</li> </ul>	<ul style="list-style-type: none"> <li>• Time to explore how to use technology for personal and professional purposes</li> <li>• Opportunities to showcase staff and student use of ICT</li> <li>• Requirement to keep-up-to date with ICT use and be willing to share this with others</li> <li>• Recognition for students’ use of ICT outside of school and be willing to ‘take advantage’ of this linkage</li> </ul>

## Limitations and recommendations for further research

Studies conducted in natural settings are normally accompanied by multiple limitations. Some of these limitations are avoidable while others are not. These limitations are inherently related to the dynamics of the study setting and the methods chosen to study them. This study was no exception. Furthermore, in the course of this study there were questions raised which were beyond the study's scope or time frame; nevertheless they are either pertinent as extensions of this study or informative for future research. In considering these areas for future studies it is worth considering aspects of the current study which may improve future research into digital technology use in schools. The conclusion of the study also provides an opportunity to reflect upon its limitations, strengths and significance, both methodological and practical.

### Limitations of the study

The first of the study's limitations was the reliance of the research on self-reported measures in the form of questionnaire surveys used as the main source of gathering data. Even so, based on the discussions about the design of the questionnaires, together with the presumption that most survey respondents would be open, truthful and sincere when responding to the questionnaire it is believed that the surveys captured the true nature of the situation from the perspectives of the respondents.

A second limitation specific to the study is in relation to representation of population, in particular the self-selecting aspect relating to the teacher interviews in which only those teachers interested in ICT may have self-nominated to be interviewed. Although the study researched and gathered data from six schools representing two Australian States and all three-education systems-government, Catholic and independent - it is equally important to obtain information from other schools, States and countries. However, more schools, States or countries were not included in the study because of the time and place limitations placed on the researcher to conduct the study whilst working full time and having a young dependent family.

In attending to these limitations, there are assertions made by Lincoln and Guba (1985) that take the view that research findings that do not claim to be able to be replicated are therefore not generalisable. This view is, in part counteracted by Miles and Huberman (1994) who ascertain that research driven by theory could be generalized because the study's findings contribute towards a greater understanding of the phenomenon being investigated, as was the case with the current study.

Ultimately the value and generalisability of the research “perspective presented is judged by its relevance to and use by those whom it is presented [to]” (Patton, 1990, p. 485). “Readers will be able to determine how closely their situations match the research situations, and hence, whether findings can be transferred” (Merriam, 1998, p. 211). Therefore each reader will apply their own limitations to this research by engaging with the cases and discussions presented here, and then applying their own understandings and “vicarious” experiences (Stake, 1995, p. 87). It is therefore the researcher's conviction that the reader will take as much or as little from this study as they want as ultimately like the case study schools and participants nothing written or read causes change, it just makes it possible. As such the sociologist John Law might have been right with his outlook that social structures represent a verb rather than a noun (Law, 1992). So for change to occur we must be willing to embrace the new to our present understandings and be willing to consider the ‘what if’s’ or the possibilities.

### Avenues for Further Research

Further research is needed into the whole area of ICT use in schools by students and teachers. There is a dearth of information and consequently many schools are making investment with little, if any, guidance as to how best to invest and utilise ICT. In thinking about the possibilities, future studies might refine, extend and/or challenge this study in numerous ways. Therefore, there are a number of possible avenues for further work, building on the study, the methodology or the research design. However the particular value of this study lies in mapping

of the field and the initial work in using data collection and modelling tools. Inevitably, some aspects of the study have not been investigated to any depth. These include the following topics which could be the basis for future research:

- A follow-up study with the same schools, tracking how they have utilised or resisted the increasing advancement of technology into our lives and the curriculum. Particularly following their reading of this thesis and its recommendations.
- A broader study with a larger number of schools, and a more focused study that covers investigating an individual's professional and social networks in detail, looking at issues that affect their technology uptake. This later study could also examine *user subversion*, looking in more depth at the way individuals appropriate technologies, and undermine the 'scripts' of the developers and promoters in order to adapt the technology to their particular needs.
- A more in-depth study that examines the types of technology being used and the duration of use versus educational benefits, such as student learning or teacher efficiencies.
- A more time intense study, which examines the role of key actors [principal actors. A term derived from Actor-Network Theory (ANT) by John Law (1992) which is used to describe how key individuals or 'leaders' form groups by aligning the key interests of each individual group member to the goals of the principal actor; which in turn creates a network with a common goal—in this case to increase the use of ICT within teaching contexts] in the adoption, diffusion and everyday use of new and established technologies in a school or organisation.

### Strengths and significance of the study

Despite the limitations of this study mentioned above, the significance of this study is that it has



resulted in a number of recommendations for schools, teachers and the wider education community. If these recommendations are enacted then there will be improvement in how teachers use technology and ultimately in how students learn with and through that technology. This study looked at the situation of six schools during a period of intense social, political and technological change, as technology moved from being the preserve of specialists (1980's and 1990's) to being a ubiquitous part of the economy, the education sector and our personal lives (new millennium). In investigating the use of ICT at these schools, it was evident that the school and its community valued the use of and the contribution these technologies could bring to teaching and students' learning. As the schools encountered new technologies many problems were encountered, and may persist. Despite improvements in design and functionality, digital technologies, in particular computers are not yet stable or simple, or so cheap that there is no risk in adopting them. Furthermore, it may be the case that the Australian Federal Government's \$2.4 billion *Digital Education Revolution* to fund individual computer access to every student from grade 9 through to 12 may result in three significant issues. First, younger students in grades 8 and below may become technology 'poor' in comparison to their older peers; second, the purchase of computers without additional supporting infrastructure such as servers, software and technical support and maintenance may result in the newly bought computers being underutilised. In addition a 'computer wasteland' may occur in the next few years as the newly purchased computers become obsolete and schools are not in a financial position to maintain, upgrade or replace the technology, given that the case study schools were already spending on average up to 15% of their budget to maintain an average computer to student ratio of 1:4. An increase to a 1:1 ratio on the surface will require a greater financial expenditure with that funding to come from yet unknown sources.

The 'wasteland' scenario indicates that there is still a considerable need for specialist knowledge, on how to choose, buy, use, maintain and dispose of digital technologies. In this respect, the case study schools have moved towards almost universal full-time technical support services (mostly on-site). Teachers and principals were overwhelmingly positive in their

attitudes and beliefs about the benefits the available technologies offered in terms of teaching and students' learning. However, there were still concerns regarding the functionality and reliability of the available technologies and teachers in general had limited knowledge of different forms of technology [that is technologies which were not available to them in schools- but offer the potential to be of immense use such as video conferencing and game making (see Saville, 2010)]. The study also found that school technology decisions together with teachers keeping up-to-date with technological developments were mostly confined to internal school sources and within the teacher-technology network, there were specific individuals who for many reasons were relatively more used than others. These local 'experts' were essentially the IT technicians, library staff and more confident teachers. This teacher-'expert'-network in turn offers schools a community of practice (CoP) for providing the school community with the opportunity to both adopt and avoid adopting new ICT. Indeed one case study school (B) did use this form of CoP with its mentor-mentee program. However, the data did not reveal any significant difference between this school's use or attitudes towards digital technologies and the other five schools indicating that attitudes and perceptions across schools were stable or generalisable.

Given the rate of technological change and the ever increasing use of technologies in our homes in the future we may become much more confident to 'experiment' 'at home' with newer technologies-and as we learn to use these technologies at home it would be hoped that teachers would be willing to embrace similar technologies in their classes. However, as Moore's Law (see <http://www.intel.com/technology/mooreslaw/>) stipulates, technology is still increasing in functionality and capacity at the same time as decreasing in cost and so there will always be new products and services to deal with, and there will always be outside influences in how that technology should be incorporated in schools.

## Concluding remarks

As a closing remark, in the future digital technology will become even more pervasive and we will need to learn as individuals and as a society-including the education sector-how to deal with it. One possible model, as shown in Figure 5.3, is an appreciation model.



*Figure 5.3* ICT inquiry process

Given the previous rate of technical change, this model may never be finished. There will always be new products and services to cope with, and there will always be times when we want to distance ourselves from that technology and the demands it makes on our attention and time.

Therefore, teachers and the school community must have positive attitudes and perceptions regarding the usefulness of using the technology for teaching and students' learning purposes and this entails teachers possess the technology skills to effectively implement ICT into their teaching and for personal learning. With this increased awareness, confidence, training and acquisition of technological skills, teachers (users) and the school as an organisation construct and reconstruct their working knowledge of that technology. This reconstruction of knowledge in turn allows users the opportunity (and some might say obligation) to adapt to, challenge, and ultimately influence the use and design of digital technologies for teaching and students' learning. As such, technology never touches a person so lightly that it does not leave a trace.

This study found that whilst technology was readily available, its use was limited in an instructional or students' learning context. The study findings conclude that computers alone cannot transform schooling and that the education sector needs to capitalise on teacher and student enthusiasm for technology, particularly in their personal lives, together with community goodwill to further maximise the potential for digital technologies for lifelong learning.

## References

- ACOT. (2000). *Changing the conversation about teaching learning & technology: A report on 10 years of ACOT research*. Retrieved from <http://www.apple.com/education/k12/leadership/acot/pdf/10yr.pdf>
- Alavi, M., & Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 25(1), 107-136.
- Albion, P. (1999). *Self-efficacy beliefs as an indicator of teachers' preparedness for teaching with technology*. Retrieved from <http://www.usq.edu.au/users/albion/papers/site99/1345.html>
- Alessi, S., & Trollip, S. (2001). *Multimediated learning* (3<sup>rd</sup> ed.). Boston, MA: Allyn & Bacon.
- Alexander, S. (1998, September 2). Human touch trumps IT. *The Australian*.
- Alexander, S., & McKenzie, J. (1998). *An evaluation of information technology projects for university learning*. Committee for university teaching and staff development. Canberra: AGPS.
- Alliance for Childhood. (2000). *Fool's gold: A critical look at computers and childhood*. College Park, MA: Author.
- Alvesson, M., & Skoldberg, K. (2000). *Reflexive methodology: New vistas for qualitative research*. London: Sage.
- Anderson, D., Johnson, R., & Milligan, B. (1999, June). Strategic planning in Australian universities. *Evaluations and Investigations Programme*, 99(1). Retrieved from <http://www.dest.gov.au/archive/highered/eippubs/99-1/report.pdf>
- Appelgate, L. (1994). *Managing in an information age: Transforming the organisation for the 1990's*. Amsterdam: IFIP.
- Arbuckle, J. (2008). AMOS 17.0 user's guide. *SPSS, Chicago: IL*.
- Archer, L. (2007). *Kevin Rudd promises computers for every student*. Retrieved from [www.news.com.au/story/0,23599,22754187-2,00.html?from=public\\_rss](http://www.news.com.au/story/0,23599,22754187-2,00.html?from=public_rss)
- Aspin, D. (Ed.). (1996). *Education and the concept of knowledge: implications for curriculum and leadership*. Dordbreacht, Netherlands: Kluwer Academic Publications.
- Atkin, J. (1997). *Enhancing learning with information technology. Promises, pitfalls and practicalities*. Retrieved from <http://www.learningtolearn.sa.edu.au/Colleagues/files/links/EnhancingLearning.pdf>
- Australia Bureau of Statistics. (2001). *Social-economic indexes*. Retrieved from <http://www.abs.gov.au/ausstats/abs@.nsf/2f762f95845417aeca25706c00834efa/459c3882fad473a2ca2570eb0083be84!OpenDocument>
- Australian Bureau of Statistics. (2004). *Australian national accounts: Information and communication technology 2002-2003*. Retrieved from

- <http://www.abs.gov.au/ausstats/abs@.nsf/productsbytopic/52F69D385978038DCA2571290008557E?OpenDocument>
- Australian Council of Deans of Education. (2001). *New learning: A charter for Australian education*. Canberra: Australian Council of Deans of Education.
- Australian Government. (2008). *Digital education revolution*. Retrieved from <http://www.deewr.gov.au/Schooling/DigitalEducationRevolution/Pages/default.aspx>
- Australian Labor Party (2007). *The Australian economy needs an education revolution*. Retrieved from [www.alp.org.au/download/now/education-revolution.pdf](http://www.alp.org.au/download/now/education-revolution.pdf)
- Australian School of the Air. (2009). *The school of the air and remote learning*. Retrieved from <http://www.cultureandrecreation.gov.au/articles/schoolofair/>
- Aviram, A. (2001). From “computers in the classroom” to mindful radical adaptation of educational systems to the emerging cyber culture. *Journal of Educational Change*, 1, 331-352.
- Babbie, E. (1983). *The practice of social research* (3<sup>rd</sup> ed.). Belmont, California: Wadsworth.
- Baek, Y., Jung, J. & Kim, B (2008).. What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample. *Computers & Education*, 50 (2008), 224–234.
- Bagley, C. (1996). Barriers to school responsiveness in the education quasi-market. *School Organisation*, 16(1), 45-58.
- Bagozzi, R., Davis, F., & Warshaw, P. (1992) Development and test of a theory of technological learning and usage. *Human Relations*, 45(7), 659-686.
- Barak, M. (2004). The use of computers in technological studies: Significant learning or superficial activity? *Journal of Computers in Mathematics and Science Teaching*, 23(4), 329-346.
- Barker, J. (2000). Sophisticated technology offers higher education options. *The Journal of Technology Horizons in Education*, 28(4), 58.
- Barnes, B. (1998). Creating the practice-learning environment: Using information technology to support a new model of continuing medical education. *Academic Medicine*, 73(3), 278-281.
- Barone, C. (2001). Conditions for transformation - infrastructure is not the issue. *Educause Review*, May/June, 41-47.
- Barron, A., Kemker, K., Harmes, C., & Kalaydjian, K. (2003). Large-scale research study on technology in K-12 schools: Technology integration as it relates to the National Technology Standards. *Journal of Research on Technology in Education*, 35, 489-507.
- Barth, R. (1990). *Improving schools from within*. San Francisco: Jossey-Bass.
- Bateman, D., & Oakley, C. (2009). Research report: The Classmate PC 1:1 e-learning project in Australia. Burwood, Australia: Deakin University. Retrieved from [http://managementofchange.wikispaces.com/file/view/Classmate+PC+Australia+Pilot\\_+Deakin+Univ+Research+Report+Final+%28%29.pdf](http://managementofchange.wikispaces.com/file/view/Classmate+PC+Australia+Pilot_+Deakin+Univ+Research+Report+Final+%28%29.pdf)
- Bates, A. W. (2000). *Managing technological change*. San Francisco: Jossey-Bass.

- Bateson, M. (1972). *Our own metaphor*. New York: Knopf.
- Baylor, A., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived students' learning in technology-using classrooms? *Computers and Education*, 39(4), 395-414.
- BBC News. (2002). *Classrooms of the future*. Retrieved from [http://news.bbc.co.uk/hi/english/education/newsid\\_1749000/1749817.stm](http://news.bbc.co.uk/hi/english/education/newsid_1749000/1749817.stm)
- Beare, H., & Millikan, R. (1983). Change strategies: A framework for systematic discussions and planning. *The Practice Manager*, 3(2), 113-118.
- Beck, L. G., & Murphy, J. (1995). *School based management as school reform: Taking stock*. Thousand Oaks, CA: Corwin Press, Inc.
- Becker, H. (2001). *How are teachers using computers in instruction?* Retrieved from [http://www.crito.uci.edu/tlc/findings/special3/How\\_are\\_teachers\\_using.pdf](http://www.crito.uci.edu/tlc/findings/special3/How_are_teachers_using.pdf)
- Becker, H., & Ravitz, J. L. (2001). Computer use by teachers: Are Cuban's predictions correct? In *Proceedings from the 2001 Annual Meeting of the American Educational Research Association*. Seattle, WA. Retrieved from <http://caret.iste.org/index.cfm?fuseaction=studySummary&studyid=422>
- BECTA. (2001). *Primary schools of the future – Achieving today*. London: British Educational Communications and Technology Agency.
- Bell, J. (1992). *Doing your research project*. Milton: Open University Press.
- Benabou, R., & Tirole, J. (2003). Intrinsic and extrinsic motivation. *Review of Economic Studies*, 70(3), 489-520.
- Benbasat, I., Goldstein, D., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, 11(3), 369-386.
- Bennett, J. (1991). Effectiveness of the computer in the teaching of secondary school mathematics: Fifteen years of reviews of research. *Educational Technology* 31(8), 44-47.
- Berg, B. (2007). *Qualitative research methods for the social sciences* (6th ed.). Boston: Pearson Education.
- Berg, M., Aarts, J., & Van der Lei, J. (2010). ICT in health care: Sociotechnical approaches. *Journal of Methods of Information Medicine*, 1, 297-301.
- Berman, P., & McLaughlin, M. (1977). *Federal programs supporting educational change*. Santa Monica, CA: RAND Corporation.
- Beynon, J. (1993). Computers, dominant boys and invisible girls: Or, 'Hannah, it's not a toaster, it's a computer!'. In J. Beynon & H. Mackay (Eds.), *Computers into classrooms*, (pp. 160-189). London: The Falmer Press.
- Bigum, C. (2001). Moving beyond I.T. for I.T.'s sake. *Professional Voice*, 1(1), 29-30.
- Blase, J., & Blase, J. (1997). *The fire is back! Principals sharing school governance*. Thousand Oaks, CA: Corwin Press, Inc.
- Blease, D., & Cohen, L. (1990). *Coping with computers: An ethnographic study in primary classrooms*. London: Paul Chapman.

- Bligh, A. (2002). *Qld state schools to share in more than \$18 million to boost ICTs*. Retrieved from <http://www.education.qld.gov.au/itt/learning/docs/ictl-grant-1instal.doc>
- Bogdan, R., & Biklen, S. (1998). *Qualitative research in education: An introduction to theory and methods* (3<sup>rd</sup> ed). Boston: Allyn & Bacon.
- Bonk, C. (2002). Collaborative tools for e-learning. Retrieved from [www.clomedia.com/content/templates/clo\\_feature.asp?articleid=41&zoneid=30](http://www.clomedia.com/content/templates/clo_feature.asp?articleid=41&zoneid=30)
- Bonk, C., & Wisher, R. (2000). *Applying collaborative and e-learning tools to military distance learning: A research framework*. Alexandria: U.S. Army Research Institute for the Behavioral and Social Sciences.
- Bonk, C., Kirkley, J., Hara, N., & Dennen, V. (2000). *Advances in pedagogy: finding the instructor in post-secondary online learning*. Retrieved from <http://php.indiana.edu/~cjbbonk>
- Bonk, J., & King, K. (1998). *Electronic collaborators: Learning-centered technologies for literacy, apprenticeship, and discourse*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Booth, A., Aiton, J., Bowser-Riley, F., & Maber, J. (1996). The BioNet project: Beyond writing courseware. *Biochem Soc Trans*, 24(1), 298-301.
- Bottino, R., & Chiappini, G. (1995). ARI-LAB: Models issues and strategies in the design of a multiple-tools problem solving environment. *Instructional Science*, 23, 7-23.
- Bottino, R., & Forcheri, P. (1994). Technology transfer in schools: From research to innovation. *British Journal of Educational Technology*, 29, 163-172.
- Bracewell, R., Breuleux, A., Laferriere, T., Beniot, J., & Abdous, M. (1998). *The emerging contribution of online resources and tools to classroom learning and teaching*. Montreal: Universite Laval. Retrieved from <http://www.tact.fse.ulaval.ca/ang/html/review98.html>
- Bradshaw, L. (1997). Technology-supported change: A staff development opportunity. *NAASP-Bulletin*, 81, 86-92.
- Brand, G. (1997). What research says: Training teachers for using technology. *Journal of Staff Development* [Electronic Version], 19(1). Retrieved from <http://www.nsd.org/news/articleDetails.cfm?articleID=268>
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Brennan, J. (1997). *Point to the future: A principal's technology planning guide*. Washington DC: National Catholic Educational Association.
- Brennan, M. (2000). *A new generation of high schools for the ACT*. Retrieved from <http://www.det.act.gov.au/publicat/pdf/Mariebrennanpaper2.pdf>
- Brown, D., Burg, J., & Dominick, J. (1998). A strategic plan for ubiquitous laptop computing. *Communications of the ACM*, 41(1), 26-35.
- Brown, J., & Duguid, P. (2001). Knowledge and organisation: A social-practice perspective. *Organisation Science*, 12(2), 198-213.
- Brynjolfsson, E., & Hitt, L. (2000). Beyond computation: Information technology, organisational



- transformation and business performance. *Journal of Economic Perspectives*, 14(4), 23-48.
- Burns, R. (1997). *Introduction to research methods*. New York: Longman.
- Butzin, S. M. (2000). Using instructional technology in transformed learning environments: An evaluation of project child. *Journal of Research in Computing Education*, 33(4), 367-384.
- Byrne, B. (2010). *Structural equation modeling with AMOS - Basic concepts, applications, and programming*. New York: Routledge.
- Byrnes, R., & Ellis, A. (2006). The prevalence and characteristics of online assessment in Australian universities. *Australasian Journal of Educational Technology*, 22(1), 104-125. Retrieved from <http://www.ascilite.org.au/ajet/ajet22/byrnes.html>
- Caci, B., Cardaci, M. & Lund, H. (2003). Assessing educational robotics by the “Robot edutainment questionnaire” Technical report The Maersk Mc-Kinney Moller Institute for Production Technology, University of Southern Denmark.
- Caelli, K., Ray, L., & Mill, J. (2003). ‘Clear as mud’: Toward greater clarity in generic qualitative research. Retrieved from [http://www.ualberta.ca/~iiqm/backissues/2\\_2/html/caellietal.htm](http://www.ualberta.ca/~iiqm/backissues/2_2/html/caellietal.htm)
- Campbell, N. (2001). Information, communication technology: The teacher does not know everything! In C. McGee & D. Fraser (Eds.), *The professional practice of teaching* (pp. 240-256). Palmerston North, New Zealand: Dunmore Press.
- Candiotti, A., & Clarke, N. (1998). Combining universal with faculty development and academic facilities. *Communications of the ACM*, 41(1), 58-63.
- Cantrell, D. (1990). *Alternative paradigms in environmental research: The interpretative perspective*. Retrieved from <http://www.uleth.ca/edu/research/ciccte/naceer.pgs/pubpro.pgs/Alternate/PubFiles/08.Cantrell.fin.htm>
- Capel, S., Leask, M., & Turner, T. (2001). *Learning to teach in the secondary school* (2<sup>nd</sup> ed.). New York: Routledge.
- Capra, F. (2002). *The hidden connections: A science for sustainable living*. London: Harper Collins Publisher.
- Carnoy, M. (2004). ICT in education: Possibilities and challenges. In *Proceedings from the Inaugural lecture of UOC 2004-2005*. Barcelona.
- Carroll, T. (2000). If we didn’t have the schools we have today, would we create the schools we have today? *Contemporary Issues in Technology and Teacher Education*, 1(1), 117-140.
- Carspecken, P. (1996). *Critical ethnography in educational research: A theoretical and practical guide*. New York: Routledge.
- Carspecken, P., & Apple, M. (1992). Critical qualitative research. In M. LeCompte, W. Millroy & J. Preissley (Eds.), *Handbook of critical research in education* (pp. 507-554). San Diego: Academic Press, Inc.

- Carter, D. (1990). Knowledge transmitter, social scientist or reflective thinker: Three images of the practitioner in Western Australian high schools. *Theory and Research in Social Education*, 18, 274-317.
- Casebeer, A., & Verhoef, M. (1997). Combining qualitative and quantitative research methods: Considering the possibilities for enhancing the study of chronic diseases. *Chronic Disease in Canada*, 18(3), 130-135.
- Casey, D. (1993). The workplace classroom. *Competence and Assessment*, 16, 13-14.
- Cepeda, G. (2006). Competitive advantage of knowledge management. In D. G. Schwartz (Ed.), *Encyclopaedia of knowledge management* (pp.34-43). Hershey, PA: Idea Group Reference.
- Chalmers, M. (2001). *Propagating online pedagogies: Studies of society and environment*. Retrieved from <http://www.discover.tased.edu.au/netlearn/research/propped.htm>
- Chang, S. & Tung, F. (2008). An empirical investigation of students' behavioural intentions to use the online learning course websites. *British Journal of Educational Technology*, 39(1): 71-83.
- Chapman, J., Gaff, J., Toomey, R., & Aspin, D. (2005). Policy on lifelong learning in Australia. *International Journal of Lifelong Education*, 24(2), 99-122. Retrieved from [http://www.informaworld.com/smpp/content~db=all~content=a714030660?words=governments\\*|schooling\\*|australia\\*](http://www.informaworld.com/smpp/content~db=all~content=a714030660?words=governments*|schooling*|australia*)
- Cheung, D., Hattie, J., & Ng, D. (2001). Re-examining the stages of concern questionnaire: A test of alternative models. *The Journal of Educational Research*, 9, 226-236.
- Claeys, C. (1997). Innovating education through the use of new technologies: Reflections from the field. *Educational Media International*, 34, 144-152.
- Clark, K. (2000). Urban middle school teachers' use of instructional technology. *Journal of Research on Computing in Education*, 33(2), 178.
- Clarke, C. (2003). *Towards a unified e-learning strategy*. London: Department for Education and Skills.
- Cohan, M., & Kottkamp, R. (1983). *Teachers: The missing voices in education*. New York: State University of New York Press.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.
- Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). London and New York: Routledge/Falmer Publications.
- Colbeck, D. (2007). Understanding knowledge genesis by means of multivariate factor analysis of epistemological belief structures. *Information Research*, 12(4). Retrieved from <http://InformationR.net/ir/12-4/colis/colis16.html>
- Collis, B., & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations*. London: Kogan Page.
- Conlon, T., & Simpson, M. (2003). Silicon Valley versus Silicon Glen: The impact of computers upon teaching and learning: A comparative study. *British Journal of Educational Technology*, 34(3), 259-270.

34(2), 137-150.

- Conole, G., De Laat, M., Dillon, T. & Darby, J. (2008). 'Disruptive technologies', 'pedagogical innovation': What's new? Findings from an in-depth study of students' use and perception of technology. *Computers and Education*, 50, 2, 511–524.
- Cooke, J., & Fine, C. (1996). *Realizing new learning for all students through professional development*. Retrieved from <http://www.ncrel.org/sdrs/areas/issues/educatrs/profdevl/pd200.htm>
- Cooley, V., & Reitz, R. (1997). Lessons learned in creating a program. *Pi Delta Kappa*, 34(1), 4-9.
- Coorey, P. (2007, January). Rudd vows education revolution. *The Sydney Morning Herald*. Retrieved from [www.smh.com.au/news/national/rudd-vows-educationrevolution/2007/01/22/1169330827940.html?page=fullpage](http://www.smh.com.au/news/national/rudd-vows-educationrevolution/2007/01/22/1169330827940.html?page=fullpage)
- Coughlin, E., & Lemke, C. (1999). *Professional competency continuum. Professional skills for the digital age classroom*. Santa Monica, CA: Milken Exchange on Education Technology.
- Cousins, J. B., & Leithwood, K. A. (1993). Enhancing knowledge utilization as a strategy for school improvement. *Knowledge: Creation, Diffusion, Utilization*, 14(3), 305-333.
- Cowley, T. (2002). *Student survey: August 2002 summary report. Project-based learning using multimedia project*. Hobart: Author.
- Cox, M. (2005). Educational conflict: The problems in institutionalizing new technologies in education. In G. Kouzelis, M. Pournari, M. Stoeppler & V. Tselves (Eds.), *Knowledge in the new technologies* (pp. 123-140). Frankfurt, Berlin: Peter Lang.
- Cox, M., Abbott, C., Webb, M., Blakeley, B., Beauchamp, T., & Rhodes, V. (2003). *ICT and attainment: A review of the research literature*. London: BECTA.
- Cox, M., Abbott, C., Webb, M., Blakely, B., Beauchamp, T., & Rhodes, V. (2004). *ICT and attainment*. London: BECTA.
- Creswell, J. (2003). *Research design: Qualitative, quantitative and mixed method approaches*. Thousand Oaks, CA: Sage Publications.
- Cuban, L. (1986). *Teachers and machines: The classroom use of technologies since 1920*. New York: Teachers College Press.
- Cuban, L. (1992). The corporate myth of reforming public schools. *Phi Delta Kappan*, 74(2), 157-159.
- Cuban, L. (1993). Computers meet classroom: Classroom wins. *Teachers College Record*, 95(2), 185-210.
- Cuban, L. (1999a). The lure of curricular reform and its pitiful history. *Phi Delta Kappan*, 75(5), 182-185.
- Cuban, L. (1999b). The technology puzzle: Why is greater access not translating into better classroom use? *Education Week*, 68, 47.
- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.

- Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal*, 38(4), 813-834.
- Cumps, B., Viaene, S., Dedene, G., & Vandenbulcke, J. (2006). An empirical study of business/ICT alignment in European organisations. In *Proceedings from the 39th Annual Hawaii International Conference on business and ICT*. Hawaii.
- Cuthell, J. (2002). *Virtual Learning: The impact of ICT on the way young people work and learn*. Burlington: Ashgate Publishing Company.
- Czerniak, C., Lumpe, A., Haney, J., & Beck, J. (1999). *Teachers' beliefs about using educational technology in the science classroom*. Retrieved from <http://smi.curtin.edu.au/ijet/v1n2/czerniak/index.html>
- Dale, R., Robertson, S., & Shortis, T. (2004). You can't not go with the technological flow, can you? Constructing 'ICT' and teaching and learning. *Journal of Computer Assisted Learning*, 20, 456-470.
- Dalin, P. (1993). *Changing the school culture*. London: Cassell.
- Dardelet, B., & Darcy, S. (2003). Rescuing the emergency, multiple expertise and IT in the emergency field. *Meth Inf Med*, 42, 360-365.
- Darke, P., Shanks, G., & Broadbent, M. (1998). Successfully completing case study research: Combining rigour, relevance and pragmatism. *Information Systems Journal*, 8, 273-298.
- Darling-Hammond, L., & McLaughlin, M. (1995). Policies that support professional development in an era of reform. In M. W. McLaughlin & I. Oberman (Eds.), *Teacher learning: New policies, new practices* (pp. 202-218). New York: Teachers College.
- Davenport, T., & Prusak, L. (2000). *Working knowledge: How organisations manage what they know*. Boston, MA: Harvard Business School Press.
- Dawes, L. (2001). What stops teachers using new technology? In M. Leask (Ed.), *Issues in teaching using ICT* (pp. 61-79). Florence, KY: Routledge.
- Dawkins, J. (1988). *Strengthening Australia's schools*. Canberra: Australian Government Publishing Services.
- de Weert, E. (1999). Contours of the emergent knowledge society: Theoretical debate and implications for higher education research. *Higher Education*, 38, 49-69.
- Dearing, R. (1997). *Higher education in the learning society*. London, United Kingdom: National Committee of Inquiry into Higher Education.
- Dede, C. (1989). The evolution of information technology: Implications for curriculum. *Educational Leadership*, 47(1), 23-26.
- Dede, C. (1997). Rethinking how to invest in technology. *Educational Leadership*, 55(3), 12-16.
- deLaine, M. (1997). *Ethnography: Theory and applications in health research*. Sydney, NSW: MacLennan & Petty.

- Denscombe, M. (1998). *Good research guide for small-scale research projects*. Buckingham: Open University Press.
- Denzin, N. (1997). Triangulation in educational research. In J. Keeses (Ed.), *Educational research methodology, and measurement: An international handbook* (pp. 318-322). Oxford: Elsevier Science.
- Denzin, N., & Lincoln, Y. (Eds.) (2000). *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications.
- Department of Education, Employment and Workplace Relations [DEEWR]. (2009). The digital education revolution . Retrieved from <http://www.deewr.gov.au/SCHOOLING/DIGITALEducationREVOLUTION/Pages/default.aspx>
- Department of Education, Employment and Workplace Relations [DEEWR]. (2008). Success through partnership. Achieving a national vision for ICT in schools. Retrieved from <http://www.deewr.gov.au/SCHOOLING/DIGITALEducationREVOLUTION/Pages/default.aspx>
- Department of Education, Science and Technology (DEST). (2002). *Making Better Connections*. Retrieved from <http://www.dest.gov.au/schools/publications/2002/MBC.pdf>
- Department of Education, Science and Training (DEST). (2004). *Australia's future using educational technology*. Retrieved from [http://www.dest.gov.au/sectors/school\\_education/publications\\_resources/profiles/australias\\_future\\_using\\_education\\_technology.htm](http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/australias_future_using_education_technology.htm)
- Department of Education, Tasmania. (2000). *Learning together: A vision for education, training and information into the 21<sup>st</sup> century*. Retrieved from <http://www.education.tas.gov.au/learningtogether>
- Department of Education, Tasmania. (2002a). *ICT in education strategic policy 2002-2005*. Retrieved from <http://www.education.tas.gov.au/Nav/StrategicPolicy.asp?Strategy=00000018&ID=00000145>
- Department of Education, Tasmania. (2002b). *Essential learning framework 1*. Hobart: Author.
- Department of Education, Training and Youth Affairs (DETYA). (1999). *Australia's information future: Innovation and knowledge management for the 21<sup>st</sup> Century*. Retrieved from [http://www.dest.gov.au/archieve/highered/eippubs/eip99-5/eip99\\_5.pdf](http://www.dest.gov.au/archieve/highered/eippubs/eip99-5/eip99_5.pdf)
- Department of Education, Training and Youth Affairs (DETYA). (2000). *Learning for the knowledge society: An education and training action plan for the information economy*. Retrieved from [http://www.dest.gov.au/sectors/school\\_education/publications\\_resources/summaries\\_brochures/learning\\_for\\_the\\_knowledge\\_society.htm](http://www.dest.gov.au/sectors/school_education/publications_resources/summaries_brochures/learning_for_the_knowledge_society.htm)

- Deshpande, R. (1983). Paradigms lost: On theory and method in research in marketing. *Journal of Marketing*, 47(4), 101-110.
- Detienne, K. B., & Jackson, L. A. (2001). Knowledge management: Understanding theory and developing strategy. *Competitiveness Review*, 11(1), 1-11.
- DeVellis, R. (1991). *Scale development: Theory and applications*. Newbury Park, CA: Sage.
- deWeert, E. (1999). Contours of the emergent knowledge society: Theoretical debate and implications for higher education research. *Higher Education*, 38, 49-69.
- Dill, D. (1996). Academic planning and organisational design: Lessons from leading American universities. *Higher Education Quarterly*, 50(1), 35-53.
- Dolence, M., & Norris, D. (1995). *Transforming higher education: A vision for learning in the 21<sup>st</sup> Century*. Ann Arbor, MI: Society for College and University Planning.
- Donovan, L., Hartley, K. & Strudler, N. (2007). Teacher concerns during initial implementation of a one-to-one laptop initiative at the middle school level. *Journal of Research on Technology in Education*, 39(3), 263-287.
- Donovan, L., Hartley, K., & Strudler, N. (2007). Teacher concerns during initial implementation of a one-to-one laptop initiative at the middle school level. *Journal of Research on Technology in Education*, 39(3), 263-287.
- Dootson, S. (1995). An in-depth study of triangulation. *Journal of Advanced Nursing*, 22(1), 171-182.
- Downes, T., & Fatouros, C. (1995). Young children learning in their preschool and primary years: A framework for planning to incorporate IT. *Australian Educational Computing*, May, 4-9.
- Downes, T., Khun, T., Scott, D., Leonard, R., & Warhurst, J. (2003). *Preservice teacher training and teacher professional development in the use of ICTs in the training of mathematics and science in participating SEAMEO countries*. Retrieved from [www.acce.edu.au/documents/store/1/reportV.4doc](http://www.acce.edu.au/documents/store/1/reportV.4doc)
- Dunn, S., & Ridgway, J. (1991). Naked into the world: IT teaching experiences on final primary school teaching practice: A second survey. *Journal of Computer Assisted Learning*, 7(4), 229-240.
- Dwyer, D. (1995). *Changing the conversation about teaching, learning & technology: A report on 10 years of ACOT research*. CA: Apple Computer, Inc.
- Dyril, O., & Kinnaman, D. (1994). Integrating technology into our classroom curriculum. *Technology & Learning*, 14(5), 38-44.
- Ehrmann, S. (1995). New technology, old trap. *Education Review*, 30(5), 41-43.
- Eib, B. (2001). Beyond the bells and whistles: Evaluating technology use in the classroom. *Principal Leadership*, 1(9), 16-23.
- Elliot, C. (1998). *Leadership and change in schools*. Edmonton: Department of Educational Administration, University of Alberta.

- Ertmer, P., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the elementary classroom. *Journal of Research on Computing in Education*, 32(1), 54-72.
- Ertmer, P., Ottenbreit-Leftwich, A. & York, C. (2007). Exemplary technology use: teachers' perceptions of critical factors. *Journal of Computing in Teacher Education*, 23 (2), 55-61.
- Erzberger, C., & Prein, G. (1997). Triangulation: Validity and empirically-based hypothesis construction. *Quality and Quantity*, 31(2), 141-154.
- Ferneding, K. A. (2003). *Questioning technology: Electronic technologies and educational reform*. New York: Peter Lang.
- Field, A. (2005). *Discovering statistics using SPSS* (2<sup>nd</sup> ed.). Thousand Oaks, CA: Sage Publications.
- Field, J. (2000). *Lifelong learning and the new educational order*. Stoke on Trent, Staffordshire: Trentham Books Ltd.
- Fleit, L. (2000). Panel on the future of the profession. *Educause Review*, January/February. Retrieved from <http://net.educause.edu/ir/library/pdf/erm001e.pdf>
- Flick, U. (1992). Triangulation revisited: Strategy of validation or alternative? *Journal for the Theory of Social Behaviour*, 22(2), 175-197.
- Flick, U. (1998). *An introduction to qualitative research*. Thousand Oaks, CA: Sage Publications.
- Fluck, A. (1998). *The KITO's - Key information technology outcomes for school students*. Retrieved from [http://cegsa.sa.edu.au/conference/acec98/papers/p\\_fluck.html](http://cegsa.sa.edu.au/conference/acec98/papers/p_fluck.html)
- Fluck, A., & Robertson, M. (2002). Classroom computer climate and national learning benchmarks. In *Proceedings from the 17<sup>th</sup> Australian Computers in Education Conference*. Hobart, Tasmania.
- Fluck, A., Pullen, D., & Harper, C. (2009). Case study of a computer-based examination system. *Australian Journal of Educational Technology*, 25(4). Retrieved from <http://www.ascilite.org.au/ajet/ajet25/fluck.html>
- Fontana, A., & Frey, J. (1998). Interviewing: The art of science. In N. Denzin & Y. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (pp. 47-78). Thousand Oaks, CA: Sage Publications.
- Forsyth, I. (1996). *Teaching and learning materials and the Internet*. London: Kogan Page.
- Freebody, P. (2003). Methods and methodologies: Ethnography, case study and action research. In P. Freebody (Ed), *Qualitative research in education: Interaction and practice* (pp. 74-89). London: Sage Publications.
- Freeman, M. (1998). Video conferencing: A solution to the multi-campus large classes problem? *British Journal of Educational Technology*, 29(3), 197-210.
- Fullan, M. (1982). *Teacher development and educational change*. London: The Falmer Press.
- Fullan, M. (1991). *The new meaning of educational change*. London: Cassall.

- Fullan, M. (1993a). *In change forces: Probing the depths of education reform*. London: The Falmer Press.
- Fullan, M. (1993b). *Change forces: Probing the depth of educational reform*. Philadelphia, PA: The Falmer Press.
- Fullan, M. (1999) *Change forces: The sequel*. Bristol, PA: The Falmer Press.
- Fullan, M., & Stiegelbauer, S. (1991). *The new meaning of educational change*. New York: Columbia University.
- Gall, M., Borg, W., & Gall, J. (1996). *Educational research: An introduction*. New York: Longman.
- Garson, D. (2003). *Ethnographic research*. Retrieved from <http://www2.chass.ncsu.edu/garson/pa765/ethno.htm>
- Gay, L., Mills, G. & Airasian, P. (2006). *Educational research: competencies for analysis and applications* (8<sup>th</sup> edition). Upper Sadler River, NJ: Pearson Merrill Prentice Hall.
- Gebhart, G. (2003). Leadership in ICT. In *Proceedings from Educause in Australasia 2003*. Adelaide, Australia. Retrieved from <http://www.caudit.edu.au/educauseaustralasia/2003/EDUCAUSE/PDF/INDEXSCR.PDF>
- George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference, 11.0 update* (4<sup>th</sup> ed.). Boston: Allyn and Bacon.
- Gibbons, M. (1995). The university as an instrument for the development of science and basic research: The implications of mode 2 science. In D. Dill & B. Sporn (Eds.), *Emerging patterns of social demand and university reform: Through a glass darkly* (pp. 90-104). Oxford: Pergamon Press.
- Gibbons, M., Limoges, C., Nowothy, H., Schwartzman, S., Scott, P., & Trow, M. (Eds.). (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies*. London: Sage.
- Gibson, I. (2001). At the intersection of technology and pedagogy: considering styles of learning and teaching. *Journal of Information Technology for Teacher Education*, 10 (1/2), 37–61.
- Giddens, A. (1984). *The constitution of society*. Cambridge: Polity Press.
- Gilbert, S. (1996). Making the most of a slow revolution. *Change*, 28(2), 10-20.
- Gilbert, S., & Green, K. (1995a). Great expectations: Content, communications, productivity, and the role of information technology in higher education. *Change*, 27, 8-19.
- Gilbert, S., & Green, K. (1995b). *Information technology: A road to the future?* To promote academic justice and excellence series. (ERIC document reproduction service No. Ed 404 924).
- Gillard, J. (2008). The importance of being digitally engaged. *Information Age*, Dec08/Jan09, 56-59. Retrieved from <http://www.acs.org.au/iage/ia200812-01.pdf>
- Gillman, T. (1989). *Change in public education: A technological perspective*. Eugene, Oregon: University of Oregon.



- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory*. London: Weidenfeld and Nicolson.
- Glesne, C. (1999). *Becoming qualitative researchers*. United States: Addison Wesley Longman.
- Goedegebuure, L., & De Boer, H. (1996). Governance and decision-making in higher education. Comparative aspects. *Tertiary Education and Management* 2(2), 160-169.
- Goodlad, J. (1984). *A place called school*. New York: McGraw Hill.
- Goodrum, D., Hackling, M., & Rennie, L. (2001). *The status and quality of teaching and learning of science in Australian schools*. Retrieved from <http://www.dest.gov.au/NR/rdonlyres/5DF3591E-DA7C-4CBD-A96C-CE404B552EB4/1546/sciencereport.pdf>
- Grabe, M., & Grabe, C. (2001). *Integrating technology for meaningful learning*. New York: Houghton Mifflin Company.
- Granger, C., Morbey, H., Lotherington, H., Owston, R., & Wideman, H. (2002). Factors contributing to teachers' successful implementation of IT. *Journal of Computer Assisted Learning*, 18, 480-488.
- Green, M., Eckel, P., & Andris, B. (2002). *The brave new (and smaller) world of higher education: A transatlantic view*. Washington: American Council on Education (ACE) and European University Association (EUA).
- Greene, J., Caracelli, V., & Graham, W. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, 11(3), 255-274.
- Gross, N., Giacuinta, J., & Bernstein, M. (1971). *Implementing organisational innovation: A sociological analysis of planned educational change*. New York: Basic Books.
- Guba, E., & Lincoln, Y. (1994). Competing paradigms in qualitative research. In N. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). Thousand Oaks, CA: Sage Publications.
- Guba, E., & Lincoln, Y. (2000). In N. K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research*. London: Sage Publications.
- Guri-Rosenblit, S. (1998). Future agendas of distance-teaching and mass-orientated universities. In *Proceedings of the seventh EDEN (European Distance Education Network) Annual Conference*. Budapest: EDEN.
- Gurr, D. (2000). The impact of information and communication technology on the work of school principals. *Leading & Managing*, 6, 60-73.
- Guskey, T. (1994). Results orientated professional development. *Journal of Staff Development*, 15, 42-50.
- Hall, G. (2001). Leading the charge. *Principal Leadership*, 1, 40-42.
- Hall, G., & Hord, S. (1984). *Change in schools: Facilitating the process*. New York: State University of New York.

- Hammersley, M. (Ed.). (1993). *Controversies in classroom research* (2<sup>nd</sup> ed.). Buckingham, UK: Open University Press.
- Hancock, V. (1993). *Information literacy for lifelong learning*. Retrieved from <http://www.askeric.org>
- Harding, S. (Ed.). (1987). *Feminism and methodology*. Indiana: Indiana University Press.
- Hardy, C. (1989). *The age of unreason*. London: Arrow books.
- Hardy, J. (1998). Teacher attitudes toward and knowledge of computer technology. *Computers in Schools*, 14(3/4), 119-136.
- Hargreaves A. & Shirley D. (2009) *The fourth way: The inspiring future for educational change*. Corwin Press, Thousand Oaks, CA.
- Hargreaves, A. (1992). Cultures of teaching: A focus for change. In M. Fullan & A. Hargreaves (Eds.), *Understanding teacher development* (pp. 216-240). New York: Teachers College Press.
- Hargreaves, A. (1994). *Devices and desires: The process of change*. London: Creswell.
- Hargreaves, A., & Fullan, M. (1992). *Teacher development and educational change*. Basingstoke: The Falmer Press.
- Hatch, J. (2002). *Doing qualitative research in education settings*. Albany, NY: State University of New York Press.
- Hattie, J. (2009). *Visible learning*. London: Routledge.
- Hay, L. (2001). Information leadership: Managing the ICT integration equation. *Computers in NZ schools*, 13(3), 5-12.
- Healey, J. (1998). *Failure to connect: How computers affect our children's minds-for better and worse*. New York: Simon & Schuster.
- Herriott, R., & Firestone, W. (1983). Multisite qualitative policy research: Optimizing description and generalizability. *Educational Researcher*, 12, 14-19.
- Higgins, S. (2003). *Does ICT improve learning and teaching in schools?* Retrieved from <http://www.bera.ac.uk/publications/pdfs/ICT%20PUR%20MB%20r-f-p%201Aug03.pdf>
- Hodas, S. (1998). *Technology refusal and the organisational culture of schools*. Retrieved from <http://www.english.upenn.edu/~afilreis/teaching-tech.html>
- Hoffman, B. (1997). Integrating technology into schools. *Education Digest*, 62(5), 51-55.
- Hoffman, D. (2002). Distance learning in higher education. *Tech Directions*, 62(1), 28-32.
- Hope, W., Kelly, B., & Guyden, J. (2000). Technology standards for school administrators: Implications for administrator preparation programs. In *Proceedings of the Information Technology and Teacher Education Conference*. Sand Diego, CA.
- Hopson, M., Simms, R., & Knezek, G. (2002). Using a technologically enriched environment to improve higher-order thinking skills. *Journal of Research on Technology in Education*, 34(2), 109-119.
- Horsley, S. (1997). Research on systemic reform: The role of teaching and learning in systemic reform. *Science Educator*, 7(1), 1-6.

- Howard, B. C., McGee, S., Schwartz, N., & Purcell, S. (2000). The experience of constructivism: Transforming teacher epistemology. *Journal of Research on Computing in Education*, 32, 455-465.
- Hoyle, H. R. (1995). The structural equation modeling approach. In H. R. Hoyle (Ed.), *Structural equation modeling: concepts, issues, and applications* (pp. 1-15). Thousand Oaks, CA: Sage Publications.
- Hyman, B. (1981). *Managing change, in how successful women manage*. New York: Macmillan.
- Isaac, S., & Michael, W. (1997). *Handbook in research and evaluation*. San Diego, EdITS.
- ISTE, (2007). Essential Conditions: Necessary conditions to effectively leverage technology for learning. Eugene, OR. Retrieved from [http://www.iste.org/Content/NavigationMenu/NETS/ForStudents/2007Standards/NETS-S-S\\_2007\\_Essential\\_Conditions.pdf](http://www.iste.org/Content/NavigationMenu/NETS/ForStudents/2007Standards/NETS-S-S_2007_Essential_Conditions.pdf)
- ISTE, (2008a). School-wide technology integration. Learning & Leading with Technology, 5. Retrieved from [http://www.iste.org/Content/NavigationMenu/Publications/LL/LLIssues/Volume\\_35\\_2007\\_2008\\_/FebruaryNo5/35505m.pdf](http://www.iste.org/Content/NavigationMenu/Publications/LL/LLIssues/Volume_35_2007_2008_/FebruaryNo5/35505m.pdf)
- ISTE, (2008b). Technology and student achievement: The indelible link. Eugene, OR. Retrieved from <http://www.iste.org/Content/NavigationMenu/Advocacy/Policy/59.08-PolicyBrief-F-web.pdf>
- Jamieson-Proctor, R., Burnett, P. C, Finger, G, & Watson, G. (2006). ICT Integration and Teachers' Confidence in Using ICT for Teaching and Learning in Queensland State Schools. *Australasian Journal of Educational Technology*, Volume 22, Issue 4, 511 – 530.
- Jenkins, J. (1999). Teaching tomorrow: The changing role of teachers in the connected classroom. In *Proceedings from the EDEN 1999 Open Classroom Conference*. Balatonfured, Hungary. Retrieved from <http://www.eden-online.org/papers/jenkins.pdf#search=%22%22EDEN%201999%20Open%20Classroom%20Conference%22%22>
- Jepson, N. (2002). *Dental education on the net*. Retrieved from <http://www.derweb.ac.uk/bscd/vol41.html>
- Jodie, B. U. (2000). Structural equation modeling. In B. G. Tabachnick & L. S. Fidell (Eds.), *Using multivariate statistics* (4th ed.). Needham Heights, MA: Allyn and Bacon.
- Johnson, H. H., & Fredian, A. J. (1986). Simple rules for complex change. *Training and Development Journal*, 40(8), 47-50.
- Johnson, J. (2003). Children, robotics and education. In *Proceedings of 7th international symposium on artificial life and robotics*, Vol. 7, 16–21, Oita, Japan.

- Johnston, M., Langton, K., Haynes, R., & Mathieu, A. (1994). Effects of computer-based clinical decision support systems on clinical performance and patient outcomes. *Annals Academy of Medicine*, 120, 135-142.
- Jones, A. (2004). *A review of the research literature on barriers to the uptake of ICT by teachers*. Retrieved from [http://research.becta.org.uk/upload-dir/downloads/page\\_documents/research/barriers.pdf](http://research.becta.org.uk/upload-dir/downloads/page_documents/research/barriers.pdf)
- Jones, C. (2001). Tech support: Preparing teachers to use technology. *Principal Leadership*, 1(9), 35-39.
- Kaplan, D. (2000). *Structural equation modeling: Foundations and extensions*. Thousand Oaks, CA: Sage Publications.
- Katz, J., Rice, R., & Aspden, P. (2001). The Internet 1995-2000: Access, civic involvement and social interaction. *American Behavioural Scientists*, 45(3), 405-419.
- Kearsley, G. (1998). *A guide to on-line education*. Retrieved from <http://www.gwis.circ.gwu.edu/~etl/online.html>
- Kenelev, V., Kommers, P., & Kotsik, B. (2004). *Information and communication technologies in secondary education*. Retrieved from [http://www.iite.ru/img/upload/Position\\_paper.pdf](http://www.iite.ru/img/upload/Position_paper.pdf)
- Kerr, S. (1991). Lever and fulcrum: Educational technology in teachers' thought and practice. *Teachers College Record*, 93(1), 114-136.
- Kerrey, B., & Iskason, J. (2000). *The power of the internet for learning. Final report of the web-based education commission*. Retrieved from <http://www.ed.gov/offices/AC/WBEC/FinalReport/index.html>
- Killian, C. (1994). Why teachers fear the internet: Many teachers must learn to see the internet as an ally rather than a threat. *Internet World*, November/December, 86-87.
- Kim, S. (2003). Research paradigms in organisational learning and performance: Competing modes of inquiry. *Information Technology, Learning, and Performance Journal*, 21(1), 9-18. Retrieved from <http://www.osra.org/itlpj/kimspring2003.pdf>
- Kim, Y. (2000). *Teachers' attitudes towards computers: A primary factor affecting computer uptake in the classroom*. London: Kings College London.
- King, B. (2000). Managing the changing nature of distance and open education at institutional level. *Open learning*, 16(1), 47-60.
- Kinsler, K., & Gamble, M. (2002). *Reforming schools*. New York: Continuum.
- Kling, R., & Iacona, S. (1984). Computing as an occasion for social control. *Journal of Social Issues*, 40(3), 77-96.
- Koehler, M. & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9 (1), 60–70. Department of Education & Training (DET), New South Wales. (2008). ICT vision. Author: Sydney. Retrieved from

- [https://www.det.nsw.edu.au/media/downloads/strat\\_direction/strat\\_plans/detictstratplan.pdf](https://www.det.nsw.edu.au/media/downloads/strat_direction/strat_plans/detictstratplan.pdf)
- Koenig, S. (1997). Relearning education in the age of technology [Electronic Version]. *Electronic Journal of the U.S. Information Agency*, 2(4). Retrieved from <http://usinfo.org/facts/edu/eductoc.htm>
- Kook, J. (1997). Computers and communication networks in educational settings in the twenty-first century: Preparation for educator's new roles. *Educational Technology*, 37(2), 56-60.
- Kozma, R. (Ed.). (2003). *Technology, innovation, and educational change. A global perspective*. Amsterdam: International Association for the Evaluation of Educational Achievement.
- Krathwohl, D. (1993). *Methods of educational and social science research: An integrated approach*. New York: Longman Publishing Group.
- Kuh, G., & Vesper, N. (2001). Do computers enhance or detract from students' learning? *Research in Higher Education*, 42(1), 87-102.
- Kumar, R. (2002). Managing risks in IT projects: An options perspective. *Information & Management*, 40(1), 63-74.
- Kushner, K., & Morrow, R. (2003). Grounded theory, feminist theory, critical theory: Toward theoretical triangulation. *Advances in Nursing Science*, 26(1), 30-43.
- Kwon, N. (2002). *Modelling the factors affecting individuals' use of community networks: A survey exploration of community information and technology use behaviour*. (Unpublished doctoral dissertation). University of Wisconsin, Madison.
- Lai, K. W., Pratt, K., & Trewen, A. (2001). *Learning with technology: Evaluation of the secondary schools technology project*. Dunedin: Community Trust of Otago.
- Lamb, R., & Kling, R. (2003). Reconceptualizing users as social actors in information systems research. *MIS Quarterly*, 27(2), 197-235.
- Lambert, P. (2001). *Report on the P.R.I.S.M. project to inform national collaboration*. Retrieved from [http://www.thelearningfederation.com.au/verve/\\_resources/prism\\_rep.pdf](http://www.thelearningfederation.com.au/verve/_resources/prism_rep.pdf)
- LaMont-Johnson, D. (2007). *Computers in schools*, 24 (3/4), 1-60.
- Lan, J. (1997). *Meeting technology challenges in teacher education: Responses from schools and colleges of education*. Retrieved from <http://www.eric.ed.gov/PDFS/ED403255.pdf>
- Larkin, K. (2012). You use! I use! Questioning the orthodoxy of one-to-one computing in primary schools. *Journal of Research on Technology in Education*, Volume 44, Issue 2, 101-120.
- Latour, B., & Woolgar, S. (1979). *Laboratory life: The social construction of scientific facts*. London: Sage.
- Lave, J., & Wenger, E. (1991). *Situated learning. Legitimate peripheral participation*. New York: Cambridge University Press.

- Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systems Practice*, 5(4), 379-393.
- Learning Federation. (2009). *Online teaching and learning resources*. Retrieved from <http://www.thelearningfederation.edu.au/default.asp>
- Lee, M. (2001). The adoption and diffusion of electronic commerce. Editorial. *Journal of Global Information management*, July. Retrieved from <http://www.highbeam.com/doc/1G1-75608563.html>
- Lehaney B., Clarke S., Coakes E., & Jack G. (2004). *Beyond knowledge management*. Hershey, PA: Idea Group Publishing.
- Leonard, L., & Leonard, P. (2003). The continuing trouble with collaboration: Teachers talk. *Current Issues in Education*, 6(15). Retrieved from <http://cie.ed.asu.edu/volume6/number15/>
- Levin, B., & Riffel, A. (1996). School system responses to external change. In C. Bagley, R. Glatter, & P. Woods (Eds.), *Choice and diversity in schooling: Perspectives and prospects* (pp. 44-48). London: Routledge.
- Liao, S. H. (2003). Knowledge management technologies and applications: Literature review from 1995 to 2002. *Expert Systems with Applications*, 25(2), 155-164.
- Lieberman, A. (1995). *Practices that support teacher development*. CA: Phi Delta Kappan.
- Lim, C. P., & Barnes, S. (2002). Those who can, teach: The pivotal role of the teacher in the information and communication technologies (ICT) learning environment. *Journal of Educational Media*, 27(1-2), 19-40.
- Lim, C. P., & Hang, D. (2003). An activity approach to research of ICT integration in Singapore schools. *Computers & Education*, 41, 49-63.
- Lin, C., & Pervan, G. (2003). The practice of IS/IT benefits management in large Australian organisations. *Information & Management*, 41(1), 13-24.
- Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. London: Sage.
- Littig, B., & Griessler, E. (2005). Social sustainability. A catchword between political pragmatism and social theory. *International Journal for Sustainable Development*, 8(1/2), 65-79.
- Llomaki, L., Lakka;a, M., & Lehtinen, E. (2004). A case study of ICT adoption within a teacher community at a Finnish lower secondary school. *Education, Communication and Information*, 4(1), 53-69.
- Lucock, S., & Underwood, G. (2001). *The role of the ICT coordinator*. Retrieved from [www.pfp-publishing.com/priamry/ict-cont.html](http://www.pfp-publishing.com/priamry/ict-cont.html)
- Lumpe, A., & Chambers, E. (2001). Assessing teachers' context beliefs about technology use. *Journal of Research on Technology in Education*, 34(1), 93-107.
- Maddin, E. (1997). The real learning begins back in the classroom: On-the-job training and support for teachers using technology. *Educational Technology*, September/October, 56-59.
- Maggs-Rapport, F. (2000). Combining methodological approaches in research: Ethnography and interpretative phenomenology. *Journal of Advanced Nursing*, 31(1), 219-225.

- Mahmood, M. A., Burn, J. M., Gemoets, L., & Jacquez, C. (2000). Variables affecting information technology end-user satisfaction: A meta-analysis of the empirical literature. *International Journal of Human-Computer Studies*, 52, 751-771.
- Malhotra, N., Hall, J., Shaw, M., & Crisp, M. (1996). *Marketing research: An applied orientation*. Sydney: Prentice Hall.
- Malouf, D., & Schiller, E. (1995). Practice and research in special education. *Exceptional Children*, 61(5), 414-424.
- Manson, C. (2000). Schools with a future: A model for IT investment effectiveness. In *Proceedings from the ACEC 2000 Conference*. Melbourne, Australia.
- Marcinkiewicz, H. (1996). Motivation and teachers' computer use. In *Proceedings of the 18<sup>th</sup> National Convention of the Association for Educational Communication and Technology*. Indianapolis, IN.
- Marginson, D., King, M., & Macauley, L. (2000). Executives' use of information technology: Comparison of electronic mail and an accounting system. *Journal of Information Technology*, 15, 149-164.
- Marina, S. (2001). Facing the challenges, getting the right way with distance learning. *At a Distance*, 15(30), 1-8.
- Markus, M., & Benjamin, R. (1997). The magic bullet theory in IT-enabled transformation. *Sloan Management Review*, 38(2), 55-68.
- Marlow, A., McCann, D., & Pullen, D. (2008). The use of online discussion areas to enhance the practicum experience of undergraduate nursing students: The experience of one Australian University. *EdVentures*.
- Marsh, K. (1987). Student's evaluations of university teaching: Research findings, methodological issues, and directions for future research. *International Journal of Educational Research*, 11(3), 253-388.
- Marsh, M. (1999). Time for teachers in your school to 'just do it.' *Technology and Learning*, 19(5), 60.
- Masanauskas, J., & Philip, M. (2007, June). Bob Hawke's biggest regret. *Herald Sun Newspaper*. Retrieved from <http://www.news.com.au/heraldsun/story/0,21985,21913423-661,00.html>
- Massy, W., & Zemsky, R. (1995). *Using information technology to enhance academic productivity*. Retrieved from <http://www.educause.edu/ir/library/html/nli0004.html>
- Mathews, J. (2000). *Educators doubt benefits of computers: Money for technology in class may be better used to trim class size*. Retrieved from <http://www.detnews.com/2000/technology/005/09/a13-50630.htm>
- Matthews, J. (2000). Predicting teacher computer use: A path analysis. *International Journal of Instructional Media*, 27(4), 385-392.
- Maxwell, J. (1998). Designing a qualitative study. In L. Bickman & D. Rog (Eds.), *Handbook of applied social research methods* (pp. 69-100). Thousand Oaks, CA: Sage Publications.

- Maykut, P., & Morehouse, R. (1994). *Beginning qualitative research: A philosophic and practical guide*. London: The Falmer press.
- McAnear, A. (2008). School-wide technology integration. *Learning & Leading with Technology*, 35 (5), 5.
- McClure, P. (2000). Panel on the future of the profession. *Educause Review*, January/February, 105-108. Retrieved from <http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume35/PanelontheFutureoftheProfessio/157609>
- MCEETYA. (2008). *Melbourne declaration on educational goals for young Australians*. Retrieved from [http://www.mceecdya.edu.au/verve/\\_resources/National\\_Declaration\\_on\\_the\\_Educational\\_Goals\\_for\\_Young\\_Australians.pdf](http://www.mceecdya.edu.au/verve/_resources/National_Declaration_on_the_Educational_Goals_for_Young_Australians.pdf)
- McKenzie, J. (1999). *How teachers learn technology best*. Bellingham, WA: FNo Press.
- McKenzie, J., Alexander, S., Harper, C., & Anderson, S. (2005). *Dissemination, adoption and adaptation of project innovations in higher education*. Retrieved from <http://www.carrickinstitute.edu.au/carrick/go/op/edit/pid98>
- McLaughlin, M. (1991). The RAND change agent study: Ten years later. In A. Odden (Ed.), *Education policy implementation* (pp. 143-156). Albany, NY: State University of New York.
- McLoughlin, C & Lee, M. (2008a). The 3 P's of pedagogy for the networked society: Personalization, participation, and productivity. *International Journal of Teaching and Learning in Higher Education*, 20(1).
- McLoughlin, C., & Lee, M. (2008b). Future learning landscapes: Transforming pedagogy through social software. *Innovate: International online Journal*, 4(5). Retrieved from <http://www.innovateonline.info/index.php?view=issue&id=26>.
- McLoughlin, C., & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. *British Journal of Educational Technology*, 29(2), 125-136.
- McRae, D. (1988). *Teachers, schools and change*. Richmond, Victoria: Heinemann Education Australia in association with the Curriculum Development Centre.
- McRae, D. (2001). *What to make, and why: Principles for the design and development of online curriculum content*. Victoria: Curriculum Corporation.
- Means, B. (1997). Interview in Koenig, S. (1997). *Relearning education in the age of technology*. Retrieved from <http://usinfo.org/facts/edu/means.htm>
- Mednet. (2001). *Evolution of internet use for health purposes*. Retrieved from [www.hon.ch/Survey/](http://www.hon.ch/Survey/)
- Meek, V., & Wood, F. (1998). Higher education governance and management: Australia. *Higher Education Policy*, 11(2/3), 165-181.
- Meredy, D., Russell, N., Blackwood, L., Thomas, J., & Wise, P. (1999). *Real time computers, change and schooling: National sample study of the information technology skills of*



- Australian school students*. Canberra: Department of Education, Training and Youth Affairs.
- Merriam, S. (1988). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass.
- Middlehurst, R. (1995). Changing leadership in universities. In T. Schuller (Ed.), *The changing university* (pp 75-92). Buckingham: The Society for Research in Higher Education and Open University Press.
- Middlehurst, R. (2003). Competition, collaboration and ICT: Challenges and choices for higher education institutions. In M. Van der Wende & M. van der Ven (Eds.), *The use of ICT in Higher Education: A mirror of Europe* (pp. 253-276). Utrecht: Lemma Publishers.
- Miles, M., & Huberman, A. (1994). *Qualitative data analysis: An expanded sourcebook* (2<sup>nd</sup> ed.). Thousand Oaks, CA: Sage Publications.
- Milis, K., & Mercken, R. (2004). The use of the balance scorecard for the evaluation of information and communication technology projects. *International Journal of Project Management*, 22(2), 87-97.
- Ministerial Council on Education Employment Training and Youth Affairs (MCEETYA). (1999). *National goals for schooling in the 21<sup>st</sup> century*. Retrieved from [www.curriculum.edu.au/mceetya/nationalgoals.htm](http://www.curriculum.edu.au/mceetya/nationalgoals.htm)
- Mintzberg, H. (1994). *The rise and fall of strategic planning*. New York: Prentice Hall.
- Mitnik, R., Nussbaum, M. & Soto, A. (2008). An autonomous educational mobile robot mediator. *Autonomous Robots*, 25 (4), 367–382.
- Moersch, C. (1995). Levels of technology implementations: A framework for measuring technology use. *Learning & Leading with Technology*, 23(3), 40-41.
- Morris, E. (2002, January 9). Classrooms of the future. London: BBC News. Retrieved from [http://news.bbc.co.uk/2/hi/uk\\_news/education/1749817.stm](http://news.bbc.co.uk/2/hi/uk_news/education/1749817.stm)
- Morse, R. (1991). *Computer uses in secondary science education*. Retrieved from <http://www.ericdigests.org/pre-9219/computer.htm>
- Moursund, D. (2007). *A faculty member's guide to computers in higher education*. Retrieved from <http://www.uoregon.edu/~moursund/Books/Faculty/Faculty.pdf>
- Mouza, C. (2008). Learning with laptops: Implementation and outcomes in an urban, underprivileged schools. *Journal of Research on Technology in Education*, 40(4), 447-473.
- Mulaik, S., & James, L. (1995). Objectivity and reasoning in science and structural equation modelling. In R. Hoyle (Ed.), *Structural equation modelling: Concepts, issues and applications* (pp. 158-176). Thousand Oaks, CA: Sage Publications.
- Mulkeen, A. (2003). What can policy makers do to encourage integration of information and communications technology? Evidence from the Irish school system. *Technology, Pedagogy and Education*, 12(2), 277-293.

- Murray, D., & Campbell, N. (2000). Barriers to implementing ICT in some New Zealand schools. *Computers in New Zealand Schools*, 12(1), 3-6.
- Nelson, B. (2003). *Australia makes excellent progress as a knowledge-based economy and society*. Retrieved from [www.dest.gov.au/ministers/nelson/sept03/n457\\_090903.htm](http://www.dest.gov.au/ministers/nelson/sept03/n457_090903.htm)
- Neuman, W. (1997). *Social research methods*. Boston: Allyn and Bacon.
- New Zealand Ministry of Education. (2001). *Information and communication technologies (ICT) strategy for schools 2002-2004 draft*. Retrieved from [http://www.oit.org/public/english/employment/skills/hrdr/init/nzl\\_2.htm](http://www.oit.org/public/english/employment/skills/hrdr/init/nzl_2.htm)
- New Zealand Ministry of Education. (2002). *Digital horizons. Learning through ICT. A strategy for schools 2002-2004*. Wellington: Author.
- New Zealand Ministry of Education. (2003). *Planning for better student outcomes*. Retrieved from [http://www.tki.org.nz/r/student\\_outcomes/](http://www.tki.org.nz/r/student_outcomes/)
- New Zealand's E-Learning Advisory Group. (2002). *Highways and pathways: Exploring New Zealand's e-learning opportunities*. Wellington: New Zealand Ministry of Education.
- Newhouse, P., Trinidad, S., & Clarkson, B. (20002). *Quality pedagogy and effective learning with information and communications technology (ICT)*. Perth: Western Australian Department of Education.
- Newmann, F., & Wehlage, G. (1995). *Successful school restructuring: A report to the public and educators by the Center on Organisation and Restructuring of Schools*. Madison: Wisconsin Center for Educational Research.
- Nielsen, A. (1998a). *Attitudes towards information technology in Australian general practice*. Sydney: Department of Health and Family Services.
- Nielsen, A. (1998b). *A study into levels of, and attitudes towards information technology in general practice*. Canberra: AC Nielson.
- Northrup, P. (1997). *Instructional technology benchmarks for teacher preparation programs and K-12 school districts*. Retrieved from <http://www.eric.ed.gov/PDFS/ED409858.pdf>
- Norton, J. (2008). The big jump to Pedagogy 2.0. Teacher Leadership: Today. Retrieved from [http://teacherleaders.typepad.com/teacher\\_leadership\\_today/2008/06/the-big-jump-to.html](http://teacherleaders.typepad.com/teacher_leadership_today/2008/06/the-big-jump-to.html)
- Novell Corporation. (1994). *Computers in education - the networked generation, white paper*. Sydney: Novell Australasia.
- Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.
- O'Donnell, E. (1996). *Integrating computers into the classroom: The missing key*. Lanham, MD: Scarecrow Press.
- O'Rourke, M. (2003). *Technology and educational change: Making the links*. (Doctoral dissertation). University of Technology, Victoria. Retrieved from <http://wallaby.vu.edu.au/adt-VVUT/public/adt-VVUT20030804.093845/>

- O'Rourke, M. (2003). *Technology and educational change: making the links*, Victoria University, Melbourne. Available at: <http://eprints.vu.edu.au/237/>
- OECD. (1997). *Information technology outlook 1997*. Retrieved from [http://www.oecd.org/LongAbstract/0,3425,en\\_2649\\_33757\\_1893078\\_1\\_1\\_1\\_37441,00.html](http://www.oecd.org/LongAbstract/0,3425,en_2649_33757_1893078_1_1_1_37441,00.html)
- OECD. (2001). *Schooling for tomorrow-learning to change: ICT in schools*. Paris: Author.
- OECD. (2005). *National case studies on ICT in schools*. Retrieved from [http://www.oecd.org/document/55/0,3343,en\\_2649\\_39263301\\_33932151\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/55/0,3343,en_2649_39263301_33932151_1_1_1_1,00.html)
- Office of Technology Assessment (OTA). (1995). *Teachers and technology: Making the connection*. Washington, DC: Office of Technology Assessment.
- Office of the National Education Commission. (2004). *Education in Thailand 2004/2005*. Bangkok: Author.
- O'Hara, M. (2004). *ICT in the early years*. London: Continuum.
- Olson, J. (1988). *Schoolworlds-microworlds*. Oxford, UK: Pergamon Press.
- Oppenheimer, T. (1997). The computer delusion. *The Atlantic Monthly*, 280(1), 45-62.
- Orlikowski, W., & Barley, S. (2001). Technology and institutions: What can research on information technology and research on organisations learn from each other? *MIS Quarterly*, 25(2), 145-165.
- Orlikowski, W., & Iacono, C. (2001). Research commentary: Desperately seeking the 'IT' in IT research - A call to theorizing the IT artifact. *Information Systems Research*, 12(2), 121-143.
- O'Rourke, M., & Harrison, C. (2004). The introduction of new technologies: New possibilities for early childhood pedagogy. *Australian Journal of Early Childhood*, 29(2), 11-18. Retrieved from [http://www.ansn.org.au/uploads/ORourke\\_Harrison.pdf](http://www.ansn.org.au/uploads/ORourke_Harrison.pdf)
- Palfrey, J., & Gasser, U. (2008). *Born digital: Understanding the first generation of digital natives*. NY: Basic Books.
- Pallant, J. (2001), *SPSS survival manual*. Sydney: Allen and Unwin.
- Papert, S. (1993). *Mindstorms: Children, computers, and powerful ideas* (2nd ed.) Basic Books, New York, NY.
- Papert, S., & Caperton, G. (1999). *Vision for education*. Retrieved from [http://www.mamamedia.com/areas/grownups/new/about\\_mmm/vision/education/](http://www.mamamedia.com/areas/grownups/new/about_mmm/vision/education/)
- Pasupathy, S. (1992). Future trends in telecommunication education. *IEICE Trans. Communication*, 75(1), 9-13.
- Patton, M. (1990). *Qualitative evaluation and research methods* (2<sup>nd</sup> ed.). Newbury Park, CA: Sage Publications.
- Patton, M. (2002). *Qualitative research and evaluation methods* (3<sup>rd</sup> ed.). Thousand Oaks, CA: Sage Publications.
- Pearlson K. E., & Saunders C. S. (2006). *Managing & using information systems: A strategic approach* (3<sup>rd</sup> ed.). Danvers, MA: John Wiley & Sons.

- Peck, C., Cuban, L., & Kirkpatrick, H. (2002). Techno-promoter dreams, student realities. *Phi Delta Kappan*, February, 472-480.
- Pelgrum, W. (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers and Education*, 37(2), 163-178.
- Peppard, J., & Ward, J. (2004). Beyond strategic information systems: Towards an IS capability. *Journal of Strategic Information Systems*, 13(2), 167-194.
- Peraklya, A. (1997). Reliability and validity in research based on tapes and transcripts. In D. Silverman (Ed.), *Qualitative Research: Theory, Method and Practice* (pp. 201-220). London: Sage Publications.
- Perkins, D. (1991). Technology meets constructivism: Do they make a marriage? *Educational Technology*, 31(5), 18-23.
- Perry, R. (2006) Diffusion theories. Encyclopedia of Sociology. Eds. Edgar F. Borgatta and Rhonda J.V. Montgomery. Vol. 1. 2nd ed. New York: Macmillan Reference USA, 2001: 674-681.
- Petre, M. & Price, B. (2004). Using robotics to motivate 'back door' learning Education and Information Technologies, 9 (2), 147–158.
- Phipps, R., & Merisotis, J. (1999). *What's the difference? A review of contemporary research on the effectiveness of distance learning in higher education*. Washington, DC: The Institute for Higher Education Policy.
- Plomp, T., Pelgrum, W., & Steerneman, A. (1990). Influence of computer use on schools' curriculum: Limited integration. *Computers in Education*, 14, 159-171.
- Polit, D., & Hungler, B. (1995). *Nursing research: Principles and methods* (5<sup>th</sup> ed.). Philadelphia: J. B. Lippincott.
- Prasad, P. (1997). Systems of meaning: Ethnography as a methodology for the study of information technologies. In J. Lee, J. Liebenau & J. DeGoss (Eds), *Information systems and qualitative research* (pp.101-118). London: Chapman and Hall.
- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5). Retrieved from <http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf>
- Preston, C., Cox, M., & Cox, K. (2000). *Teachers as innovators: An evaluation of the motivation of teachers to use information and communications technologies*. South Crodon, UK: Mirandanet.
- Prestridge, S. (2007). Engaging with the transforming possibilities of ICT. Australian Educational Computing, 22 (2), 3–9.
- Pullen, D., & Cusack, B. (2007). Schooling without borders. In J. Sigafos & V. Green (Eds.), *Technology & Teaching* (pp. 101-114). New York, NY: Nova Science Publishers.
- Pullen, D., & Cusack, B. (2008). Content management systems: The potential for open education.

*EdVentures.*

- Pullen, D., & Fluck, A. (2008). Open education versus MacEducation: The potential of open-source software. *EdVentures.*
- Pullen, D., & Turner, J. (2008). The importance of teacher relationship building for effective use of ICTs in a post-primary school. *EdVentures.*
- Pullen, D., & Vaughn, V. (2008). Teachers needing to understand technical support to teach effectively. *EdVentures.*
- Pullen, D., Baguley, M., & Gitaski, C. (Eds.). (2009). *Technoliteracy, discourse and social practice: Frameworks and applications in the digital age.* Hershey, PA: Information Science Reference.
- Pullen, D., Baguley, M., & Marsden, A. (2009). Back to basics: Electronic collaboration in the education sector. In J. Salmons & L. Wilson (Eds.), *The handbook of research on electronic collaboration and organisational synergy* (pp. 205-222). Hershey, PA: Idea Group Reference, Inc.
- Pullen, D., Reid, P., & Lavery, P. (2008). Using ICT to just get on with the job of teaching. *EdVentures.*
- Reil, M. (2000). The future of technology and education: Where are we heading? In D. Watson & T. Downes (Eds.), *Communication and networking in education* (pp. 9- 24). Boston, MA: Klumer Academic Press.
- Reinen, I., & Plomp, T. (1997). Information technology and gender equality - a contradiction in terminus? *Computers Education*, 28(2), 65-78.
- Reiser, R., & Dick, W. (1990). Evaluating instructional software. *Educational Technology Research and Development*, 38(3), 43-50.
- Rice, P., & Ezzy, D. (1999). *Qualitative research methods: A health focus.* Melbourne: Oxford University Press.
- Richards, B., Bolton, P., Veale, B., & Quinlan, F. (2002). *Information technology in general practice (monograph).* Canberra: Commonwealth Department of Health and Aged Care.
- Richardson, V., & Anders, P. (1994). The study of teacher change. In V. Richardson (Ed.), *A theory of teacher change and the practice of staff development: A case in reading instruction* (pp. 159–180). New York: Teachers College Press.
- Riedl, R., Smith, T., Ware, A., Wark, A., & Yount, P. (1998). Leadership for a technology-rich educational environment. In *Proceedings of the Society for Information Technology & Teacher Education International Conference.* Washington, DC.
- [http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?\\_nfpb=true&\\_ERICExtSearch\\_SearchValue\\_0=ED421128&ERICExtSearch\\_SearchType\\_0=no&accno=ED421128](http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_ERICExtSearch_SearchValue_0=ED421128&ERICExtSearch_SearchType_0=no&accno=ED421128)
- Riffel, J., & Levin, B. (1997). Schools coping with the impact of information technology. *Educational Management Administration & Leadership*, 25(1), 51-64.

- Ringle, M., & Updegrave, D. (1998). Is strategic planning for technology an oxymoron? *Cause/Effect*, 2, 18-23.
- Robertson, I., Calder, J., Fung, P., Jones, A., & O'Shea, T. (1997). Computer attitudes in an English secondary school. *Computers and Education*, 24, 73-81.
- Robertson, J. (1995). *Principals' partnerships: An action research study on the professional development of New Zealand school leaders*. (Doctoral dissertation). The University of Waikato, Hamilton.
- Robertson, M., & Williams, M. (2004). *Young people, leisure and place: Cross cultural perspectives*. New York: Nova Science Publishers.
- Robertson, M., Grady, N., Fluck, A., & Webb, I. (2006). Conversations toward effective implementation of information communication technologies in Australian schools. *Journal of Educational Administration*, 44(1), 71-85.
- Rockman, S. (2003). Learning from laptops. *Threshold*, 1(1), 24-28. Retrieved from [www.rockman.com/pubhcations/articles/LearningFromLaptops.pdf](http://www.rockman.com/pubhcations/articles/LearningFromLaptops.pdf)
- Rogers, E. (2003) *Diffusion of innovations*, (5th ed.). New York: Free Press.
- Rosenholtz, S. J. (1991). *Teacher's workplace: The social organisation of schools*. New York: Teachers College Press.
- Ross, J., & Weill, P. (2002). Six IT decisions your IT people shouldn't make. *Harvard Business Review*, November, 85-91.
- Rusk, N., Resnick, M., Berg, R. & Pezalla-Granlund, M. (2008). New pathways into robotics: strategies for broadening participation. *Journal of Science Education and Technology*, 17 (1), 59-69.
- Russell, G. (1999). Implications of the 1999 DEYYA report for professional development in learning technology. In *Proceedings of the ACEC 2000 Conference*. Melbourne, Australia.
- Russell, G., & Bradley, G. (1997). Teacher's computer anxiety: Implications for professional development. *Education and Information Technologies*, 2, 17-30.
- Russell, G., & Russell, N. (1997). Dissonance in educational cyberspace. In *Proceedings of the ACEA Virtual Conference, Beyond The Boundaries*. Canberra, Australia: ACEA.
- Russell, T. (1999). *The no significant difference phenomenon*. Chapel Hill, NC: Office of Instructional Telecommunications.
- Salaman, G., & Storey, J. (2002). Managers' theories about the process of innovation. *Journal of Management Studies*, 39(2), 147-165.
- Sallimah, M. S. (2007). *The influence of external factors on secondary teachers' intention to use and actual use of information and communication technology in teaching*. (Unpublished doctoral dissertation). Gadong, Brunei.
- Salomon, G. (1991). From theory to practice: The international science classroom: A technology-intensive, exploratory, team-based and interdisciplinary high school project. *Educational*

- Technology*, 31(3), 41-44.
- Sandholtz, J. H., Ringstaff, C., & Dwyer, D. (1997). *Teaching with technology: Creating student-centered classroom*. New York: Teachers College Press.
- Sartore, J. (1997). *Technology counts: IT in schools expenditure*. Retrieved from <http://www.edweek.org/sreports/tc/>
- Saville, M. (2010). Robotics as a vehicle to multiliteracy. In D. Pullen & D. Cole (Eds.), *Multiliteracies and technology enhanced education: Social practice and the global classroom* (pp. 207-228). New York, NY: IGI Global.
- Saye, J. (1997). Technology and educational empowerment. *Educational Technology Research and Development*, 45(2), 5-24.
- Schiff, T., & Solmon, L. (1999). *California digital high school process evaluation. Year one report*. Retrieved from <http://mff.org/publications/publications.taf>
- Schiller, J. (1992). What do principals do when implementing computer education? *The Practicing Administrator*, 14(4), 36-39.
- Schiller, J. (2000). Facilitating the integration of computers in schools: Meeting today's major leadership challenge. In *Proceedings of the 16th Annual Computers in Education Conference Program and Abstracts*. Melbourne, Australia.
- Schofield, A., & Olsen, A. (2000). *A report for DETYA on: An evaluation of the CUTSD initiative*. Retrieved from <http://www.autc.gov.au/pbus.htm#1>
- Schofield, J. (1995). *Computers and classroom culture*. Cambridge, NY: Cambridge University Press.
- School Education Initiatives. (2000). *Education Network Australia (EdNA)*. Retrieved from [http://www.edna.edu.au/search="School Education Information Technology Initiatives"](http://www.edna.edu.au/search=)
- Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research*, 99, 323-337.
- Schrum, L. (1995). Educators and the Internet: A case study of professional development. *Computers and Education*, 24(3), 221-228.
- Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling* (2nd ed.). London: Routledge.
- Schwandt, T. (2001). *Dictionary of qualitative enquiry*. Thousand Oaks, CA: Sage Publications.
- Schwartzmann, H. (1993). *Ethnography in organisations*. London: Sage Publications.
- Scott, P. (1997). The changing role of the university in the production of new knowledge. *Tertiary Education and Management*, 3(1), 5-14.
- Scrimshaw, P. (2004). *Enabling teachers to make successful use of ICT*. Retrieved from [http://partners.becta.org.uk/page\\_documents/research/enablers.pdf](http://partners.becta.org.uk/page_documents/research/enablers.pdf)
- See, J. (1994). Technology and outcome-based education: Connection in concept and practice. *The Computing Teacher*, 17(3), 30-31.

- Selander, M. (2003). The development of new educational practices - The meeting between ICT and NMP in Swedish schools. In *Proceedings of the 7<sup>th</sup> International Research Conference Dilemmas in Human Services*. London. Retrieved from <http://www.handels.gu.se/S.I.T/Publikationer/Dilemma-paper-03.pdf>
- Selwyn, N., Potter, J., & Cranmer, S. (2009). Primary pupils' use of information and communication technologies at school and home. *British Journal of Educational Technology*, 40(5), 919-932.
- Senge, P. (1990). *The fifth discipline: The art and practice of the learning organization*. New York: Doubleday Currency.
- Shakeshaft, C. (1994). Measurement issues with instructional and home learning technologies. In *Proceedings of the Secretary's Conference on Educational Technology*. Washington, DC. Retrieved from [http://eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?\\_nfpb=true&\\_ERICExtSearch\\_SearchValue\\_0=ED452826&ERICExtSearch\\_SearchType\\_0=no&accno=E D452826](http://eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_ERICExtSearch_SearchValue_0=ED452826&ERICExtSearch_SearchType_0=no&accno=E D452826)
- Sharma, S. (1996). *Applied Multivariate Techniques*. New York: John Willey and Son, Inc.
- Sheingold, K., & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice*. New York, NY: Centre for Technology in Education.
- Shelly, G. B., Cashman, T. J., Gunter, R. E., & Gunter, G. A. (2003). *Teacher discovering computers: Integrating technology in the classroom* (3rd ed.). Boston, MA: Course Technology.
- Sherman, S. (2000). *Science and science teaching*. Boston: Houghton Mifflin Company.
- Shipley, B. (2000). *Cause and correlation in Biology: A user's guide to path analysis, structural equations and causal inference*. Cambridge, UK: Cambridge University Press.
- Shriner, M., Schlee, B., Hamil, M. & Libler, R. (2009). Creating teachers' perceptual, behavioral, and attitudinal change using professional development workshops. *Teacher Development*, 13 (2), 125–134.
- Silber, D. (2004). The case for eHealth. In E. Sigel, J. Christense, O. Rienhoff, O. Le Dour & N. Saranummi (Eds.), *E-Health: current situation and examples of implemented and beneficial e-health applications* (pp. 3-27). Amsterdam: IOS Press.
- Silberman, C. (1970). *Crisis in the classroom*. New York: Random House.
- Silverman, D. (1993). *Interpreting qualitative data. Methods for analyzing talk, text and interaction*. Thousand Oaks, CA: Sage Publications.
- Simpson, M., & Payne, F. (2002). *The introduction of ICT into Scottish primary and secondary schools: A cross cultural exploration*. Edinburgh: Edinburgh University.
- Siraj-Blatchford, J., & Whitebread, D. (2003). *Supporting information and communications technology in the early years*. Berkshire: Open University Press.



- Skilbeck, M. (1979). The nature of history and its place in the curriculum. *The Australian History Teacher*, 6, 2-9.
- Slowinski, J. (2000). Becoming a technologically savvy administrator. *ERIC Digest*, 135. Retrieved from <http://eric.uoregon.edu/publications/digests/digest135.html>
- Smerdon, B., Cronen, S., Lanahan, L., Anderson, J., Iannotti, N., & Angeles, J. (2000). *Teachers' tools for the 21st century: A report on teachers' use of technology*. Washington, DC: National Center for Education Statistics.
- Smith, J. (2001). *Troubled IT projects: Prevention and turnaround*. London: Institution of Electrical Engineers.
- Smith, R. (1988). The logic and design of case study research. *The Sport Psychologist*, 2, 1-12.
- Smith, R. (2002). Successfully incorporating Internet content and advanced presentation technology into collegiate courses: Lessons, methodology, and demonstration. *The Journal of Education, Community, and Values*, 2, 10. Retrieved from <http://bcis.pacificu.edu/journal/2002/10/smith.php>
- Somekh, B. (1989). The human interface: Hidden issues in computer mediated communication affecting use in schools. In R. Mason & A. Kaye (Eds.), *Mind weave* (pp. 242-246). Oxford: Pergamon.
- Soy, S. (2003). *The case study as a research method*. Retrieved from <http://www.gslis.utexas.edu/~ssoy/usesusers/l391d1b.htm>
- Spiege, A. (2001). *The computer ate my gradebook: Understanding teachers' attitudes towards technology*. CA: Iona College.
- Stake, R. (1994). Case studies. In E. Guba & Y. Lincoln, (Eds.), *Handbook of qualitative research* (pp. 435-454). London: Sage publications.
- Starkey, L. (2010). Teachers' pedagogical reasoning and action in the digital age. *Teachers and Teaching*, 16 (2), 233-244.
- Statsoft. (2008). *Structural equation modeling*. Retrieved from <http://www.statsoft.com/textbook/stsepath.html>
- Steelman, J. (2005). Multimedia makes its mark. *Learning and leading with technology*, 33(1), 16-19.
- Stephenson, J. (2001). *Teaching and learning online: Pedagogies for new technologies*. London: Kogan Page Limited.
- Stiegelbauer, S. M. (1994). Change has changed: Implications for implementation of assessments from the organisational change literature. In R. J. Anson (Ed.), *Systemic reform: Perspectives on personalizing education* (pp. 25- 46). U.S. Department of Education, Office of Educational Research and Improvement. Washington, DC: U.S. Government Printing Office.
- Stier J. (2010) International education: Trends, ideologies and alternative pedagogical approaches. *Globalisation, Societies and Education* 8(3): 339-349.

- Stratford, R. (2000). Professional development and the barriers to successful ICT integration in classrooms and schools. *Computers in New Zealand Schools*, 7, 12-19.
- Suhr, K. A., Hernandez, D., Grimes, D., & Warschauer, M. (2010). Laptops and fourth-grade literacy: Assisting the jump over the fourth-grade slump. *Journal of Technology, Learning and Assessment*, 9(5), 4-45.
- Surry, D., & Land, S. (2000). Strategies for motivating higher education faculty to use technology. *Innovations in Education and Teaching International*, 37(2), 145-153.
- Swan, K., van t'Hooft, M., Kratcoski, A., & Schenker, J. (2007). Ubiquitous computing and changing pedagogical possibilities: Representations, conceptualizations and uses of knowledge. *Journal of Educational Computing Research*, 36(4), 481-515.
- Tashakkori, A., & Teddie, C. (Eds.). (2003). *Handbook of mixed methods in social and behavioural sciences*. Thousand Oaks, CA: Sage Publications.
- Taylor, I. (1997). *Developing learning in professional education: Partnerships for practice*. Buckingham, UK: Open University Press.
- Taylor, S., & Todd, P. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, 6, 144-176.
- Teachers Registration Board Tasmania. (2007). *Annual Report July 2006 - June 2007*. Retrieved from <http://www.trb.tas.gov.au/TRB%20Report%2006-07%20all.pdf>
- Teo, T. S. H. (2005). Meeting the challenges of knowledge management at the Housing and Development Board. *Decision Support Systems*, 41, 147-159.
- The CEO Forum. (2001). *Key building blocks for pupils achievement in the 21<sup>st</sup> century*. Retrieved from <http://ceoforum.org>
- Tobin, K., & Fraser, B. (1998). Qualitative and quantitative landscapes of classroom learning environments. In B. Fraser & K. Tobin (Eds.), *International handbook of science education* (pp. 623-640). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Tobin, K., Kahle, J., & Fraser, B. (Eds.). (1990). *Windows into science classrooms: Problems associated with higher-level cognitive learning*. London: The Falmer Press.
- Tondeur, J., Cooper, M. & Newhouse, P. (2010). From ICT coordination to ICT integration: a longitudinal case study. *Journal of computer assisted learning*, Volume 26, Issue 4, 296 – 306.
- Tong, K., & Trinidad, S. (2005). Conditions and constraints of sustainable innovative pedagogical practices using technology [Electronic Version]. *International Electronic Journal for Leadership in Learning*, 9(3). Retrieved from <http://www.ucalgary.ca/iejll/vol9/trinidad>
- Toomey, R. (2001). *Schooling issues digest: Information and communication technology for teaching and learning*. Sydney: Department of Education, Training and Youth Affairs.

- Trimble, S., & Peterson, G. (1999). *Beyond the process of teaming: Administrative support, classroom practices, and students' learning*. Montreal, Canada: American Educational Research Association.
- Trinitas Pty Ltd, (2001). Online education: An exploratory study into success factors. *The Journal of Educational Computing Research*, 24(1), 72-92.
- Tsui, E. (2005). The role of IT in KM: where are we now and where are we heading? *Journal of Knowledge Management*, 9(1), 3-6.
- Twigg, C. (2005). *Course redesign improves learning and reduces costs*. Retrieved from [http://www.highereducation.org/reports/pa\\_core/index.shtml](http://www.highereducation.org/reports/pa_core/index.shtml)
- Tytler, R., Smith, R., Grover, P., & Brown, S. (1999). A comparison of professional development models for teachers of primary mathematics and science. *Asia-Pacific Journal of Teacher Education*, 27, 193-214.
- U.S. Department of Education National Centre for Educational Statistics (NCES). (2000). *Teachers' tools for the 21<sup>st</sup> Century: A report on teachers' use of technology*. Retrieved from <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000102>
- Ullman, J. B. (2001). Structural equation modeling. In B. G. Tabachnick & L. S. Fidell (Eds.), *Using multivariate statistics* (4<sup>th</sup> ed.). Needham Heights, MA: Allyn & Bacon.
- UNESCO. (2003). *Developing and using indicators of ICT use in education*. Retrieved from [www.unsecobkk.org/ips/ebooks/documents/ICTindicators.pdf](http://www.unsecobkk.org/ips/ebooks/documents/ICTindicators.pdf)
- UNESCO. (2008). *ICT competency standards for teachers: Policy*. Retrieved from <http://unesdoc.unesco.org/images/0015/001562/156210e.pdf>
- United Kingdom Department for Children, Schools and Families (DCSF) (2004). Information and communications technology in schools in England 2004. Retrieved from <http://www.dcsf.gov.uk/rsgateway/DB/SFR/s000480/index.shtml>
- United States of America, Department of Education. (2000). *E-learning: Putting a world-class education at the fingertips of all children. The national educational technology plan*. Retrieved from [http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?\\_nfpb=true&\\_ERICExtSearch\\_SearchValue\\_0=ED444604&ERICExtSearch\\_SearchType\\_0=eric\\_acno&accno=ED444604](http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_ERICExtSearch_SearchValue_0=ED444604&ERICExtSearch_SearchType_0=eric_acno&accno=ED444604)
- Van Scoter, J., & Boss, S. (2002). Learners, language, and technology: Making connections that support literacy. Retrieved from <http://www.netc.org/earlyconnections/pub/index.html>
- Veen, W., Vogelzang, F., Neut, V., & Spoon, P. (1992). How computers are used in the instructional practice. In T. Plomp, J. Peiters & A. Feteris (Eds.), *Proceedings of the European Conference on Educational research (ECER)*. Enschede: University of Twente.
- Venezky, R. (2001). Procedures for evaluating the impact of complex educational interventions. *Journal of Science Education and Technology*, 10(1), 17-30.

- Venezky, R., & Davis, C. (2001). *Quo Vademus? The transformation of schooling in a networked world*. Retrieved from <http://akgul.bilkent.edu.tr/egitim/vademus-oecd-k12.pdf>
- Victorian Institute of Teachers. (2009). *Annual report 2008-2009*. Retrieved from [http://www.vit.vic.edu.au/SiteCollectionDocuments/PDF/Annual%20Report/1681\\_VIT-Annual-Report-08.pdf](http://www.vit.vic.edu.au/SiteCollectionDocuments/PDF/Annual%20Report/1681_VIT-Annual-Report-08.pdf)
- Wagner, C., & Masden-Copas, P. (2002). An audit of the culture starts with two handy tools. *Journal of Staff Development*, 23(3), 42-53.
- Wallace, G. (1997). Changing structure, changing experiences: How policy effects reverberate through secondary-school students' life chances. *Research Papers in Education*, 12(3), 299-316. Retrieved from [http://www.informaworld.com/smpp/content~db=all~content=a746799534?words=policy\\*|effects\\*|schooling\\*](http://www.informaworld.com/smpp/content~db=all~content=a746799534?words=policy*|effects*|schooling*)
- Wang, Y. (2006). Be excited, stay cool, and take the lead: Embracing the opportunities in information and communications technology. *Educational Technology*, 46(6), 35-39.
- Ward, D., & Hawkins, B. (2003). Presidential leadership for information technology. *Educasuse Review*, May/June, 36-47.
- Warschauer, M. (1999). *Electronic literacies: Language, culture, and power in online education*. Mahwah, NJ: Erlbaum.
- Warschauer, M. (2003). *Technology and social inclusion: Rethinking the digital divide*. Cambridge, MA: MIT Press.
- Watson, D. (2000). Pedagogy before technology: Re-thinking the relationship between ICT and teaching. *Educational and Information Technologies*, 6(4), 251-266.
- Watson, D. (2006). Understanding the relationship between ICT and education means exploring innovation and change. *Education and Information Technologies*, 11 (3-4), 199-216.
- Weimer, G. & Hall, T. (2009). TPCK: A revision of the technology course for teachers. Retrieved from <http://www.ascue.org/files/proceedings/2009/p162.pdf>
- Wenglinsky, H. (1998). *Does it compute? The relationship between educational technology and student achievement in mathematics*. Princeton, NJ: ETS Policy Information Center.
- Wheeler, S. (2000). *The role of the teacher in the use of ICT*. Bohemia: University of Western Bohemia.
- Wiburg, K. (1997). The dance of change: Integrating technology in classrooms. In D. LaMont Johnson, C. D. Maddus & L. Liu (Eds.), *Using technology in the classroom*. (pp. 171-184). New York: The Haworth Press, Inc.
- Wiersma, W. (1995). *Research methods in education*. Boston, MA: Allyn and Bacon.
- Wikipedia. (2007). *Hawthorne Effect*. Retrieved from [http://en.wikipedia.org/wiki/Hawthorne\\_effect](http://en.wikipedia.org/wiki/Hawthorne_effect)
- Williams, D., Coles, L., Wilson, K., Richardson, A., & Tuson, J. (2000). Teachers and ICT: Current

- use and future trends. *British Journal of Educational Technology*, 31(4), 307-320
- Williams, D., Wilson, K., Richardson, A., Tuson, J., & Coles, L. (1998). *Teachers' ICT skills and knowledge needs: Final report to SOEID*. Scotland: Robert Gordon University.
- Williams, G. (1995). The 'marketization' of higher education: Reforms and potential reforms in higher education finance. In D. Dill & B. Sporn (Eds.), *Emerging patterns of social demand and university reform: Through a glass darkly* (pp. 170-193). Oxford: Pergamon Press.
- Williams, M. (1997). *Piecing telecommunications IT together – NOT!* Retrieved from <http://www.cowan.edu.au/pa/ecawa/resource/pd/confer/Keynote.htm>
- Williams, Y. Ma, L. Prejean, G. Lai & Ford, M. (2007). Acquisition of physics content knowledge and scientific inquiry skills in a robotics summer camp. *Journal of Research on Technology in Education*, 40 (2), 201–216.
- Wilmore, D. (2000). Information technology and schools: The principal's role. *Educational Technology and Society*, 3(4). Retrieved from [http://www.ifets.info/journals/3\\_4/discuss\\_october2000.html](http://www.ifets.info/journals/3_4/discuss_october2000.html)
- Wolcott, H. F. (1994). *Transforming qualitative data: Description, analysis, and interpretation*. Thousand Oaks, CA: Sage Publications.
- Woods, J. (1995). *Teaching effectiveness: Using students' perceptions of teaching style and preferred learning style to enhance teaching performance*. (Unpublished doctoral thesis). Curtin University of Technology, Perth, Western Australia.
- Wozney, L., VenKatherinesh, V., & Abrami, P. (2006). Implementing computer technologies: teachers' perceptions and practices. *Journal of Technology and Teacher Education*, 14 (1), 173–207.
- Yelland, N. (2001). *Teaching and learning with information and communication technologies (ICT) for numeracy in the early childhood years of schooling*. Canberra: Department of Education, Training and Youth Affairs.
- Yelland, N., & Swaminathan, S. (2003). Global perspectives on educational technology: Trends and issues. *Childhood Education*, 79(5), 258-260.
- Yin, R. (1981). The case study as a serious research strategy. *Knowledge*, 3, 97-114.
- Yin, R. (1993). *Applications of case study research*. Beverly Hills, CA: Sage Publications.
- Yin, R. (1994). *Case study research: Design and methods*. Beverly Hills, CA: Sage Publications.
- Yocam, K. (1996). Teacher-centered staff development for integrating technology into classrooms. *Technological Horizons In Education*, 24(4), 88-91.
- Yuen, A., & Ma, W. (2002). Gender differences in teacher computer acceptance. *Journal of technology and Teacher Education*, 10(3), 365-382.
- Zandvliet, D. (1999). *The physical and psychosocial environment associated with classrooms using new information technologies - A cross-national study*. (Doctoral dissertation). Curtin University, Perth, Australia.

Zehr, M. (1997). *Teaching the teachers*. Retrieved from

<http://www.edweek.org/rc/articles/2004/10/15/tc-archive.html>

Zucker, A., & Hug, S. (2008). Teaching and learning physics in a 1:1 laptop school. *Journal of Science Education Technology*, 17, 586-594.

## **Appendices**

**Note:** The survey tools presented in the following appendices have a different format than they did when given to participants due to them being printed in a different format than the original survey tools which allowed computer optical scanning.

## **Appendix 1 Principals' Survey**



## Principal Questionnaire and implicit consent

### Survey for principals

This questionnaire is intended for principals' or campus directors'. The questionnaire consists of **68** questions, organised into **10** sections. It takes on an average about 30 minutes to fill in the questionnaire. You may like to reprint this questionnaire and have the best suited people, where appropriate, to fill in the details. However, we ask that you take responsibility for this information. After you have checked that the information is accurate and complete please fill in the survey. When you are finished filling in the questionnaire please send it back to us using the supplied postage paid envelope.

The information sought below is concerned with educational and not administrative uses of learning technology (IT, ICT, e-learning, m-learning and web-based learning) policy, practice and resources in your institution. Therefore please indicate only those learning technology resources available to students and for teaching related purposes, as distinct from those used solely for administrative purposes. Library computers with common access or teacher access should be considered as dedicated to teaching and learning and included in the survey.

### Section 1 - Details about your institution

1: Please fill in the name of your institution (optional):

2: Please fill in the postcode and the country of your institution:

Please choose your country

3: Which of the following best describes your institution's location? (Check one box only):

- |   |  |
|---|--|
| <input type="checkbox"/> Capital city           | <input type="checkbox"/> Small country town                                  |
| <input type="checkbox"/> Other major urban area | <input type="checkbox"/> Small rural community                               |
| <input type="checkbox"/> Provincial city        | <input type="checkbox"/> Isolated community                                  |
| <input type="checkbox"/> Large country town     | <input type="checkbox"/> Provider for distance education/home schooling only |

4: Please describe the categories which best describes your student population and educational model:  
*Eg Primary K-6* *Independent*

Please type in your school's grade levels:

Please choose your educational model

5: How many years has your institution been operating for (check one box only)?

- |                                    |                                |                                |  |
|------------------------------------|--------------------------------|--------------------------------|--|
| <input type="checkbox"/> 5 or less | <input type="checkbox"/> 21-30 | <input type="checkbox"/> 51-60 | <input type="checkbox"/> 81-90         |
| <input type="checkbox"/> 6-10      | <input type="checkbox"/> 31-40 | <input type="checkbox"/> 61-70 | <input type="checkbox"/> 91-100        |
| <input type="checkbox"/> 11-20     | <input type="checkbox"/> 41-50 | <input type="checkbox"/> 71-80 | <input type="checkbox"/> more than 100 |

6: Number of students enrolled in your institution (check one box only):

- |                                     |                                  |                                  |                                    |                                    |   |
|-------------------------------------|----------------------------------|----------------------------------|------------------------------------|------------------------------------|---|
| <input type="checkbox"/> 50 or less | <input type="checkbox"/> 201-300 | <input type="checkbox"/> 501-600 | <input type="checkbox"/> 801-900   | <input type="checkbox"/> 1101-1200 | <input type="checkbox"/> 1401-1500      |
| <input type="checkbox"/> 51-100     | <input type="checkbox"/> 301-400 | <input type="checkbox"/> 601-700 | <input type="checkbox"/> 901-1000  | <input type="checkbox"/> 1201-1300 | <input type="checkbox"/> 1501-1600      |
| <input type="checkbox"/> 101-200    | <input type="checkbox"/> 401-500 | <input type="checkbox"/> 701-800 | <input type="checkbox"/> 1001-1100 | <input type="checkbox"/> 1301-1400 | <input type="checkbox"/> more than 1600 |

7: Number of teaching staff employed (check one box only):

- ☐ 5 or less    ☐ 21-30    ☐ 51-60    ☐ 81-90  
☐ 6-10    ☐ 31-40    ☐ 61-70    ☐ 91-100  
☐ 11-20    ☐ 41-50    ☐ 71-80    ☐ more than 101

## Section 2 - Mission and general ICT aspects

8: Please indicate in your view how important the following aspects are in the mission (statement) of your institution:

	Not at all	Low	Moderate	High
Providing capacity for students to become "lifelong learners"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching international students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Innovation in teaching and learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Internally funded research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Externally funded research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interaction with business and industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interaction with other compulsory education institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interaction with higher education institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9: In your view, to what extent do the following aspects contribute to good education in your institution?

	Not at all	Very little	Some	Very much
Face-to-face contact	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Appropriate use of learning technologies for teaching and learning support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Individualisation for different student characteristics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Students being allowed to choose the time and place of learning (independent learning)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication among students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pedagogy related to group work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contact with the teacher when needed by the students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. In your opinion, what is the current balance in your institution between "face-to-face" and "via the Internet" with respect to administrative procedures for students?	only face- to- face	balanced, both in use	only via the Internet
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11: To what extent do you consider your institution as being successful with regard to the overall use of learning technologies?	Weak <input type="checkbox"/>	Average <input type="checkbox"/>	Strong <input type="checkbox"/>
--	----------------------------------	-------------------------------------	------------------------------------

### Section 3 - Policy and leadership processes

12. Which group of actors has the primary formal responsibility for the learning technology-related policy in your institution (including decisions on budget expenditures) select all that apply?

- ☐ Principal/Head of campus  
☐ District management or Board of Governance  
☐ Head of learning technologies  
☐ Parents' group  
☐ Other, namely:  
☐ We don't have a learning technology policy

13: Is systematic adoption of new learning technologies an ongoing part of you institution's planning?

- ☐ Yes
 ☐ No
 ☐ Uncertain

14: Please indicate whether learning technology purchases is one of the three highest budget priorities for the institution?

- ☐ Yes
 ☐ No
 ☐ Uncertain

15: Please indicate the extent to which you believe the following apply in your institution?

	Definitely disagree	Tend to disagree	Neither agree or disagree	Tend to agree	Definitely agree
Use of learning technologies at one or more levels on a daily basis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Daily planned access for students to learning technologies as a means of instruction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Daily planned access for students to learning technologies as an object of instruction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Student access to learning technologies is viewed as an indispensable component of instruction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of learning technologies at one or more levels on a regular basis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regular planned access for students to learning technologies as a means of instruction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regular planned access for students to learning technologies as an object of instruction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16: Please indicate the extent to which you agree that learning technologies are a strong point of the institution (check one box only)	Definitely disagree	Tend to disagree	Neither agree or disagree	Tend to agree	Definitely agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

17: To what extent is each of the following an objective of the learning technology-related policy in your institution?

	None	Low	Moderate	High	Very high
Increasing efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing the quality of teaching and learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing flexibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing cost-effectiveness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generating institutional income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creating more opportunities for self-directed (lifelong) learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creating more opportunities for international students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Widening access to special need students (i.e. disadvantaged or gifted)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing competitiveness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing the status and reputation of the institution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18: Which of the following groups of actors do you consider of most importance with respect to the ongoing implementation of the learning technology-related policy in your institution?

- ☐ Principal/Head of campus
- ☐ District management or Board of Governance
- ☐ Head of learning technologies
- ☐ Parents' group
- ☐ Teachers
- ☐ Students
- ☐ Other, namely:
- ☐ We don't have a learning technology policy

19: Which of the following policy instruments are used for the implementation of the learning technology-related policy in your institution? (Indicate as many as are relevant)

- ☐ Financial instruments
- ☐ Regulation
- ☐ Information
- ☐ Organisational instruments

20: Which of the following aspects are problems confronting the implementation of the learning technology-related policy in your institution? (Indicate as many as are relevant)

- ☐ Not enough financial resources
- ☐ Inadequate national or state regulations
- ☐ Not enough internal support
- ☐ Lack of skilled staff

21: In your view, how much leadership do the following groups of actors show in the process of developing and implementing the learning technology-related policy in your institution?

	Not at all	Low	Moderate	High
Principal/Head of campus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
District management or Board of Governance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Head of learning technologies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parents' group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teachers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

22: Which one of the following is the most common communication mechanism for discussing learning technology-related policy issues in your institution?

- ☐ Minimally active, ad hoc committee(s)
- ☐ Minimally active, standing committee(s)
- ☐ Regularly active, ad hoc committee(s)
- ☐ Regularly active, standing committee(s)
- ☐ Very active, ad hoc committee(s)
- ☐ Very active standing committee(s)

23: Which of the following groups of actors are involved in the most common communication mechanism? (Indicate as many as are relevant)

- ☐ Principal/Head of campus
- ☐ District management or Board of Governance
- ☐ Head of learning technologies
- ☐ Parents' group
- ☐ Students
- ☐ Other, namely:

#### Section 4 - Funding and support

24: What is your impression of the percentage of your institution's annual budget that is spent on learning technologies?	<1%	1-5%	5-10%	10-15%	>15%
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

25: Please indicate, as a percentage, approximately what proportion of you learning technology resources was funded by the following (total should add up to 100%):	%
Purchased or leased via school recurrent funding/income from fees	
Provided by the education authority	
Provided by parents' organisation through levy or fundraising	
Donated or funded from other community resources (e.g. parish, service clubs)	
Commercial sponsorship	
Leasing arrangements involving commercial sponsorship through discount	
<b>TOTAL</b>	<b>100%</b>

26: Does the institution charge a specific learning technology fee for the hire/purchase of learning technology software or equipment (e.g. laptops)?

☐ Yes ☐ No, but are considering it ☐ No

27: Is the institution currently using learning technologies to make a profit (e.g. as a service provider or selling learning objects)?

☐ Yes, please give brief details

☐ No

☐ No, but would consider the possibility

28: Please indicate if the institution has or is considering the following learning technology support options

	Have	Considering
Full-time network manager, or person responsible for the computer network	<input type="checkbox"/>	<input type="checkbox"/>
Part-time network manager, or person responsible for the computer network	<input type="checkbox"/>	<input type="checkbox"/>
Full-time technician	<input type="checkbox"/>	<input type="checkbox"/>
Part-time technician	<input type="checkbox"/>	<input type="checkbox"/>
Teacher to coordinate learning technologies in the institution	<input type="checkbox"/>	<input type="checkbox"/>
Assistance from external learning technology consultants or services	<input type="checkbox"/>	<input type="checkbox"/>
Help desk, or technical support phone hotline	<input type="checkbox"/>	<input type="checkbox"/>
Technical support by e-mail or WWW	<input type="checkbox"/>	<input type="checkbox"/>
Hardware/software installation services	<input type="checkbox"/>	<input type="checkbox"/>
Learning technology (hardware, software or staff) sharing with the local community (e.g. online access centre or adult computing classes)	<input type="checkbox"/>	<input type="checkbox"/>
Learning technology (hardware, software or staff) sharing with local businesses (e.g. access to business CAD machines, shared Internet Services or business mentors)	<input type="checkbox"/>	<input type="checkbox"/>
Learning technology (hardware, software or staff) sharing with other local schools	<input type="checkbox"/>	<input type="checkbox"/>
Learning technology (hardware, software or staff) sharing with higher education institutions (e.g. TAFE or Universities)	<input type="checkbox"/>	<input type="checkbox"/>

Question 29 Cont.	Have	Considering
Learning technology (hardware, software or staff) sharing with international schools or institutions	<input type="checkbox"/>	<input type="checkbox"/>
Student access to learning materials outside of the institution (remote access)	<input type="checkbox"/>	<input type="checkbox"/>
Staff access to learning materials outside of the institution (remote access)	<input type="checkbox"/>	<input type="checkbox"/>
Parent access to learning materials outside of the institution (remote access)	<input type="checkbox"/>	<input type="checkbox"/>

29: Does the schools' I.T. systems support the following teacher administrative functions?	Grading	Attendance	Reporting	e-mail	Lesson planning
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Section 5 - Student aspects

30: What is the current ratio of computers (for student use) to students in the institution, expressed as one computer to a proportion of total student enrolments (check one box only)?

**One computer to: proportion of students**

☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5   ☐ 6   ☐ 7   ☐ 8   ☐ 9   ☐ 10   ☐ 11   ☐ 12   ☐ 13   ☐ 14  
☐ 15   ☐ 16   ☐ 17   ☐ 18   ☐ 19   ☐ 20   ☐ 21   ☐ 22   ☐ 23   ☐ greater than 24

31: With regard to class subjects or learning areas (programmes) in your institution, which of the following best describes the current amount of choice available to students?

- ☐ Students are free to choose from the available learning areas or programmes  
☐ Students are not free to choose from the available learning areas or programmes  
☐ Students have some choice to choose from the available learning areas or programmes

32: In your opinion, to what extent is your institution's current learning technology-related policy affected by student demands in the following areas?

	Not at all	Little	Some	Much	Very much
Demand for more/wider access to online resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in learning material or content choices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for remote access to resources and materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in locations of learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in times of learning events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in pace of learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

33: In your view, to what extent is each of the following a typical learning setting in your institution?

	None	Little	Some	Much	Very much
On-campus settings for course activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many variations in where and how students participate in courses, but campus-based settings remain the basis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many students are attending at a distance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Question 33 Cont.	None	Little	Some	Much	Very much
Students use the home institution as a "base" but pick and choose course material from those we offer electronically	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

34: In your opinion, the level of support for students with respect to the use of learning technologies for learning in your institution is:	Very low	Low	Average	High	Very high
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### Section 6 - Staff aspects

35: Do teaching staff receive professional development support (through time release and/or finance) to **acquire basic skills** in relation to using and implementing learning technologies into their curriculum?

☐ Yes

☐ No

36: Do teaching staff receive professional development support (through time release and/or finance) to **acquire advanced skills** in relation to using and implementing learning technologies into their curriculum?

☐ Yes

☐ No

37: Are additional status and incentives available in your institution or system to teachers who possess learning technology skills in relation to any of the following?

☐ Recruitment

☐ Transfer

☐ Promotion

☐ I am unaware of any incentives

38: Please indicate the extent to which you believe the teachers in your institution are well-trained and knowledgeable in the use of learning technologies?	Definitely disagree	Tend to disagree	Neither agree not disagree	Tend to agree	Definitely agree
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

39: List the top five learning technology professional development needs you envisage your institution requires over the next 12 months.



40: In your view which of the following best describes the experience of teachers in your institution with respect to the use of learning technologies in their teaching?

- ☐ In general, a very low level of experience  
☐ In general, a minimal level but with occasional pioneers  
☐ In general, teachers make occasional experiments  
☐ In general, teachers are regular users of standard applications  
☐ In general, teachers are regular users of standard applications and also pioneers with new applications

41: How would you describe the climate for change among teachers in your institution when it comes to the use of learning technologies in teaching?	Very negative	Negative	Neutral	Positive	Very positive
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

42: In your opinion, the level of support for teachers with respect to the use of learning technologies for teaching purposes in your institution is?	Very low	Low	Average	High	Very high
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

43: To what extent do learning technologies (LT's) play a role in the following aspects of your institution's personnel policy?

	Not at all	Little	Some	Much	Very much
LT's use in education counts towards promotion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LT's use in education is an integral part of regular staff assessments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LT's use in education is part of regular external quality assurance exercises	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LT's competencies are systematic criteria for selection and recruitment of new staff	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professionalisation of staff in LT's competencies is mandatory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial incentives to individual staff are provided for development of LT's use in education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LT's use in education is mandatory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

44: To what extent do the following learning technologies influence general teaching practice in your institution?

	Not at all	Little	Some	Much	Very much
E-mail systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Web resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wireless solutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Web-based course management systems (e.g. WebCT, Moodle)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planning tools, such as network-accessible agendas or lesson planners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Externally available courses or modules, accessible via the Web	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(Video) conferencing tools	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal Digital Assistants (PDA's)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mobile technologies (e.g. mobile phones and smart phones)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of interactive whiteboards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of laptops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

45: Where are the majority of the institutions computers located?

☐ Labs      ☐ classrooms      ☐ multimedia centres      ☐ Library      ☐ other

46: Please indicate in your view the extent to which the following aspects involve the use of learning technologies in your institution?

	None	Low	Moderate	High
Teaching post-school aged students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Providing opportunities for self-directed (or "lifelong") learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching international students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Innovation in teaching and learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Internally funded research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Externally funded research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interaction with business and industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interaction with other schools or education providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching current students remotely or off-campus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

47: The general level of learning technology infrastructure in my	Very low	Low	Average	High	Very high
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institution is:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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48: In your opinion, to what extent is learning technology being used in your institution?

	Rarely	Some	Extensively
For course preparation or organisational purposes?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In classroom activities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Via a Web environment used outside of classroom activities?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
For communication with and among students and teachers?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
To support group activities and project work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

49: In your opinion, to what extent are the following teaching practices common in your institution?

	Very uncommon	Somewhat	Very common
Teacher demonstrations or lectures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Practice activities (labs, field work, practical exercises)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Studying via (non-Web) computer software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Studying via Web-based environments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participation in project work, group work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Section 8 - External environment

50: In your opinion, how much does competition from each of the following sources currently influence the learning technology-related policy in your institution?

	Not at all	Little	Some	Much	Very much
Higher education institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National education authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
State/local educational authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commercial hardware or software providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

51: In your opinion, how much is the internal learning technology-related policy of your institution influenced by (policies of) the following external actors?

	Not at all	Little	Some	Much	Very much
Higher education institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National education authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
State/local educational authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commercial hardware or software providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
International body (e.g. OECD)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National / federal government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National department of education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sub-national (regional or state-level) government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teacher unions or teacher groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work/industry groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

52: In your opinion, to what extent does your institution cooperate with the following external partners with respect to learning technology-related activities?

	Not at all	Little	Some	Much	Very much
Higher education institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National education authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
State/local educational authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commercial hardware or software providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
International body (e.g. OECD)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National / federal government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National department of education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sub-national (regional or state-level) government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teacher unions or teacher groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work/industry groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Section 9 - Perceived impact of technology use

53: How important in your view is the use of learning technologies for the strategic position of your institution?	Very unimportant	Unimportant	Neutral	Important	Very important
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

54: In your view, to what extent is the use of learning technology important for the quality of education programmes and services in your institution?	Very unimportant	Unimportant	Neutral	Important	Very important
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

55: In your view, the impact of learning technologies on the efficiency of teaching activities in your institution is...?	Very negative	Negative	Neutral	Positive	Very positive
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

56: In your view, the level of satisfaction among personnel in your institution with respect to their working conditions related to the use of learning technologies is...?	Very low	Low	Neutral	High	Very high
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

57: In your view, the impact of learning technology on learning effectiveness in your institution is...?	Very negative	Negative	Neutral	Positive	Very positive
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

58: In your view, the impact of learning technologies on general working practices in your institution over the last two years has been...?	Very negative	Negative	Neutral	Positive	Very positive
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### Section 10 - Predictions for the year 2010

59: In your view, to what extent will the following aspects involve the use of learning technologies in your institution in the year 2010?

	None	Low	Moderate	High
Teaching post-school aged students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Providing self-directed (or "lifelong) learning opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching international students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Innovation in teaching and learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Internally funded research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Externally funded research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interaction with business and industry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interaction with other schools or education providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teaching current students remotely or off-campus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

60: With regard to subjects or key learning areas (programmes) in your institution, which of the following do you predict will best describe the amount of choice available to students in the year 2010?

- ☐ Students are free to choose from the available learning areas or programmes
- ☐ Students are not free to choose from the available learning areas or programmes
- ☐ Students have some choice to choose from the available learning areas or programmes

61: What do you predict will be the balance in your institution between "face-to-face" and "via the Internet" with respect to administrative procedures for students in the year 2010?	only face-to-face	balanced, both in use	only via the Internet
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

62: In your view, to what extent will your institution's learning technology-related policy be affected by the following types of student demands in the year 2010?

	Very little	Little	Some	Much	Very much
Demand for more/wider access to online resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in learning material or content choices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for remote access to resources and materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in locations of learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in times of learning events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demand for more flexibility in pace of learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

63: In your view, to what extent will each of the following be a typical learning setting in your institution in the year 2010?

	Very unlikely	Unlikely	Some	Likely	Very likely
On-campus settings for course activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many variations in where and how students participate in courses, but campus-based settings remain the basis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Many students are attending at a distance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Students use the home institution as a "base" but pick and choose course material from those we offer electronically	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

64: In your opinion, which of the following policy instruments will be used for the implementation of learning technology-related policy in your institution in the year 2010? (Indicate as many as are relevant)

- ☐ Financial instruments
- ☐ Regulation

- ☐ Information
- ☐ Organisational instruments

65: Which of the following aspects do you predict will be problems confronting the implementation of learning technology-related policy in your institution in the year 2010? (Indicate as many as are relevant)

- ☐ Not enough financial resources
- ☐ Inadequate national regulations
- ☐ Not enough internal support
- ☐ Lack of skilled staff

66: In your opinion, to what extent will each of the following actors influence learning technology-related policy in your institution in the year 2010?

	Not at all	Little	Some	Much	Very much
Higher education institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National education authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
State/local educational authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Commercial hardware or software providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
International body (e.g. OECD)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National / federal government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
National department of education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sub-national (regional or state-level) government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teacher unions or teacher groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work/industry groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

67: In your opinion to what extent will each of the following be a major objective in learning technology-related policy in your institution in the year 2010?

	None	Low	Moderate	High	Very high
Increasing efficiency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing the quality of teaching and learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing flexibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing cost-effectiveness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generating institutional income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creating more opportunities for self-directed (lifelong) learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creating more opportunities for international students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Widening access to special need students (disadvantaged or learning)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing competitiveness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enhancing the status and reputation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

of the institution					
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68: Please write down a few sentences about how you think technology will be used in classrooms in the year 2010.

When you are finished filling in the questionnaire please send it back to us using the supplied postage paid envelope.

***Thank you for your cooperation***



## **Appendix 2 Teachers' Survey**

## TEACHERS' SURVEY

### Instructions

For every question put an 'X' in the box ☐ that matches your answer. Only cross one box if it tells you to. For those questions that ask for a written response – please indicate your opinion – not what you think your teacher or we want you to write – we greatly value your opinion.

For the purposes of this questionnaire we interpret ICT (Information and Communications Technology) to mean:

*Any computer based and communication technologies, networked and stand alone, including both hardware and software, which can be used as teaching, learning and information resources.*

We are interested in your experiences of ICT in different contexts. We have defined these as follows:

**Classroom practice** e.g. using ICT to support your teaching in the classroom.

**Professional development** e.g. networking with other teachers; using software packages for developing professional skills.

**Personal use** e.g. finding information for personal interest; playing computer games.

**Administration** e.g. monitoring student progress; recording student grades.

**We would appreciate it if you could complete and return the survey in the reply paid envelope by September 19.**

**Please tear off this instruction page and commence the survey.**

# TEACHERS' SURVEY

## Section 1 – Using technology

1. Do you use technology in your teaching practice?

- ☐ Yes  
☐ No

2. How often do you use the following ICT resources in each of the contexts - classroom practice, professional development, personal use, administration? (SEE NOTES ON PAGE 1)

Please code as follows: **D = Daily W = Weekly M = Monthly T = Termly N = Never**

**Please cross only one box for each question and category.**

	Classroom					Professional					Personal					Admin				
	D	W	M	T	N	D	W	M	T	N	D	W	M	T	N	D	W	M	T	N
Internet and World Wide Web (WWW)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E-mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Network computer conferencing (e.g. First Class; Net Meeting)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Video conferencing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Word-processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Databases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spreadsheets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Desk Top Publishin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

g (DTP)																				
Digital camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital scanner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Education al software packages (externall y produced)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Education al software packages (internall y produced)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CD-ROM informati on sources e.g. Encarta	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On-line informati on sources e.g. ERIC (Educatio n Research Index)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using a mobile phone e.g. for SMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Where do you generally use ICT resources? (Please cross all that apply)

- ☐ Classroom
- ☐ Computer lab
- ☐ Library
- ☐ Home
- ☐ Other (please state) .....

4. If you **do not** use a specific ICT resource in a classroom, professional development, or administrative context, please indicate why (please cross the appropriate boxes).

	<b>Not availabl e at all</b>	<b>Not accessibl e when needed</b>	<b>Not familia r with</b>	<b>Lac k of skill s</b>	<b>Not appropria te</b>	<b>Cost of buyin g/ using</b>	<b>Lack of technic al support</b>	<b>Lac k of time</b>
Internet and WWW	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E-mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Network computer conferenci ng (e.g. First Class; Net Meeting)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Video conferenci ng	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Word- processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Databases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Not availabl e at all</b>	<b>Not accessibl e when needed</b>	<b>Not familia r with</b>	<b>Lac k of skill s</b>	<b>Not appropria te</b>	<b>Cost of buyin g/ using</b>	<b>Lack of technic al support</b>	<b>Lac k of time</b>
Spreadshee ts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Desk Top Publishing (DTP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital Camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital scanner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Educationa l software packages (externally produced)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Educationa l software packages (internally produced)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CD-ROM based informatio n sources e.g. Encarta	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On-line informatio n sources e.g. ERIC (Education Research Index)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using a mobile phone e.g. for SMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 5. What do you think about ICT?

Whether you use ICT or not, we would like to know what you think about it. Please indicate whether or not you agree with each of the statements below by crossing the most appropriate box.

	<b>Definitely agree</b>	<b>Tend to agree</b>	<b>Neither agree nor disagree</b>	<b>Tend to disagree</b>	<b>Definitely disagree</b>
I'd like to know more about ICT.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Computers scare me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ICT helps me find heaps of relevant information for my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I know the basics of ICT but that is all.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I've got information overload.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I use it effectively myself but I'm not sure how to teach the students to use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I don't know what I would do without it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I manage information more effectively because of ICT.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I wish it had never been invented.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I find it helpful for non-work related tasks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I find using ICT time consuming.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Some students are as scared as me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It makes my work easier.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I prefer using it on my own when no-one is around to see	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

me make mistakes.					
ICT helps students acquire new knowledge effectively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It cuts down my preparation time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It's all moving too fast for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I find it easy to select appropriate ICT resources for my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can't cope with all the ICT jargon.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel supported in my use of ICT.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Definitely agree</b>	<b>Tend to agree</b>	<b>Neither agree nor disagree</b>	<b>Tend to disagree</b>	<b>Definitely disagree</b>
Students can get distracted by all the technology.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ICT helps me communicate with colleagues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Systems are slow; I'd be quicker using a book.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel lost in the information age.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ICT encourages students to work together collaboratively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can never find anything relevant for my students.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My current school has a positive attitude to ICT use.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I don't have the appropriate skills to use it effectively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It seems to motivate the students to learn.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



ICT swamps students with information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The students are way ahead of me in their use of ICT.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6. In general has ICT had a positive or a negative impact on your teaching?

- ☐ Positive  
☐ Negative  
☐ Mixed  
☐ Don't know

Please give examples.....

7. In general has ICT had a positive or a negative impact on your students' learning?

- ☐ Positive  
☐ Negative  
☐ Mixed  
☐ Don't know

Please give examples.....

## Section 2 - keeping up-to-date with ICT

8. How do you keep up to date with ICT developments? (Please number in order of use all that you have used in the last 12 months)

- ☐ Other teachers  
☐ E-mail  
☐ Librarians  
☐ Conferences  
☐ Senior management  
☐ In-service  
☐ Computing department  
☐ Schools Library Service  
☐ Technician  
☐ Educational Resource Services  
☐ Educational Advisers  
☐ Teacher Education Institute or University

- ☐ Professional journals
- ☐ Australian Council For Educational Research (ACER)
- ☐ Newsletters
- ☐ State Education Departments
- ☐ Research journals
- ☐ National or Federal Departments of Education
- ☐ Computing journals
- ☐ Internet
- ☐ Publishers catalogues
- ☐ World Wide Web

Other (please state) .....

9. If you use ICT, how would you describe your level of ICT competence in the following contexts?

If you do not use ICT, please go to question 10.

	<b>Classroom practice</b>	<b>Professional development</b>	<b>Personal use</b>	<b>Administration</b>
Very competent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Competent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Not competent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Don't know	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. a) Have you ever received any ICT training, in the last 12 months?

Yes ☐

No ☐

Can't remember ☐

If yes please give details of this training.....

and a) anything that was useful about it.....

and b) anything that was not useful.....

10. b) Do you believe that you have enough involvement in how technology is used for teaching and learning at your school? (Additional comments about your involvement or how you would like to be involved would be appreciated)

Yes ☐

No ☐

Comments:

11. a) Are you interested in developing your skills and knowledge in ICT?

Yes ☐

No ☐

11. b) Please indicate whether or not you agree with each of the statements below by crossing the most appropriate box.:

	<b>Definitely agree</b>	<b>Tend to agree</b>	<b>Neither agree nor disagree</b>	<b>Tend to disagree</b>	<b>Definitely disagree</b>
I am interested in learning more about using ICT.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel ICT training isn't appropriate to my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I find training courses in ICT useful.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I need to develop my skills and knowledge for professional development.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel I should develop my skills to keep up to date with developments in teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I don't think I need ICT skills to progress in the profession.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I'm not that interested but I suppose I should be.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I need to develop my skills and knowledge for the students' benefit.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I don't see the need to learn about ICT.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I'm interested but don't have the time.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I'm interested but don't have access.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I don't need to use ICT in my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I really want to know more about developing my skills in ICT.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am interested personally but developing my skills and knowledge in ICT isn't appropriate to my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I'm interested but training doesn't seem to be available.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I don't think it's necessary, no-one else in	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

the school is bothering.					
I would like to develop my skills and knowledge in ICT as everyone else is.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel my skills and knowledge in ICT are adequate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ICT training isn't a priority for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. What are your priorities for developing your skills and knowledge in ICT in each of the contexts below, over the next 12 months? Please list up to three in each context.

Classroom practice	1. 2. 3.
Professional development	1. 2. 3.
Personal use	1. 2. 3.
Administration	1. 2. 3.

### Section 3 - You and your teaching experience

13. How long have you been teaching (including probationary period)?

- Less than 1 year ☐  
1-5 years ☐  
6-10 years ☐  
More than 10 years ☐

14. Are you a:

Teacher? ☐

Senior Teacher? ☐

Subject Head? ☐

Grade/Form Head? ☐

Teacher Administrator (assistant principal or principal)? ☐

15. Would you describe your teaching experience as predominantly:

Full-time? ☐

Part- time? ☐

Relief/Supply? ☐

Mixed? ☐

16. What level/grade(s) are you currently teaching? (Please indicate all that apply).....

17. If you are a secondary teacher, what subjects are you currently teaching?.....

18. Which of the following educational qualifications (degrees) do you have?

Diploma ☐

Bachelor ☐

Masters ☐

Post-Graduate Degree ☐

Post –Graduate Certificate ☐

PhD ☐

Other ☐ (please state)

19. Where did you undertake your initial teacher training? (Please name the institution).....

20. How many schools have you previously taught in?

0 ☐

1 ☐

2 ☐

3 ☐

4 or more ☐

21. How would you describe these schools? (please cross all that apply)

Rural ☐

Town ☐

City ☐

Remote/Island ☐

22. Are you:

Male? ☐

Female? ☐

23. Which age group do you belong to?

20-30 ☐

31-40 ☐

41-50 ☐

51-60 ☐

61+ ☐

Section 4 - Your future predictions:

24. Please write down a few sentences about how you think technology will be used in classrooms in the year 2010.

### OTHER COMMENTS

25. Please use this space for any additional comments (e.g. what you feel would encourage your use of ICT in the classroom; anything you feel discourages you from using ICT):

We will be following up this survey with in-depth interviews looking further at teachers' experience of ICT and what teachers perceive to be the important issues. If necessary would you be prepared to take part in these interviews? If so, please cross the box below, providing your name, current school and telephone number.

☐ I am interested in taking part in the interviews.

Name:

School:

Telephone number (work):

E-mail:

Thank you very much for your assistance.

We would appreciate it if you could complete and return the survey in the reply paid envelope by *September 19*.

### **Appendix 3 Teachers' Interview Questions**



## **Teacher semi-structured Interviews (Interview schedule)**

### **Overview of the interview phase (Teachers)**

Interviewer gives a general description of the research and the research questions.

#### **Interview Part 1**

1. Interviewer asks the respondent about his or her function within the organisation, his or her experience in relation to using new forms of learning technologies in education and the experiences of the organisation itself in relation to using new forms of learning technologies in education.

#### **Interview Part 2**

Interviewer relates the data as gathered from the first part of the interview to the following research questions:

2. Which factors are important in the decision of a school to start using new forms of learning technologies in education?

2a. To what extent are environmental pressures (government, changing student demographics, industry requirements etc.) important?

2b. To what extent are technology developments (new possibilities, emerging technologies, etc.) important?

2c. To what extent are organisational conditions (policy, vision, etc.) important?

2d. To what extent are educational developments (focus on learner, active learning, individual learning, etc.) important?

2e. To what extent is cost-effectiveness (reducing costs, improving effects, etc.) important?

2f. To what extent are support facilities (administrative support, educational and technical support, etc.) important?

3. Does the use of new forms of learning technologies in education offer possibilities in relation to social and economical questions? – ie .Is your organisation influenced by economic or social reasons to use learning technologies in education?

3a. How should learning technologies be used in order to create a useful learning process for students?

3b. How are learning technologies implemented in education? Which persons and processes are important before, during and after the implementation?

3c. Who has been involved in the decision to use learning technologies in your organisation?

3d. Has the use of new forms of learning technologies in education been consistent with previous practice or are there constraints?

3e. Is the use of new forms of learning technologies in education voluntary or is there coercion / pressure to use it?

## **Appendix 4 Students' Survey**

## Student survey

### Instructions

**Don't write your name on this form.** This is not a test and we don't need to know your name. This survey is confidential. You cannot be identified by us.

For every question put an 'X' in the box ☐ that matches your answer. Only cross one box if it tells you to. For those questions that ask for a written response – please indicate your opinion – not what you think your teacher or we want you to write – we greatly value your opinion.

**Ask your teacher if you need help with any question from here on.**  
**Leave blanks where you don't need to answer a question.**

For the purposes of this questionnaire we interpret ICT (Information and Communications Technology) to mean:

*Any computer based and communication technologies, networked and stand alone, including both hardware and software, which can be used as teaching, learning and information resources.*

We are interested in your experiences of ICT in different contexts. We have defined these as follows:

**School uses** e.g. using ICT to support your learning such as word processing assignments or using the internet to obtain information for school related work.

**Personal use** e.g. finding information for personal interest; playing computer games or entertainment.

**Please tear off this cover letter and commence the survey.**

### Student survey

#### Section 1 – About you

1: I am a .....?

Girl ☐

Boy ☐

2: My age is .....? (in whole years)

Under 10 ☐

10 ☐

11 ☐

12 ☐

13 ☐

14 ☐

15 ☐

16 ☐

17 ☐

18 or older ☐

3: What year level (grade) are you in?

Year 4 ☐

Year 9 ☐

Year 5 ☐

Year 10 ☐

Year 6 ☐

Year 11 ☐

Year 7 ☐

Year 12 ☐

Year 8 ☐

4: I was born in Australia

Yes ☐

No ☐

5: I am Aboriginal and/or Torres Strait Islander

Yes ☐

No ☐

6: My family and/or I speak a language other than English at home

Yes ☐

Please write your language here ..... No ☐

## Section 2 – Using technology

7: Do you use a computer outside of school?

☐ Yes .....go to question 8

☐ No .....go to question 9

8: Where do you use a computer outside of school? (Cross all that apply):

☐ At home

☐ Library

☐ Youth or drop-in centre

☐ Community centre

☐ Online access centre

☐ Sports centre

☐ Internet cafe

☐ Other (name) .....

9: Outside of school how many hours per week do you spend using the following technology devices? (Cross only one box for how long you spend using each device for)

	Less than 1 hour	1-2 hours	2-3 hours	More than 3 hours	I don't do this
Using ICT for entertainment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using ICT for school related activities (such as homework or internet research)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using a mobile phone for entertainment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using a mobile phone for school related activities (such as phoning/SMSing a friend for assignment help)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10: What other forms of technology have you used outside school in the last week?  
(Cross all that apply):

- |   |   |
|---|---|
| <input type="checkbox"/> Television               | <input type="checkbox"/> Video camera                               |
| <input type="checkbox"/> Mobile phone             | <input type="checkbox"/> Game player (such as Nintendo/PS/Game boy) |
| <input type="checkbox"/> CD/DVD player            | <input type="checkbox"/> PDA  |
| <input type="checkbox"/> Digital camera           | <input type="checkbox"/> Smart phone                                |
| <input type="checkbox"/> Other (please name)..... |   |

11: Do you believe that you have enough involvement in how technology is used for teaching and learning at your school? (Additional comments about your involvement or how you would like to be involved would be appreciated)

Yes ☐                      No ☐

Comments:

12: How often do you use the following technology resources in each of the contexts – school uses or personal? (SEE NOTES ON PAGE 1)

The code is as follows: **D = Daily W = Weekly M = Monthly T = Termly N = Never**

**Please cross only one box for each question and category.**

	School					Personal				
	D	W	M	T	N	D	W	M	T	N
Internet and World Wide Web (WWW)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E-mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Network computer conferencing (e.g. First Class; Net Meeting)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Video conferencing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Word-processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Databases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spreadsheets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Desk Top Publishing (DTP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital scanner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Educational software packages (externally produced)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Educational software packages (internally produced)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CD-ROM information sources e.g. Encarta	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On-line information sources e.g. ERIC (Education Research Index)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using a mobile phone to send and receive text (SMS) messages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Section 3 –Technology skills

13. How would you describe your level of ICT competence in the following contexts?

If you do not use the technology leave the question blank:

	My skill level			
	Don't know	Not competent	Competent	Very competent
Internet and World Wide Web (WWW)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E-mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Network computer conferencing (e.g. First Class, Net meeting)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	My skill level			
	Don't know	Not competent	Competent	Very competent
Video conferencing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Word-processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Databases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spreadsheets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Desk Top Publishing (DTP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital scanner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital video camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using CD-ROMs or DVD's for assignment information e.g. Encarta	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using CD-ROMs or DVD's for entertainment e.g. Play station/Nintendo gaming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sending or opening text (SMS) messages on a mobile phone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Section 4 – Using technology my future predications

14: Please write down a few sentences about how you think technology will be used in classrooms in the year 2010.

**YOU HAVE NOW FINISHED – PLEASE HAND THE SURVEY TO YOUR TEACHER.**

**THANK YOU.**

## **Appendix 5 Guardians' Survey**

## Guardian survey

### Instructions

**Don't write your name on this form.** This is not a test and we don't need to know your name. This survey is confidential. You cannot be identified by us.

For every question put an 'X' in the box ☐ that matches your answer. Only cross one box if it tells you to. For those questions that ask for a written response – please indicate your opinion – not what you think we want you to write – we greatly value your opinion.

**Leave blanks where you don't need to answer a question.**

For the purposes of this questionnaire we interpret ICT (Information and Communications Technology) to mean:

*Any computer based and communication technologies, networked and stand alone, including both hardware and software, which can be used as teaching, learning and information resources.*

We would appreciate it if you could complete and return the survey in the reply paid envelope by **September 18, 2006.**

### Current levels of access:

1. Does your child have access to a computer at your home?

Yes ☐

No ☐

2. Does your child have access to the internet at your home?

Yes ☐..... go to question 4

No ☐..... go to question 3

3. Can you take your child to a public library or other place where he or she has access to computer or the internet after school or on weekends?

Yes ☐

No ☐

4. How often in the last year have you taken your child to a library or other public place to use a computer or the internet? Cross the best response.

Monthly or more often ☐ Three to five times ☐ Only once or twice ☐ Never ☐

**Assessment of further need:**

5. If your child could have access to a computer lab at school after school hours, would you be able to make arrangements to pick them up or have someone else pick them up?

Yes ☐

No ☐

6. What school-related computer tasks would your child need to do if he or she could have access to the lab after school? (please list)

7. What computer or technology skills do you feel your child should be learning at school? (please list)

8. What do you think the school could do to increase students' access to technology? (please list)

9. Do you believe that you have enough involvement in how technology is used for teaching and learning at your child's school? (Additional comments about your involvement or how you would like to be involved would be appreciated)

Yes ☐

No ☐

Comments:

**Current levels of utilisation:**

10. How often does your child get to use computers or technology to learn something at school? Cross the best response. If he or she is taking computers as a subject, don't count it.

Almost daily ☐

Weekly ☐

Monthly ☐

Rarely or never ☐

11. Please number in order of use (with 1 being the most used and 8 being the least used) your child's usage of the following technologies:

Internet ☐ Word processing ☐ Spreadsheet software ☐ Presentation software ☐

Online chatting ☐ Mobile phone for talk ☐ Mobile phone for text ☐

Game station (i.e. XBox or Play Station) ☐

**Future predictions:**

12. Please write down a few sentences about how you think technology will be used in classrooms in the year 2010.

## **Appendix 6 Demographic background of teacher respondents by school**

<i>Variable</i>	<i>Characteristic</i>	<i>School A</i>	<i>School B</i>	<i>School C</i>	<i>School D</i>	<i>School E</i>	<i>School F</i>	<i>Total</i>
	(%)	n=3	n=25	n=9	n=7	n=9	n=3	N=56
Gender	Male	100	20	11	43	33.3	33.3	29
	Female	-	80	89	57	66.6	66.6	71
Age	20-30	-	8	-	14	12.5	-	7
	31-40	100	20	11	43	25	33.3	28
	41-50	-	48	67	14	37.5	66.6	43
	51-60	-	12	22	29	12.5	-	14
	61+	-	12	-	-	12.5	-	5
Teaching experience	Less than 1	-	4	-	-	-	-	2
	1-5	-	4	-	-	44.5	33.3	10.5
	6-10	33.3	12	11	14	11	-	12.5
	10+	66.6	80	89	86	45.5	66.6	75
Teaching qualifications	Diploma	-	-	-	1	-	-	1
	Bachelors	2	10	6	3	4	3	28
	Masters	-	6	2	2	1	-	11
	Postgraduate	-	9	1	1	3	-	14
	PhD	-	-	-	-	1	-	1

*Statistically significant stepwise regression outcomes*

<i>IV</i>	<i>Coefficient</i>	<i>Beta</i>	<i>t value</i>	<i>Sig.</i>	<i>DV</i>
Age range	-0.52	0.12	-4.32	***	Curriculum plusses
Age range	0.42	0.13	3.19	**	ICT negative issues
Age range	-0.28	0.11	-2.58	*	ICT useful
Female teacher	0.49	0.19	2.61	*	School attitudes
Taught in town setting	-0.94	0.40	-2.34	*	ICT useful
Taught at four or more schools	-0.73	0.23	-3.14	**	Student issues
Pg degree tchg qualification	-0.83	0.31	-2.73	**	Curriculum plusses
Masters teaching qualification	0.60	0.26	2.28	*	Skills development
Masters teaching qualification	-0.71	0.32	-2.23	*	ICT issues
Teaching role is subject head	-0.80	0.34	-2.34	*	Personal interest
Teaching role is senior teacher	-0.56	0.24	-2.34	*	Skills development
ICT skills adequate	0.42	0.21	2.04	*	Student negative issues

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001



## **Appendix 7 Reasons for teacher's non-use of technology**

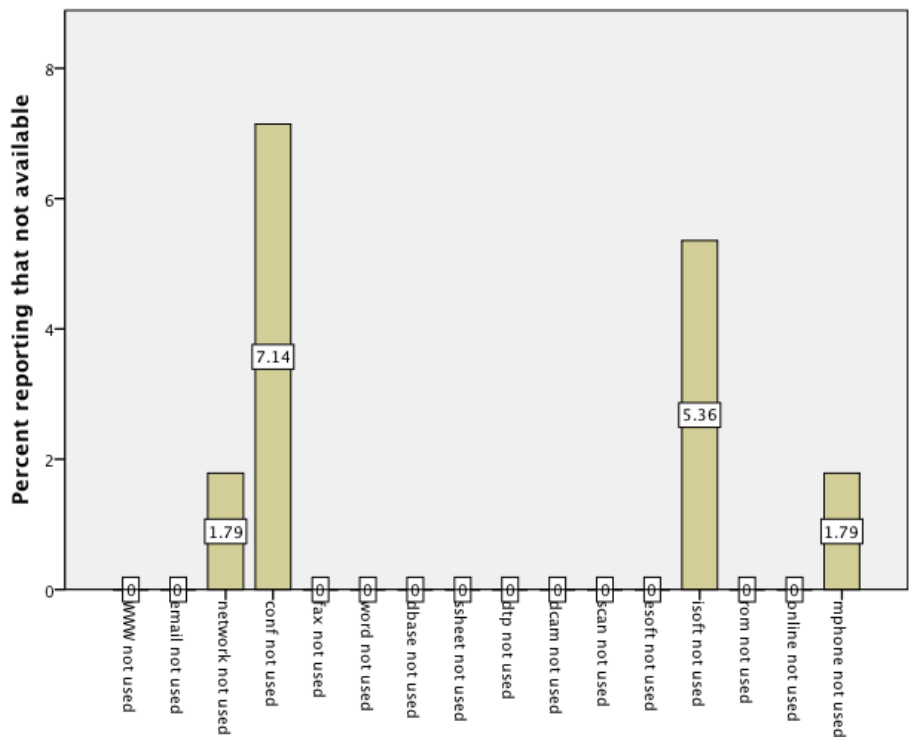


Figure 7.1: Percent of teachers stating that NOT using specific technologies because not available

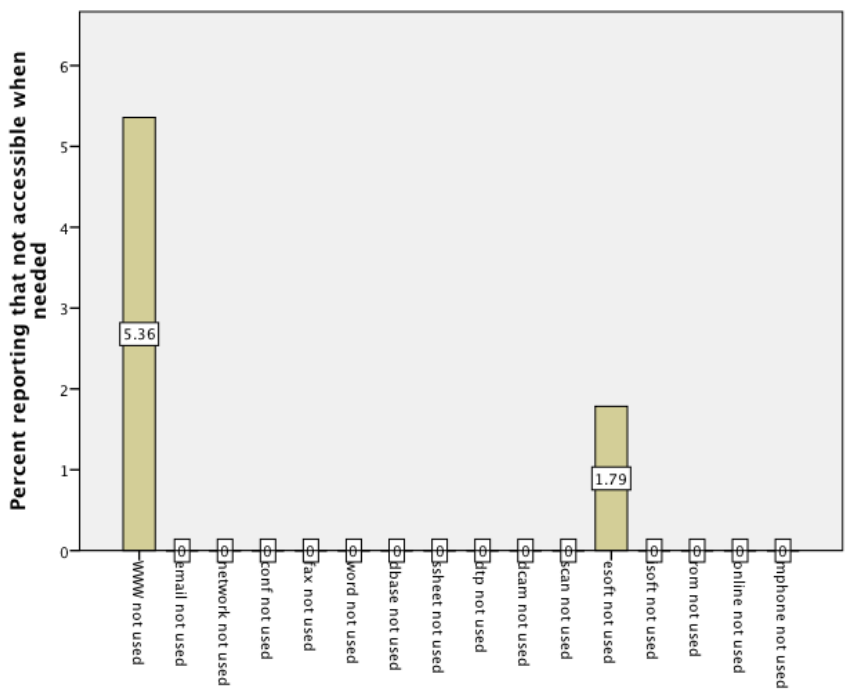


Figure 7.2: Percent of teachers stating that NOT using specific technologies because not accessible when needed

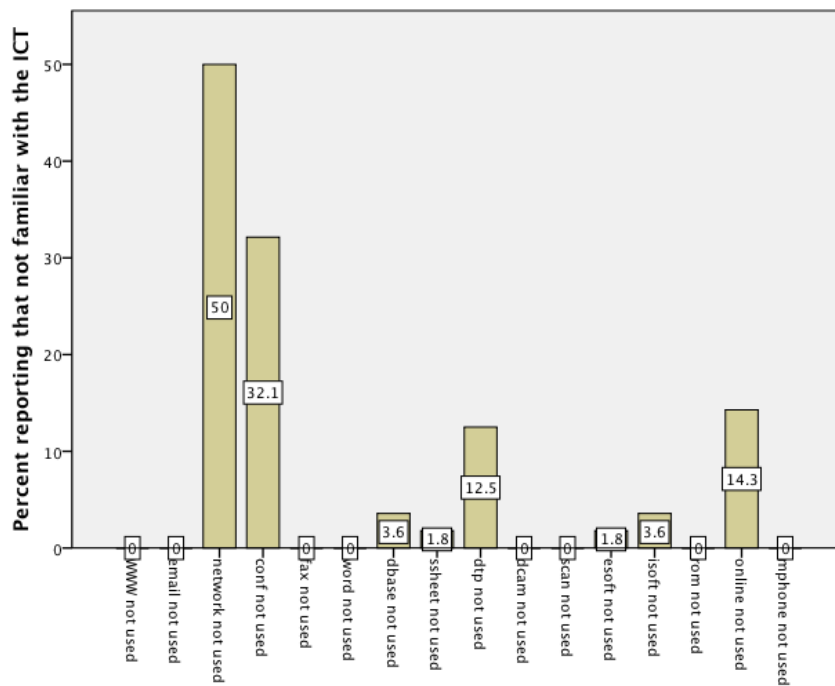


Figure 7.3: Percent of teachers stating that NOT using specific technologies because not familiar with them

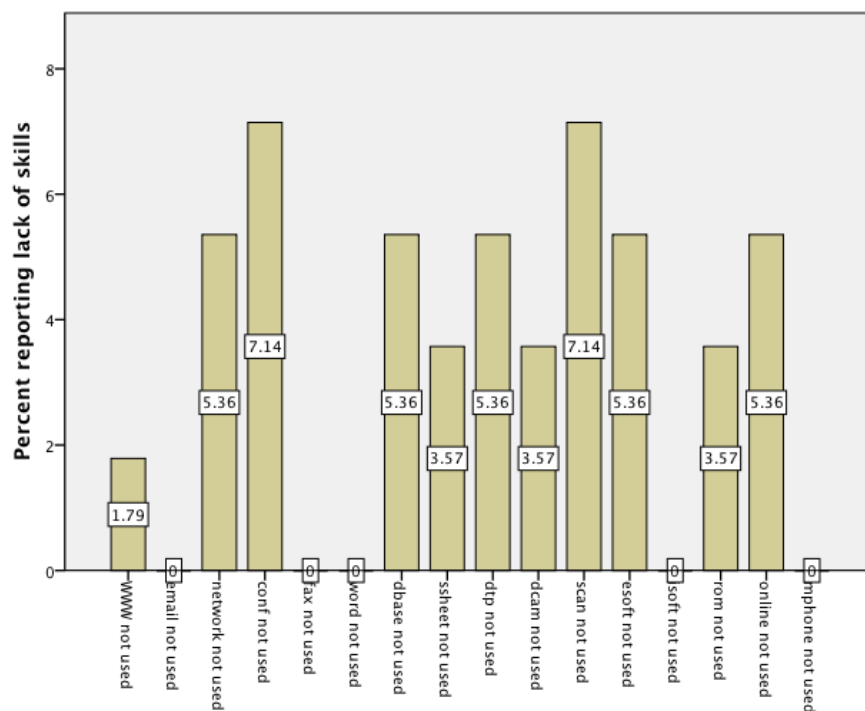


Figure 7.4: Percent of teachers stating that NOT using specific technologies because of lack of skills

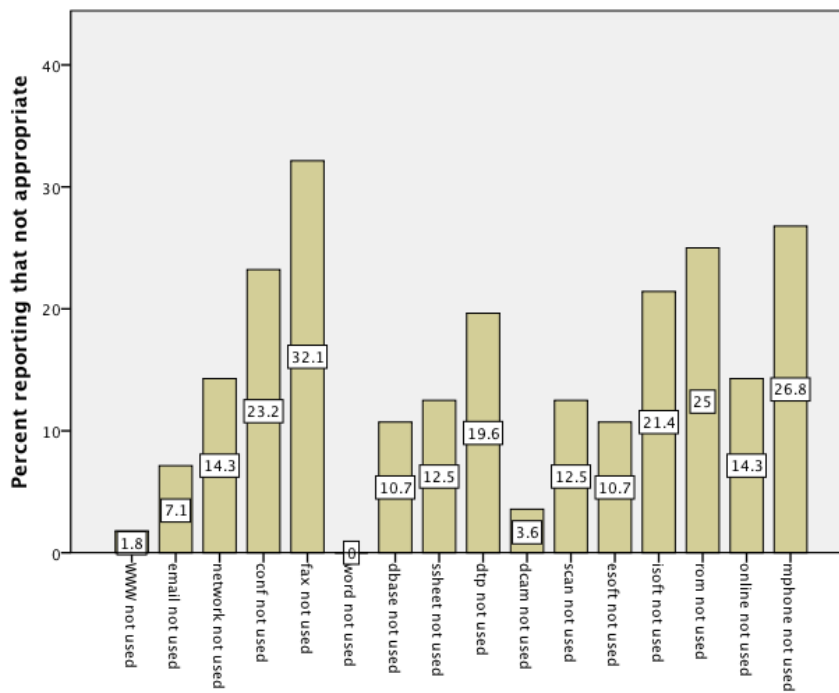


Figure 7.5: Percent of teachers stating that NOT using specific technologies because not appropriate

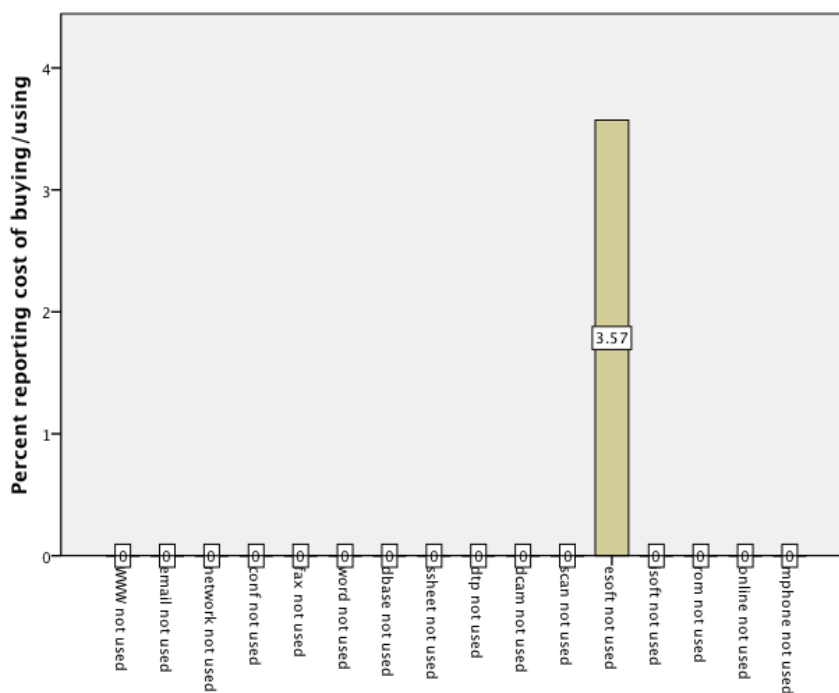


Figure 7.6: Percent of teachers stating that NOT using specific technologies because of cost to buy/use

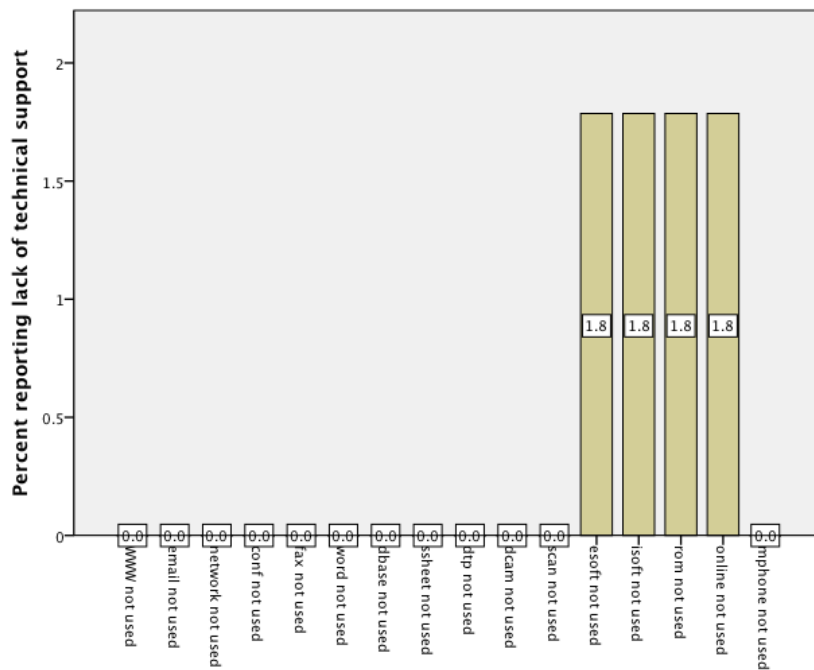


Figure 7.7: Percent of teachers stating that NOT using specific technologies because of lack of technical support

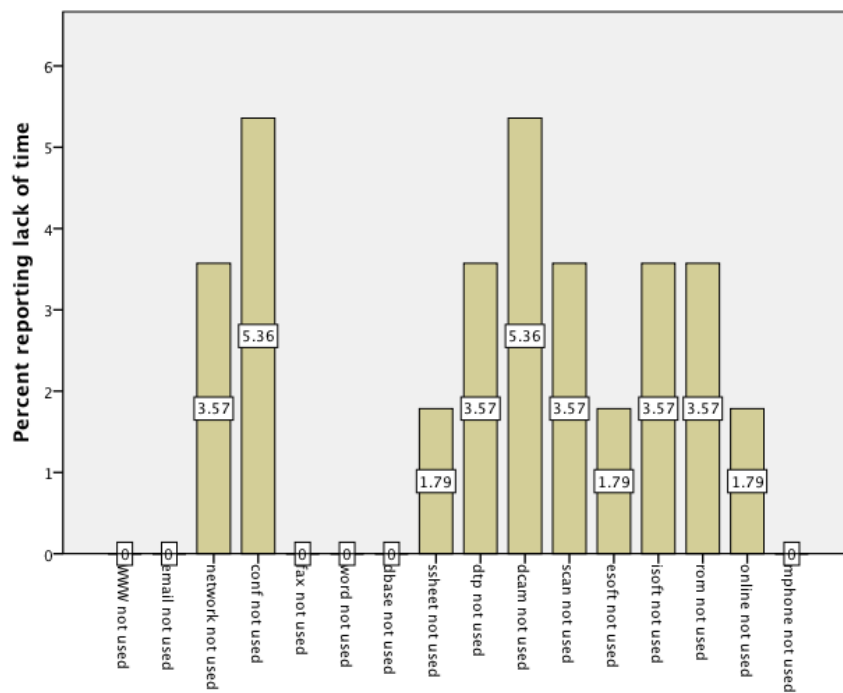


Figure 7.8: Percent of teachers stating that NOT using specific technologies because of lack of time