Towards the Social
Practice of Digital
Pedagogies:
Teachers' ICT Literacy
in Contemporary
Primary Schools

—————o—————

Eva Dakich

Doctor of Philosophy

2009
VU

Towards the Social Practice of Digital Pedagogies:

Teachers' ICT Literacy in Contemporary Primary Schools

Eva Dakich

School of Education,

Faculty of Arts, Education and Human Development,

Victoria University,

Melbourne, Australia

Submitted in total fulfilment of the requirements of the degree of

Doctor of Philosophy (PhD)

January, 2009

Anyámnak és szülővárosomnak, Szabadkának.

Abstract

Information and Communication Technologies (ICT) have been introduced to schools without fundamentally changing learning and teaching. In most cases they have been adapted to traditional school structures, classroom organisation and existing pedagogical practices, falling short of facilitating significant educational and cultural shifts. The promise of ICT to transform teaching and learning in schools has not yet been realised due to a range of barriers including teachers' lack of confidence, and pedagogical understanding in drawing on the potential of digital technologies

In response to these issues, the research project described in this dissertation explored connections between teachers' ICT literacy and pedagogical practices. The aims of the research were to study the situated nature of ICT integration, and to portray the knowledge and skills that would help teachers facilitate new, ICT-rich social practices of teaching and learning in contemporary primary schools. A mixed methods research was designed including three sub-studies: an international online Delphi process, a survey of teachers from a random sample of Victorian government primary schools, and a qualitative field inquiry documenting the practices and perceptions of four primary school teachers.

The Delphi process generated a new Framework of ICT Literacy for Primary School Teachers, which consists of four dimensions: Operational Understanding and Application of ICT, ICT-rich Pedagogies and Learning Environments, ICT for Professional Learning and Engagement, and The Social Ecology of Living and Learning with ICT. The framework was validated in the teacher survey, and was used to collect data about teachers' pedagogical ICT literacy. It also aided the consolidation interpretation and theorisation of findings.

Teachers participating in the survey reported to have intermediate to advanced levels of ICT literacy. They perceived themselves the most competent in operating software and hardware, and the least competent in understanding the pedagogical and socio-cultural consequences of teaching and learning with ICT. With regards to individual capabilities, teachers reported to be the most competent in using ICT to enhance or replicate traditional practices of teaching and learning, such as: presenting units of work, preparing handouts, and using common computer software. They perceived themselves the least

competent in taking learning beyond the classroom walls, which included encouraging students to become members of local and extended communities of learning, and facilitating online collaboration and communication.

Findings of the qualitative fieldwork complemented and confirmed the results of the survey study, and indicated that teachers focusing on the pedagogical and socio-cultural dimensions of ICT integration are more likely to transform their practices and engage their students in new learning experiences. The snapshots from the field also revealed that a supportive school culture and a holistic approach to ICT integration had a considerable influence on teachers' pedagogical understanding and use of new technologies. ICT integration was more successful when teachers were provided with full-time technical support and just-in-time professional learning in their school context, which allowed them to move forward with ICT within their comfort zone.

Overall, the findings of this research indicate the need for rethinking current discourses on teachers' ICT literacy. In particular, they suggest shifting the focus from the acquisition of functional techno-literacy to pedagogical and socio-cultural understandings of ICT integration. They also signify the need for rethinking current professional development structures in order to better prepare teachers for their new roles. Findings of this study suggest that teacher learning about, with and through ICT is more effective when it is contextualised in the everyday social practices of learning and teaching, and allows for communication, collaboration, and sharing of experiences, insights and practices. Such opportunities for professional learning would enable teachers to explore deep connections between technological artefacts and contemporary pedagogies, and develop a critical understanding of the socio-cultural implications of living and learning in the digital world.

Declaration

I, Eva Dakich, declare that the PhD thesis entitled Towards the Social Practice of Digital Pedagogies: Teachers' ICT Literacy in Contemporary Primary Schools is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Signature

Date: January 19th, 2009

Acknowledgements

Publications associated with this dissertation

Dakich, E. (2004). *From ICT competencies to the social practice of ICT-rich pedagogies: Results of a Delphi study.* Conference presentation. AARE 2004, Melbourne, Australia.

Dakich, E. (2005). *Teachers' ICT literacy in the contemporary primary classroom: Transposing the discourse.* Paper presented at the Australian Association for Research in Education (AARE) Conference 2005. Parramatta, NSW, Australia. Retrieved January 3, 2006, from http://www.aare.edu.au/05pap/dak05775.pdf

Dakich, E. (2006). *"Mediating the frames of meaning" through mixed methods research.* Conference presentation. Mixed Methods Conference, 2006, Cambridge, UK.

Dakich, E. (2008a). *Drawing on the wisdom of the Oracle: Utilizing the Delphi method in mixed methods research in education.* Paper presented at the Mixed Methods Conference, 2008, Cambridge, UK.

Dakich, E. (2008b). Towards the social practice of digital pedagogies. In N. Yelland, G. Neal & E. Dakich (Eds.), *Rethinking education with ICT: New directions for effective practices.* Rotterdam and Taipei: Sense Publishers.

Yelland, N., Neal, G., & Dakich, E. (Eds.). (2008). *Rethinking education with ICT: New directions for effective practices.* Rotterdam and Taipei: Sense Publishers.

Dakich, E., Cherednichenko, B., Vale, C., & Thalathoti, V. (2008). *Are teachers ready to engage the digital natives in 21st century learning? An Australian perspective.* Refereed paper presented at the Valuing shared and individual learning, IFIP WG 3.5 Conference, Prague, Czeck Republic.

Dakich, E., Vale, C., Thalathoti, V., & Cherednichenko, B. (2008). *Factors influencing teachers' ICT literacy: A snapshot from Australia.* Refereed paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications 2008, Vienna, Austria.

Table of contents

List of figures

List of tables

List of appendices

Please note: A CD containing all appendices is enclosed.

List of abbreviations and acronyms

ACCE	Australian Council for Computers in Education
ACDE	Australian Council of Deans of Education
BECTA	British Educational Communications and Technology Agency, UK
CSF	Curriculum and Standards Framework, Victoria
DEECD	Department of Education and Early Childhood Development, Victoria
DEST	Department of Education, Science and Training, Australia
DE&T	Department of Education and Training. Victoria
ICT	Information and Communication Technologies
ISTE	International Society for Technology in Education
MAV	Mathematical Association of Victoria
MCEETYA	Ministerial Council on Education, Employment, and Youth Affairs, Australia
OECD	Organisation for Economic Co-Operation and Development
OFSTED	Office for Standards in Education, UK
VCAA	Victorian Curriculum and Assessment Authority
VELS	Victorian Essential Learning Standards

Chapter 1.

Introduction

It is now well understood that the challenge of integrating technology into schools and classrooms is much more human than it is technological. What's more, it is not fundamentally about helping people to operate machines. Rather, it is about helping people, primarily teachers, integrate these technologies into their teaching as tools of a profession that is being redefined throughout the incorporation process. (Sheingold, 1991, p. 1)

This chapter is an introduction to a dissertation that explores connections between teachers' ICT (Information and Communication Technologies) literacy and pedagogical practices. Chapter 1 sets the scene and introduces the research problem. It describes the purpose and aims of the study and articulates the research questions that guide the inquiry. The introductory chapter also provides a synopsis of the methodology and the theoretical frameworks and ideas influencing the study design, data analysis and interpretation. It identifies the significance of the study and provides an overview of the dissertation.

1.1   Context and research problem

Many argue that human civilisation has entered a new era in which social practices have been dramatically reconceptualised (Agger, 1989, Cope & Kalantzis, 2000; Friedman, 2005; Gee, Hull, & Lankshear, 1996). The networked society (Castells, 2004) has expanded not only across the globe, but into virtual worlds that allow for human communication, collaboration and business. In this flat world (Friedman, 2005) the digital natives (Prensky, 2001a, 2001b) or the neomillennials (Dede, 2007) are comfortably navigating their way through the new avenues of life, leaving behind their teachers, classrooms and schools. With their lack of interest in what school has to offer, new

generations are clearly indicating that there is a disconnection between learning in schools and real life experiences (Yelland, 2008).

While digital technologies are seamlessly integrated into almost all aspects of our lives (Greenfield, 2006), large international studies show that their potential for bringing about change in education has not been sufficiently harnessed (Chaptal, 2002; Conlon & Simpson, 2003; OFSTED, 2002). In most schools, the integration of new technologies in learning and teaching has been slow, inconsistent (Cuban, Kirkpatrick, & Peck, 2001; OECD, 2006), and rarely engaging students in new learning experiences (Neal, 2007; Yelland, 2007). In most cases they have been simply adapted to traditional school structures, classroom organisation and existing teaching practices (Anderson & Becker, 2001; Watson, 2001; Yelland, 2007), failing to address comprehensive educational reform (Apple, 2004a; Fullan, 1993). It took considerable time, to realise that new technologies will not revolutionise education without human agency (Cuban, 2000a, 2001; Dede, 2007; Rogers, 2001), and to understand that one of the most significant barriers to successful integration of ICT and transformation of learning has been teachers' lack of confidence, experience, and pedagogical understanding in mobilising the potential of digital technologies (Becker & Ravitz, 2001; Becker & Riel, 2001; Dale, Robertson, & Shortis, 2004). As a result, identifying skills and knowledge that could empower teachers to harness the advantages of new technologies for student learning has become an issue of global importance, engaging various stakeholders such as policy makers, researchers and practitioners.

Governments and corporate leaders, worldwide, have initiated large investments with the hope that infusing ICT into schools will help prepare students for the 21st century (Anderson & Becker, 2001; Papert, 1995; Salpeter, 2000), and equip them with new skills and new forms of literacy. The objectives of the implementation of new technologies have been to make schools more efficient and productive, to transform teaching and learning into an engaging and active process connected to real life, and to prepare the new generations for their future workplaces (Cuban, 2001). National and international initiatives have been developed worldwide (Becta, 2003a; DEST, 2002; ISTE, 2000) and numerous studies have been conducted in the last decade (Burke, 1998; Finger, Jamieson-Proctor, & Watson, 2003; Scheffler & Logan, 1999; Winship, 2000), with the aim of identifying ICT skills and competencies for pre-service and practising teachers. Yet none of these initiatives have offered a sound pedagogical rationale for new learning with ICT

2

so far. Most of these frameworks have emerged from the standardisation and teacher accountability discourse, and prioritised technology skills over the pedagogical, socio-cultural and critical dimensions of ICT literacy.

1.2 Purpose and aims

The purpose of this research therefore was to explore connections between teachers' ICT literacy and pedagogical practices, and interpret the implications of these connections for student learning and educational change.

The aims of the study were to examine the situated nature of ICT integration in learning and teaching, and to portray the skills and knowledge that would help teachers facilitate new, ICT-rich social practices of teaching and learning in contemporary primary schools by:

- developing a framework for primary teachers' ICT literacy using an international panel of experts,
- evaluating primary teachers' ICT literacy in a random sample of 350 Victorian government primary schools, using the framework developed in the first stage of the research project,
- observing teachers' pedagogical practices with ICT in everyday classroom settings, and
- exploring, analyzing and interpreting the relationship between primary teachers' ICT literacy and their pedagogical practices.

1.3 Research questions

The following research questions guided the inquiry:

Main question:

- How does teachers' ICT literacy influence the nature of ICT integration into teaching and learning in primary schools?

Sub-questions:

- What are the dimensions of teachers' ICT literacy?
- What factors influence teachers' ICT literacy?
- How do teachers integrate ICT in the everyday social practices of teaching and learning?
- To what extent are they transforming student learning with ICT?

1.4 Research design

This research project utilised a mixed methods design (Creswell, 2005; Dakich, 2008a; Tashakkori & Teddlie, 1998). The project contained a string of sub-studies, including an international online Delphi process, a survey of Victorian government primary school teachers, and a qualitative field inquiry of four primary school teachers' pedagogical practices with ICT.

By combining quantitative and qualitative techniques of data collection, analysis and interpretation, this research project addressed the methodological gap emerging from the review of research on ICT and pedagogical change, that is, the need for triangulation and validation of findings (Cuban, 2001; Ravitz, Becker, & Wong, 2000). Previous research enquiring about ICT, the changing role of teachers and teaching practices in transition, mostly relied on data collected by survey method. Only a few studies were accompanied by in-depth observation of teaching and learning practices (Ravitz et al., 2000). According to the literature, there has been far too much reliance on self-reports and far less investigation of teaching practices in schools. Cuban (1993, 2001) argued that in-depth classroom observations show how typical instruction is much more traditional (fact and skill-oriented) than is suggested by teachers' survey responses. Drawing on Cuban (1993, 2001) and Ravitz et.al's (2000) critique, this study developed a research design that allowed for triangulation and validation of findings through all stages of the research process.

1.5   Theories and ideas influencing the research process

This research project was a meeting point of several existing and emerging philosophical and theoretical perspectives that influenced the research design, data analysis, interpretation, and the contextualisation of findings. As indicated in the previous section, the researcher explored the potential of the emerging mixed methods research paradigm in order to arrive at deeper understandings and more holistic answers to the proposed research questions.

From an epistemological perspective the research adopted Vygotsky's social constructivism (Vygotsky, 1967, 1978), according to which knowledge is embedded in socio-cultural contexts, and meaning emerges from human interaction. It also drew on Kincheloe's (2005) critical constructivism and his explanations of teacher professionalism and professional knowledge.

In order to deconstruct the relationships between ICT and pedagogy this study built on the ideas of the pedagogy of multiliteracies (Cope & Kalantzis, 2000; The New London Group, 1996), constructivist learning environments (Jonassen, 1999a) and new learning (Kalantzis & Cope, 2008b; Yelland, 2007). Giddens' (1984) interpretation of structure and agency helped unpack the complex interplay between new technologies, represented by rules and resources, and the agency of the teacher. Bauman's liquid modernity (Bauman, 2000) was recognised as the underlying context of the inquiry that embodies the changing conditions of human existence in the globalised world. These theoretical stances will be discussed further in Chapters 2 and 3, and will be used to scaffold theory building in Chapter 7.

1.6   Overview of the dissertation

This dissertation consists of seven chapters. In the next chapter the review of the literature positions the research within contemporary discourses around teaching and learning with ICT. The literature review is organised around four major themes: the context of the knowledge society, and current policy directions in Australian education, the relationship between ICT and pedagogy, empirical research on current practices and pedagogies with ICT, and contemporary interpretations of teachers' ICT literacy.

Chapter 3 describes the research design. This is an important part of this dissertation which explores innovative approaches to utilising the emerging mixed methods paradigm in educational research. The chapter provides a brief introduction to mixed methods and explores the benefits and challenges of bringing together qualitative and quantitative findings in order to arrive at deeper understandings. It describes each stage of the research project and provides details on data collection, analysis and interpretation. It has a strong emphasis on ethical conduct and identifies the limitations of each method utilised in the study.

Chapter 4 is about the emergence of the new framework of teachers' ICT literacy. The framework was generated in a four round Delphi process which was the most challenging and the most interesting part of the research. The chapter takes the reader through the four Delphi rounds and devotes considerable attention to the emergence and impact of an outlier. It is an account of the dynamic relationship between the Delphi process, constrained by a methodological design, and the outcomes of the inquiry. It shows how the outcomes of each round interact with the research design, demanding changes and adjustments. The Delphi process described in this chapter demonstrates the flexibility of the Delphi method, and provides evidence that underpins its reflexive, democratic and collaborative nature. The chapter concludes with the validation of the framework. Aspects of the Delphi process have been reported on at two international conferences (Dakich, 2004, 2008a) while the Framework of ICT Literacy for Primary School Teachers has been published in a book chapter (Dakich, 2008b).

Chapter 5 is an account of teachers' ICT literacy in Victorian primary schools. It discusses the findings of the teacher survey, the aim of which was to gather data on teachers' ICT literacy by utilising the survey instrument developed in the Delphi process. The chapter describes the demographic characteristics of the survey sample in comparison with the target population, recounts teachers' self-reported competence in integrating new technologies in learning and teaching, and identifies factors influencing teachers' ICT literacy. The findings of the teacher survey have been reported on at three international conferences (Dakich, 2005b; Dakich, Cherednichenko, Vale, & Thalathoti, 2008; Dakich, Vale, Thalathoti, & Cherednichenko, 2008).

Chapter 6 brings together the findings of the qualitative field inquiry about teachers' pedagogical practices with new technologies in two Victorian government primary schools. The findings emerging from qualitative teacher interviews and naturalistic

6

classroom observations allowed the researcher to take a closer look at the benefits and challenges of ICT integration in learning and teaching, and observe connections between teachers' ICT literacy and pedagogical practices.

Chapter 7 represents the most significant part of the dissertation. It triangulates, integrates, and interprets the findings of the study described in chapters 4, 5 and 6. In this chapter the researcher responds to the research questions and arrives at new understandings in relation to the existing body of knowledge. The discussion of findings in Chapter 7 is followed by the conclusions, implications for theory, policy and practice, and recommendations for future research.

Chapter 2.

Teaching and learning in a digital world

The aspiration that technology will transform the way we learn has not yet been realized in any of the countries studied, although some have progressed to the threshold of this vision. While the information society requires that traditional education values should be reasserted, it also requires shifts in the way individuals, organisations, and communities learn in order to meet the conditions, imperatives, and opportunities of the globalised information society. (Kearns, 2002, p. 129)

This chapter reviews current literature and research in the field of ICT pedagogies. It identifies key authors and research studies that investigate issues related to the pedagogy of ICT integration into student learning, and discusses relevant curriculum initiatives and policies which impact on teachers' engagement with ICT in the classroom. The chapter also reports on the barriers to and catalysts for effective practices with ICT, and evaluates recent initiatives related to teachers' ICT skills and knowledge.

The chapter is comprised of five sections. Section 1 positions the research within the context of the knowledge society and provides an overview of Australian and Victorian strategic policies and initiatives. Section 2 deconstructs the relationship between ICT and pedagogy. It explores the theoretical and epistemological foundations of ICT integration and ICT-rich learning environments by providing a synopsis of the most influential theoretical frameworks such as behaviourism, cognitivism, constructivism, and connectivism. The section also includes sociological and organisational explanations of technology integration into schools, which will aid the interpretation of findings and theory generation in the final chapter. Section 3 is dedicated to emerging pedagogical thought and it provides an overview of new pedagogical and instructional models that support the integration of ICT in teaching and learning. Section 4 is a review of empirical studies many parts of the world and identifies catalysts for and barriers to successful technology integration, one of which is teachers' skills and knowledge related to the

application of new technologies. Section 5 takes a closer look at teachers' ICT related knowledge and skills by providing an overview of existing competency standards and ICT literacy frameworks. The chapter ends with a summary and conclusions.

2.1 Education in the era of Liquid Modernity

The transformation from the industrial to the knowledge society has created a new work order and a new world order. The paradigm of Fordist mass production was abandoned and a new type of capitalism emerged often referred to as 'post-Fordism', late/advanced capitalism, or fast capitalism (Agger, 1989; Cope & Kalantzis, 2000). Flying on the wings of new technologies, fast capitalism has re-engineered space and time and resulted in dramatic global changes affecting our work, public and private lives. Cultures and discourses have been reconstructed, calling for new understandings and interpretations of our shared reality. The traditional hierarchic and controlling workplace structures have been replaced with new social practices that are based on the premises of collaboration, teamwork, and lifelong learning (Cope & Kalantzis, 2000; The New London Group, 1996). These changes have generated a new workplace culture and created a need for a flexible and multi-skilled workforce, which can effectively cope with the demands and uncertainties of the knowledge society (Bábosik & Torgyik, 2007).

The changes in our public and private lives have been no less significant (Cope & Kalantzis, 2000; The New London Group, 1996). New technologies have contributed to increased interconnectedness, cross-cultural mobility, diversification of local communities, the development of "hybrid cross-cultural discourses" and the emergence of new literacies (The New London Group, 1996, p. 9). All these have been reshaping our values, relationships and the social realities within which we operate. Gee, Hull and Lankshear (1996) argued that "no one is able to escape the reach of these changes because they shape the context - the material and cultural conditions of existence - within which people must now interpret their lives and construct their futures" (p. vii).

In the past education helped us understand and interpret the world and envisage our future. In fact, the purpose of education was to prepare us for the future which was in most cases more or less linear and predictable. However, the future we are about to meet is ominously uncertain and "holographic", as envisaged by physicists Bohm (1980) and Talbot (1992) towards the end of the twentieth century, according to whom time and

9

space would no longer be viewed as fundamentals, and past, present and future would exist simultaneously in the deeper structures of reality. Bohm and Talbot's vision became the reality of the 21st century. According to Bauman, in this era of liquid modernity (Bauman, 2000, 2003), "when time and space are separate from living practice" (Bauman, 2000, p. 8), the world is changing so quickly, that we "can no longer rely on strategies acquired through learning experiences, let alone those derived from traditional values or wisdom", because "knowledge is confined - discarded like refuse - in the infinite capacity of cyber-computers" (2003, p. 114). He poses an important question: "What should we humans keep and what should we reject in this process? In times of liquid modernity, how and what should our children be taught in order to be able to develop survival strategies throughout their lives" (p. 114)?

So has knowledge become obsolete in the knowledge society? Portella (2003) believed that "knowledge is power" (p. 5) more than ever before. However, in his view the so-called knowledge society, the "commerce of knowledge, the outpost of market economies fails to make the needed qualitative leap" (p. 5). He argued that we live in an information society where despite the abundance of information, little learning is happening. In his opinion legitimate knowledge "must be anchored in social life" and "take root in the life of the world" (p. 5). But the 'life of the world' and our social reality are undergoing dramatic global changes. Bigum (1999) asserted that the challenges of global changes for education are such that "there is an urgent need to revisit the stories we tell ourselves about the future and the role of education in those futures" (p. 6). This includes scenario planning about the future of schooling and asking ourselves "important 'what if' questions about the social conditions we have created for the next generations" (p. 8).

2.2 Envisaging the future of schooling in Australia

Scenarios about the future of schooling in Australia are created at many different levels. Commonwealth, national and state initiatives have been built around aspirations and assumptions about the needs of future economies and the society of the future. These strategic plans have been emphasising the leading role of education for preparing "a highly skilled and capable workforce" (Moyle, 2005, p. 1) armed with 21st century literacy skills for living and working in the knowledge society and the digital world. Similarly to other developed countries such as the UK, EU, the US and Canada, the

10

integration of ICT in learning and teaching in Australian schools has been viewed as crucial to educating the workforce of the future (Boston, 1999; Kearns, 2002; Moyle, 2005).

2.2.1 National strategies for integrating ICT in education

Australia is one of the key players on the stage of the global knowledge society. According to a report published by the Australian Government (Australian Government, 2007), Australia has positioned itself as a world leader in the provision of technology solutions for government, e-learning and IT services. It has become the 11th largest market in the world and the fifth in the Asia Pacific region. The same report envisaged Australia's competitive edge in educating a highly–skilled multi-lingual workforce. However, it is also aware of present and emerging risks of off-shoring due to inadequate skill levels and booming ICT driven economies in the region. These data suggested that ICT–related skills and knowledge have become an important part of 21st century literacies both at the workplace and in day-to-day life. In 2004, the Minister for Communications, Information Technology and Arts, announced that ICT literacy has become a priority for the Australian Government and that ICT literacy has become an essential component of fundamental literacy skills required for the future (The Hon Daryl Williams Minister for Communication Information Technology and the Arts, 2004). A year later the Australian Computer Society (2005) released the Policy Statement entitled Computer Literacy: ICT professionals shaping our future, in which it recognised the disparity between current national priorities in education and the realities of teaching and learning with ICT in our schools, and proposed the development of national standards for all primary and secondary school students:

> ICT literacy has moved from being a fringe issue to the centre stage of the school education platform. While ICT has become embedded into all aspects of our home and work lives, this has not yet been achieved in the nation's classrooms. Increasingly we are seeing Australian school students completing school with differing levels of ICT accomplishment due to the variety of state requirements and disparate school systems. The ACS believes that ICT literacy must be seen as an essential life skill. Students that graduate from school without an adequate grasp of ICT are setting themselves up for a life with a limited ability to meet their fundamental needs such as employment, quality health care, access to facilities and information. To remedy this situation, we need to develop

11

and test a national standard for ICT literacy consistent with the national standards for numeracy and literacy. It should be applied to all primary and secondary students. The aim should be for all students to be not only fluent in the use of ICT but able to use it to their advantage in learning. (ACS, 2005, p. 2)

The need for educating technologically skilled generations to meet the challenges of our times was initially articulated in the Hobart Declaration (1989), the first agreement to provide a framework for national collaboration in achieving the shared educational vision of all Australian States. Ten years later the Adelaide Declaration on National Goals for Schooling in the Twenty-first Century (Ministerial Council on Employment Education Training and Youth Affairs, 1999) shifted the focus from acquiring "skills of information processing and computing", as specified in Goal 6.b of the Hobart Declaration, to becoming "confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society" (Goal 1.6). The Adelaide Declaration paved the way to other key policy documents such as: Learning in an Online World: The School Education Action Plan for the Information Economy (MCEETYA, 2000), and the recent Learning in an Online World, Contemporary Learning (MCEETYA, 2005b).

Several publications set out to provide an overview and/or analysis of the policy context related to ICT in education (Kearns, 2002; Kearns & Grant, 2002; Moyle, 2005; Tsui, 2005; Yelland, 2002). Even though the following section reflects on their analysis, the purpose of this argument is not to reiterate the findings of previous research, but to look at strategic policies and their critique from the perspective of this study and observe their implications for learning, the learner, the teacher, the learning environment and the broader community.

According to Tsui (2005), recent discourses and policy orientations in education reflect paradigms set by the corporate world and market economies, as education as a social practice is more than ever associated with national progress and economic efficiency. New concepts are introduced such as professional competence, output and quality assurance. Tsui argued that "schooling is seen as a financial investment aimed at increasing the economic value of young people. The effectiveness of a school is judged in terms of 'value added' indices derived from quantitative measures such as examination scores" (2005, p. 4). ICT has been a key element in debates about providing effective and high-quality education for the 21st century workforce, consequently the primary focus of

12

policy orientations was the infusion of ICT into schools and the practices of teaching and learning.

Kearns and Grant (Kearns & Grant, 2002) claimed that the Australian education system progressed through two major phases of policy development, which they regarded as foundations stages: the initial rolling out phase focusing on infrastructure, professional development and software development, and a mainstreaming phase with an emphasis on integration of ICT in learning and teaching.

This resembled the experiences of ten other countries, including Canada, Finland, Ireland, Malaysia, New Zealand, Singapore, Sweden, United Kingdom and the United States of America, reported in Kearns' (2002) international comparative study of ICT policies. According to Kearns, several countries were "standing on the threshold of a third phase development which could lead to a more radical transformation of the way people learn in a learning society" (2002, p. ii). In Kearns' study, Sweden was the only country progressing towards the third phase which is illustrated by the vision of the Swedish Ministry for Education and Science in 2001:

> Here the role of ICT in schools is not only changing, but the whole view of learning and the school as an institution is also changing. Learning is increasingly regarded as something for each and everyone throughout the course of their lives. Traditional school boundaries are being removed, classrooms are being opened up and at the same time new groups are starting to use school resources e.g. through learning at the workplace, while the school itself is increasingly using resources in society for educational purposes. (Kearns, 2002, p. 29)

The above vision represented a shift towards the redefinition/reconstruction of the traditional 'parameters' of learning as a social practice such as time, space, structure and agency (Giddens, 1984). Similar aspirations were articulated three years later in Learning in an online world: Contemporary learning (MCEETYA, 2005b) which are discussed later in this argument.

Moyle (2005) asserted that there had been a considerable change in the Australian policy context related to education and training in the last two decades. She argued that the focus on teaching students computer skills shifted to whole school changes in teaching and learning, issues related to access, research and teacher professional

development. Kearns and Grant (2002) arrived at similar conclusions in examining policies for ICT in education across Australia. They observed that policy agendas became increasingly responsive to the following key issues:

- responses to the pressures for lifelong learning,
- new strategies for teaching and learning,
- a start to the process of redefining roles and relationships including school and community relationships,
- balancing and harmonising competing educational, economic, social and cultural objectives,
- fostering new forms of partnership and collaboration,
- providing access to affordable infrastructure, and
- addressing equity issues including the core social issue of assisting those 'left behind' by the changes. (Kearns & Grant, 2002, pp. 9-10)

These shifts manifested themselves in Learning in an Online World: A School Education Action Plan for the Information Economy (MCEETYA, 2000) that outlined some of the most influential policy directions at a national level for learning in the new millennium. The main focus of this strategic plan was to "to improve the quality of teaching and learning in order to contribute to Australia's development as an equitable, imaginative and economically strong knowledge society" (MCEETYA, 2000, p. front cover). The following five key action areas were identified: people, infrastructure, content and service, supporting policies, enabling regulation. The objectives for student learning and the outcomes of the learning were stated as follows:

- All students will leave school as 'confident, creative and productive users of new technologies, including information and communication technologies, and understand the impact of those technologies on society.
- All schools will seek to integrate information and communication technologies into their operations, to improve student learning, to offer flexible learning opportunities and to improve the efficiency of their business practices. (MCEETYA, 2000, p. 3)

According to Yelland (2002), even though integration was implied under the themes of infrastructure and content, there has not been sufficient emphasis on embedding ICT in

14

curricula "relevant for the 21st century" (p. 40). In her opinion "no integration is possible without significant rethinking about curricula" (p. 39). She argued that in most instances old curricula have been dressed up in new technologies which cannot bring about the much expected renewal of education. Yelland saw the solution to these problems in curriculum and assessment reform.

The Learning in an Online World Action Plan (2000) was accompanied by several supporting statements and frameworks released by the Ministerial Council on Employment, Education, Training and Youth Affairs. They were related to priorities identified in the action plan such as bandwidth, professional development and the development of online content. The supporting documents included the Bandwidth Action Plan (MCEETYA, 2003a), Research Strategy (MCEETYA, 2003d), Learning Architecture Framework (MCEETYA, 2003b), Online Content Strategy (2004), Online Curriculum Content and Investment Proposal 2006-2008 (MCEETYA, 2005d), Bandwidth Implementation Plan (MCEETYA, 2005a), Pedagogy Strategy (MCEETYA, 2005e), Leadership Strategy (MCEETYA, 2006b) and Content Specifications Framework (MCEETYA, 2006a). The progress of these strategic plans have been continuously monitored and reported on.

The 2000, 2001, 2002 and 2003 National Reports on Schooling in Australia reported on the progress of ICT integration into Australian schools. The 2002 report (MCEETYA, 2002) presented some of the key findings of the Programme of International Student Assessment (PISA) study of student outcomes providing us with the following statistics: nearly 85% of Australian students had access to computers compared to 63% of their peers in the OECD countries. Only 9% of students never had access to computers at home compared to 23% in OECD countries. Almost half of the Australian students used computers at least a few times a week, while nearly a third of them accessed the Internet every day. Australian students who used computers on a daily basis also rated higher on the reading literacy tests than their OECD counterparts.

Apart from providing access and improving student outcomes, several national online content initiatives were brought to life. These included the Learning Federation, a nationally funded online curriculum content project, the Curriculum Corporation and the Education Network Australia (EdNA) online, which provide educators with online support services such as forums, chat rooms, discussion lists, and free access to online resources. In 2003 the focus was on improving the bandwidth of Internet connection for

all Australian schools and embedding ICT in the curriculum, instead of teaching ICT as a 'single learning category'. Incorporating ICT in all learning areas across the curriculum represented a significant shift from techno-centric and behaviourist applications of ICT to student learning. Having reliable Internet connection also meant opening up the traditional learning environment, the physically contained classroom to possibilities of local and global communication and collaboration.

In 2005 the Learning in an Online World Action Plan (2000) was replaced by Learning in an Online World: Contemporary Learning (MCEETYA, 2005b). There was a noticeable change in direction, rhetoric, and pedagogical rationale. The authors of the document acknowledged that young people live and learn in a different socio-cultural reality from that known by their parents, and that this new environment characterised by mobile devices, multimedia, hypertext, and the Ipodification of education (Brabazon, 2006) shaped student "expectations and their abilities to access, acquire, manipulate, construct, create and communicate information" (MCEETYA, 2005b, p. 4). Responding to these expectations the Australian Government's vision for 21st century learning redefined interpretations of learning and knowledge:

> Continuous learning with clear purpose and connection to the real-world is critical to developing the capabilities, dispositions and literacies required to participate in society and to deal with the complexity of issues and change. Knowledge is situational, complex, diverse and rapidly changing. Learning is inquiry-focused, requiring application construction and creation of knowledge. Learners connect understandings across disciplines, applying key concepts and evaluating multiple solutions within ethical frameworks. This requires high levels of personalisation and collaboration. (MCEETYA, 2005b, p. 5)

New literacy skills, and innovative applications of ICT that support learning across all ages and curriculum areas and promote problem-solving, communication and collaboration, creative and critical thinking, motivation and risk-taking, were considered pivotal to student learning. The expected educational outcomes were focusing on developing students ICT capabilities and digital literacy.

Even though the strategic areas outlined in Learning in an Online World (MCEETYA, 2000) remained priorities, the focus of this policy document was on people and equity. The notion of equitable learning with ICT had also been reconstructed and

embodied increased options, access, participation and achievement for all students. Continuous professional learning is considered essential in supporting staff to "critically integrate ICT in learning and teaching" (MCEETYA, 2005b, p. 7). Leadership, communication, collaboration and partnerships are viewed as strengthening individual and institutional capabilities for successful integration of ICT for student learning. This endorses earlier claims that the traditional learning environment has been redefined by promoting flexible learning spaces:

> School, home and community spaces will increase flexibility, with learning taking place outside the boundaries of school buildings and beyond the school day: requiring connected access to resources anywhere, anytime. (MCEETYA, 2005b, p. 9)

In 2007 the new Australian Federal Government made a strong commitment to creating equitable learning opportunities for all Australian students. The ruling Australian Labor Party promised to deliver an education revolution for Australia's economic future, and The New Directions Discussion Paper (The Australian Labor Party, 2007) have identified human capital as a driver of productivity and growth. As part of the investment into developing human capital, the new Australian Government made a commitment to provide every high school student from year 9 to year 12 with access to a computer in schools (including 896 secondary schools nationwide) and deliver 116,820 computers for secondary school students.

2.2.2   *The Victorian policy context*

In the last two decades the Victoria State Government took a leading role in both resourcing schools and developing policy initiatives (Fluck, 2001), thus helping to reinforce the links between the needs of the new economy and the transformation of learning. In order to make ICT ubiquitous in student learning, the Victorian Government has provided significant funds to:

- grant access to computers in every classroom,
- provide teachers and school principals with Notebook computers (or laptops),
- provide and improve Internet connectivity for all Victorian government schools,

17

- develop online content and resources for learning and information purposes, and
- facilitate teacher professional learning and development related to the integration of ICT in teaching and learning.

Several initiatives were established to ensure equal student access to computers for learning in Victorian government schools. Grants were provided to every Victorian government school to sustain and refresh their ICT infrastructure. One of the most fruitful initiatives has been the Notebooks for Teachers and Principals Programme. Established in 1998 by the Victorian Department of Education and Training, which was one of the first projects of that kind in the world. Since then the purpose of the Notebook Programme has been to encourage teachers and principals to integrate ICT with their classroom and administrative practices by providing them with Notebook computers on three-year replacement periods. Teachers and principals taking part in this programme have been required to make regular use of Notebook computers through, planning teaching, professional learning and the promotion and development of eLearning (DE&T, 1998).

There have also been significant improvements to Internet connectivity. According to a 2006 media release from the state Minister for Education Services (Victorian State Government, 2006a), Victoria took leadership in Australia in providing more than half a million students from 1600 government schools with secure wireless network connection, opening up opportunities for learning that goes beyond the classroom.

Apart from providing learners and teachers with access to ICT infrastructure, the Victorian Government developed several initiatives accompanied with online content to support student learning, school management, teacher collaboration and connectedness in the community, such as SOFWeb, the Global Classroom Project, the Victorian Education Channel, the Edumail service, and the Technical Support for Schools Programme.

The all-embracing ICT infrastructure, including hardware and online content, with comprehensive technical support, has been accompanied by a progressive pedagogical vision about educating young Victorians for the information economy and the knowledge society.

In 2003 the Victorian State Government released the Blueprint for Government Schools: Future Directions for Education in the Victorian Government School System, which positions education as the State Government's number one priority, and one of the

18

most fundamental investments "towards securing the future wellbeing of Victorians" (DE&T Victoria, 2003, p. 1). The document focused on improving student outcomes especially in the areas of literacy and numeracy and identified the following key areas for educational reform:

- recognizing and responding to diverse student needs,
- building the skills of the education workforce to enhance the teaching–learning relationship,
- continuously improving schools. (DE&T Victoria, 2003, p. 11)

The Blueprint emphasised the need for collaboration and partnerships between the department, schools, parents and the broader community. It prioritised teacher professional development by investing AU$5 million each year in order to help teachers meet the diverse needs of their students, improve classroom practices and relationships. It left behind the existing Curriculum and Standards Framework II (CSF II) (VCAA, 2002) for its "apparent inflexibility ... and inability to cater for different learning styles" (DE&T Victoria, 2003, p. 14), and recognised the importance of interdisciplinary learning, collaboration and school-based curriculum programmes by setting the scene for a new framework of essential learnings underpinned by directions drafted in the Improved educational outcomes: A better reporting and accountability system for schools (DE&T Victoria, 2002) document released by the Victorian Government.

New directions for the integration of ICT in learning and teaching have been promoted also by the Victorian Essential Learning Standards (VCAA, 2005). While the previous Curriculum Standards Framework, CSF II (VCAA, 2002), focused on integrating ICT in the Key Learning Areas (KLAs) in order to develop technical skills, the Victorian Essential Learning Standards, VELS (VCAA, 2005), that replaced CSF in Victorian Schools in 2006, considered ICT as an interdisciplinary domain that "focuses on providing students with the tools to transform their learning and to enrich their learning environment" (VCAA, 2005). These tools are expected to enable students to:

- develop new thinking and learning skills that produce creative and innovative insights,
- develop more productive ways of working and solving problems individually and collaboratively,

- create information products that demonstrate their understanding of concepts, issues, relationships and processes,
- express themselves in contemporary and socially relevant ways,
- communicate locally and globally to solve problems and to share knowledge,
- understand the implications of the use of ICT and their social and ethical responsibilities as users of ICT. (VCAA, 2005)

No matter how optimistic the above detailed policies and government strategies for the integration of new technologies have been, so far they have not resulted in substantial change in the social practices of teaching and learning. One of the reasons was their limited focus on teacher agency and teachers' capacity to facilitate pedagogical transformation in schools utilising the potential of ICT.

2.2.3 *Utopian aspirations or realistic goals?*

A number of authors argued that apart from deploying state-of-the-art technological infrastructure into schools, successful technology integration needs to embrace the development of human capacities that would enable teachers to engage with these new tools of profession (Lankshear et al., 1997; Lankshear, Snyder, & Green, 2000; Moyle, 2005).

In her recent review of Australian policies related to ICT in school education, Moyle (2005) argued that it is utopian to believe that "technologies will bring about an improved future for all" (p. 5) and contribute to new social realities by transcending current boundaries set by time and space. Moyle saw the solution in reconceptualising the relationship between people and technologies. She called for new visions that place the members of the school community as "creators either of or with technologies" (p. 6). In her article she referred to an earlier project funded by the Department of Employment, Education, Training and Youth Affairs funded project, Digital Rhetorics (Bigum et al., 1997; Lankshear et al., 1997) that provided a three dimensional model of learning and teaching with technologies including the operational, cultural and critical dimensions. The authors' report was based on a two-year study investigating the interactions and relationships between literacy technology and teaching and learning focusing on these three dimensions. The operational dimension involved the technical and mechanical skills of being able to read and write using different media. The cultural dimension referred to

understanding the relevance of text and information "to the contexts – and real-life practices in which they are produced, received and used" (Bigum et al., 1997, p. 17), while the critical dimension embraced the ability of people to "innovate, transform, improve and add value to social practices and literacies associated with them" (Bigum et al., 1997, p. 17).

Drawing on the above literature this dissertation argues that innovation, transformation and change cannot occur without helping teachers develop a critical understanding of the complex interplay between pedagogy and ICT in the context of the knowledge society. In order to understand the interconnectedness of pedagogy and ICT it is necessary to discuss the epistemological stances and pedagogical theories that inform the integration of ICT in teaching and learning.

2.3 Deconstructing the relationship between ICT and pedagogy

This section provides an overview of theoretical and pedagogical perspectives related to ICT integration. It evaluates dominant discourses, epistemological frameworks and theories of learning that have been influencing the deployment of new technologies into schools and their integration in learning and teaching.

2.3.1 Critical perspectives on technology-driven educational reform

Two major discourses have emerged around the deployment of ICT in schools: the dominant discourse of educational reform, the "visionary narrative of the information society" as referred to by Drenoyianni, (2006, p. 401), and the critical perspective on the "technology-driven reform" (Ferneding, 2003, p. 41). According to Drenoyianni (2006), the visionary narrative has been driven by the hidden agendas of global market economies and views ICT as a catalyst for educational and social change. It associates the deployment of ICT with improved student outcomes, more effective practices of teaching and learning, which can better prepare the new generations for their future workplaces. Critical perspectives on technology-driven change in education "examine the significance of the dialectic between the two spheres of educational reform discourse with regards to the construction of social visions within a technological society" (Ferneding, 2003, p. 41). While these critical views occasionally reveal "neo-Luddite" undertones (Apple, 2003, p. 456) they pinpoint important issues and ask important questions that keep us alert in these

times of "technological somnambulism" (Langdon, 2004, p. 104). Central to the critique of "technologizing education" (Law, 2006, p. 1) are unsubstantiated promises linked to the integration of new technologies in schools, value-free, culturally neutral interpretations of technological artefacts, and their often unquestioned role in reconstructing existing structures and power relationships in the global society.

According to Drenoyianni (2006), technological progress is associated with educational change and new technologies are often viewed as "an agent for change and a substitute for education" (p. 401). However, this totemistic view of ICT could bring us to the conclusion that technology is a value-free, "apolitical and a-historical treatment" (Drenoyianni, 2006, p. 411) that will change the rigid structures of the education establishment. Drenoyianni argued that in the current context educational media and tools become assimilated into current practices and "further reinforce established educational goals, curriculum contents, teaching and learning methods ... and, to a certain degree, exacerbate prevailing socioeconomic problems and current educational conditions" (p. 401). Yet she believed that in progressive educational settings, where ICT promotes student participation, expression, reflection and creation "ICT represents an interesting, challenging and essential educational theme, one of the necessary keys for unlocking, understanding and participating in a competitive, demanding and insecure world" (Drenoyianni, 2006, p. 401).

The idea of culturally neutral technologies had been also problematised by Apple (2003), Bromley (1998), Bowers (1998) and Lankshear (1998). Like Drenoyianni, Apple (2003) argued that technology is perceived as an "autonomous process" (p. 440), with a "life of its own, independent of social intentions, power, and privilege" (p. 440). He asserted that technology is not merely an "assemblage of machines and accompanying software" (p. 454) but it "embodies a form of thinking that orients the person to approach the world in a particular way" (p. 454).

Bromley (1998) and Bowers (1998) viewed new technologies as culturally non-neutral tools framed by economic rationalism and globalisation. Bromley (1998), however, regarded new technologies as a symbol that allows different values to be attached to them. He argued that the power of symbol related to values and assumptions attached to the nature and uses of technology. He maintained that one of the assumptions is that computers will benefit the learning of all students as a "neutral instrument with no connection to the unequal distribution of power along lines of gender, race, class,

22

religion, and ethnicity; that access to such technology is a guarantee of upward social mobility..." (Bromley, 1998, p. 6). In Bromley's opinion this does not depict the reality as new technologies are involved in the "construction and use of power: in the way they are designed and built, in how they are sold and to whom, and in how they are used" (p. 6), which indicates that the relevant issues around the integration of new technologies are not technical but social. According to Bromley, it is important to question existing power relations and look for constructing alternative contexts in favour of more progressive outcomes.

Concerns about the influence of economic rationalism and techno-determinist worldview forced upon education are further accentuated in Lankshear's (1998) critique of current directions in educational reform. Lankshear argued that the current "intrusive, highly regulatory techno-rationalist business world view" (p. 313) is also manifested in educational reform, and powerfully influences existing social practices. In his opinion this worldview "reduces human goals and values to constructs which can be broken down into material tasks, steps, categories, and processes, etc. and tackled in systematic ways using appropriate tools and techniques applied in a means-to-ends fashion" (p. 313).

These perspectives on the role and manifestations of technology in human society, education reform and existing social practices reflect the paradigms and epistemologies in which they were conceived and promote "certain visions of knowledge and notions of who counts as a knowing subject" (Bromley, 1998, p. 2).

2.3.2 *Theoretical and epistemological foundations of ICT in education*

As the previous argument illustrates, existing paradigms and dominant epistemologies have a powerful influence on ways of using new technologies to improve student learning and outcomes. They determine what constitutes knowledge, shape the way we envisage our social futures, educational goals and have an effect on relationships between teachers, learners and their communities. According to Jonassen and Land (Jonassen & Land, 2000), new technologies have the potential to enable and extend underlying assumptions and pedagogical approaches.

The following sub-sections provide a sketch of dominant paradigms and accompanying epistemologies of learning in the recent history of education. They examine four epistemological models for the integration of new technologies: behaviourism, cognitivism, constructivism and connectivism, and also explore

sociological and organisational interpretations of integrating new technologies into teaching and learning. The analysis focuses on the nature of knowledge, the nature of learning, the learning environment, the role of technology in student learning, the changing roles of teachers and learners, the emergence of a "new epistemological infrastructure" (Kincheloe, 2005, p. 42) for reconceptualising teacher professionalism, and the social and organisational consequences of technology integration.

2.3.2.1 *Behaviourism and the technology of instruction*

Behaviourism is a school of psychology influenced by pragmatism, functionalism and experimental animal psychology (Todd & Morris, 1995). Critics of behaviourism associated it with evolutionary epistemology that assumed that "knowledge is entirely a product of our evolutionary history" (Staddon, 2004, p. 234). Behaviourist approaches to student learning have dominated education in the 20th century. Their influence on teaching and learning can still be observed in educational institutions around the world. These approaches rest on the shoulders of giants such Pavlov, Watson, Thorndike, Skinner, Keller, Binet and Terman, who made significant contributions to understanding human behaviour. The basic assumption of behaviourist approaches to learning is that learning results in a change in behaviour that can be observed and measured (Skinner, 1974; Thorndike & Hagen, 1969). Change in behaviour must be evaluated and assessed by carefully designed means of psychometrics, such as direct observation and tests. The goal of the learning process is strongly linked to learning outcomes and assessment of learning. Learning is a response to external stimuli, through classical conditioning (Pavlov, 1927) or operant conditioning (Skinner, 1984; Thorndike, 2000), and is strongly influenced by reinforcement, which comes in a form of reward/punishment or consequences (Skinner, 2005). However, behaviourist interpretations of learning and learners are often oversimplified and taken out of context in contemporary literature (Burton, Moore, & Magliaro, 2004; Catania & Harnad, 1988; Gaynor, 2004). Gaynor (2004) argued that many authors over-generalise and are making exaggerated claims. Examples of such approaches are linking radical behaviourism to logical positivism; and the myth 'tabula rasa' (blank slate) which is incompatible with Skinner's view of the learner who, in his own words, "does not passively absorb knowledge from the world around him, but must play an active role" (Skinner, 1968, p.5).

Behaviourist applications of instructional technology are based around basic principles related to the role of the learner, the nature of learning, and the generality of

24

learning principles (Burton et al., 2004). According to Burton et al., learning occurs "by doing, experiencing and engaging in trial and error" (p. 9). The emphasis is on the active responding of the learner who "must be engaged in the behaviour in order to learn and to validate that learning has occurred" (p. 9). As discussed above the nature of learning is defined as "a change of behaviour due to experience" (p. 9). Central to learning is content. The learning material, based around the content, is delivered in contingencies or sequences that are broken down into small steps. The steps are taking the learner from simple to more complex task and reward him/her upon successful completion. Behaviourists claim that learning follows universal laws and "the basic processes that promote or inhibit learning are universal to all organisms" (Burton et al., 2004, p. 9)

The implications of behaviourist principles for learning environments have been summarised by Wilson (2000, p. 62) and are presented in the Table 2.1.

Table 2.1 Behaviourist insights for designing learning environments

Learn by doing	People learn best by actively engaging in tasks. This is commonly called practice or learning by doing.
Taxonomies	Learning outcomes can be differentiated in their type and complexity—for example, simple S-R bonds, concept classification, and rule-following. Such learning outcomes are compiled into classification schemes called learning taxonomies, which in turn guide selection of learning objectives and instructional strategies.
Conditions of learning	For each type of learning, conditions can be identified that lead to effective learning. Identifying optimal conditions of learning forms the basis of prescriptive instructional theory using the formula: To accomplish X learning outcome, apply or arrange for Y conditions.
Behavioral objectives	Instruction should be based on clear, behaviorally specified learning objectives. Explicit formulation of objectives helps link instructional goals with evaluation and assessment, leading to increased accountability.
Focus on results	Teachers and schools should be accountable for their students' learning. Measurable behaviors are the best index of true learning outcomes and should be used to gauge instructional effectiveness.
Alignment	Good instruction exhibits an alignment or consistency between learning objectives, instructional strategies, and strategies used to assess student learning. Misalignment of these components results in inadequate or unfair instruction.

(table continues)

25

Table 2.1 Behaviourist insights for designing learning environments   *(continued)*

Task decomposition	People learn best when complex tasks are broken down into smaller, more manageable tasks and mastered separately.
Prerequisites	Subtasks often become prerequisites to larger tasks. That is, students learn the larger task more easily when they have first mastered the subtasks. This leads to parts-to- whole instructional sequence.
Small successes	Subtasks have another advantage: They allow students to succeed. Succeeding at tasks is reinforcing, resulting in greater motivation to continue.
Response-sensitive feedback	People learn best when they know the correctness of their efforts. When performance is not correct, specific information should be conveyed concerning what was wrong and how to improve the next time.
Science of instruction	Educators need to be precise and systematic in their thinking, their teaching, and their evaluation of students. Education can be treated as an applied science or technology, where through empirical inquiry, principles are discovered and applied.
Performance support	People need support as they perform their jobs, through the use of job aids, help systems, and feedback and incentive systems. On-the-job, just-in-time training and support works best. In general, the closer the training is to job conditions, the more effective learning will be.
Direct instruction	Giving clear directions, well prepared presentations, suitable examples, and opportunities for practice and transfer--are proven methods that result in substantial student learning.
Pretesting, diagnostics, and placement	Students should not all be forced to endure the same instructional program. Instead, instruction should branch into alternative treatments according to prior skills, motivation, and other critical variables.
Transfer	In order to be able to transfer a skill from one task to another, students need practice doing it. If students never have opportunities to practice transferring their skills, they should not be expected to be able to perform on demand in test situations.

Note. Source: Wilson (2000, p. 62)

According to Gillani (2003), the principles of behaviourist theories of learning have been successfully applied to instructional designs integrating technology in multimedia and e-learning environments. Such instructional designs are: Carroll's Mastery Learning; Skinner's Programmed Instruction; Personalised System of Instruction; Teaching to the Test; and Direct Instruction Model. These applications of educational technologies utilise

instructional approaches to learning such as tutorials and drill and practice tasks that are often criticised by contemporary literature on ICT. According to Yelland (2007), such applications of new technologies do not use their potential to engage students in new learning experiences, and in Bowers' (1998) opinion "amplify decontextualized forms of knowledge" (p. 79).

2.3.2.2 Cognitivism in education and new technologies

Cognitivism emerged in the 1950s as an alternative to behaviourist conceptions of learning. It was a response to the growing need for understanding the mental processes in human beings, such as perception, memory, attention and thinking. Cognitivism in education was influenced by new developments in cognitive sciences such as psychology, mathematics, cybernetics and linguistics (Nahalka, 1997). Theories of learning based on cognitive developmental research focused on mental processes by which knowledge was acquired and retrieved in order to solve problems (Gillani, 2003).

Departing from behaviourist explanations of learning, cognitivists brought the mind to the centre of psychology (Wilson, 2000). However, like their behaviourist counterparts, cognitivists also emphasised the importance of empirical research as a legitimate pathway in arriving at new understandings. According to Wilson, cognitive researchers used methods such as reaction-time experiments, eye-movement studies and think-aloud protocols to develop "computational models of the human mind that filled many of the gaps left by behaviourism" (p. 63).

The following key ideas and theoretical stances have shaped the development of cognitive theories of learning:

- Tolman's pioneering work on purposive behaviour and cognitive maps (Tolman, 1967; Tolman, 1990),
- Piaget's theory of cognitive development (Piaget, 1952),
- Vygotsky's Marxist psychology and social constructivism (Vygotsky, 1967, 1986),
- Blooms's Taxonomy of Educational Objectives (Bloom, 1956),
- Ausubel's theory of Advance Organizers (Ausubel, 1960),
- Gagne's Nine Events of Instruction (Gagné, 1985),
- Bandura's social cognitive theory (Bandura, 1989), and

- Bruner's views on education, and his theory on categorisation (Bruner, 1986; Bruner, 1990).

There are two main schools of cognitivist interpretations of learning that influenced the use of new technologies in education (Jonassen, Davidson, Collins, Campbell, & Haag, 1995; Wilson, 2000): symbolic cognition or Information Processing Theory, and situated cognition.

Symbolic cognition or Information Processing Theory (IPT) has shaped the early cognitivist theory of learning environments and instructional design. According to Lewis' explanation in the MIT Encyclopaedia of Cognitive Sciences (Lewis, 1999), symbolic models of human cognition are perceived as computational processes. These cognitive models are made up of a set of procedures that enable the performance of specific tasks, such as memory tasks, language comprehension and problem-solving. Lewis (1999) argued that scientific explanations of these models come from cognitive psychology and artificial intelligence, which provide the theoretical foundations of symbolic cognition or IPT.

IPT had a significant influence on instructional design towards the end of the 20th century. It was anticipated that artificial intelligence and expert systems would replace the teacher. Distance learning and early online learning environments held hopes for automatising the learning process. Situated cognition viewed children's growth in knowledge "as a series of stages from concrete to abstract forms of reasoning or as accumulation of procedural and declarative knowledge about the world" Wilson (2000, p. 64). Wilson argued that children "make sense of their worlds by reference to schemas, mental models, and other complex memory structures" (p. 64). In his opinion "differences between encountered experience and schemas can prompt further inquiry and reflection to resolve the conflict. Instruction should help learners assimilate and accommodate new information into existing schemas and cognitive structures" (p. 64).

Situated cognition is the other cognitive theory of learning. According to Wilson (2000), situated cognition departs from rigid models of IPT and symbolic computation. It focuses on "conscious reasoning and thought" (p. 65) and the context of situated action. Situated cognition is often associated with social constructivism (Wilson, 2000, p. 65).

Jonassen, Davidson, Collins, Campbell, & Haag (1995) argued that while cognitivism represented a paradigm shift from behaviourism, symbolic learning and situated learning

represented two distinct schools of thought. According to Jonassen at al. (1995), proponents of symbolic reasoning represented the traditional objectivist paradigm. They perceived the world as a structure that can be "modelled and mapped onto the learner, and that the goal of the learner was to 'mirror' reality as interpreted by the instructor" (p. 10). Because knowledge was thought to be external to the knower it was believed that it could be transmitted from one person to another (Jonassen et.al, 1995, pp. 10-11).

According to Jonassen et al. (1995), unlike symbolic reasoning, situated learning rests on different epistemological assumptions about the learner and learning. This is how they describe this new paradigm:

> Constructivism (which provides the psychological/philosophical foundation for situated learning) begins with a different set of assumptions about learning. Constructivists believe that our personal world is constructed in our minds and that these personal constructions define our personal realities. The mind is the instrument of thinking which interprets events, objects and perspectives rather than seeking to remember and comprehend an objective knowledge. The mind filters input from the world in the process of making those interpretations. The important epistemological assumption of constructivism is that knowledge is a function of how the individual creates meaning from his or her experiences; it is not a function of what someone else says is true. Each of us conceives of external reality somewhat differently, based upon our unique set of experiences with the world and our beliefs about them. (Jonassen et.al, 1995, p. 11)

The authors argued that constructivist educators strive to create learning environments that require active participation of the learner with the learning environment "in order to create a personal view of the world" (p. 10). Furthermore, the purpose of this new theory of learning was not to "predict the outcomes of instructional interventions" (p. 10) but as Bruner (1990) said to encourage learners to discover new meanings through their encounters with the world. Jonassen et al. (1995) maintained that this new learning theory "transcended the behaviourism–cognitivism dialectic and entered a new era of theorizing" (p. 9). The authors' summary of the features of these two distinctive cognitive theories is presented in the Table 2.2.

Table 2.2 Contrasting assumptions of paradigms

Symbolic Reasoning		Situated Learning
	Knowledge	
Objective		Subjective
Independent		Contextualized
Stable		Relative
Applied		Situated in Action
Fixed		Fluid
	Learning	
Objectivist		Constructivist
Product-oriented		Process-Oriented
Abstract		Authentic
Symbolic		Experiential
	Memory	
Stored Representations		Connections , potentials
	Knowledge representation	
Functionally equivalent to the real world		Embedded in experience
Replication of expert		Personally constructed
Symbolic, generalized		Personalized
	Instruction	
Top down		Bottom up
Deductive		Inductive
Application of Symbols		Apprenticeship
	Computational model	
Symbolic reasoning		Connectionist
Production rule		Neural network
Symbol manipulations		Probabilistic, embedded

Note. Source: Jonassen et, al. (1995, p. 10)

Jonassen et al.'s theoretical framework revealed a powerful shift in the way the knowledge-learner-teacher-technology relationships were conceptualised. Similarly to other transitions in pedagogical thought, this shift reflected the hallmarks of fresh and emerging schools of thought of the second half of the 20th century in social and natural sciences, such as postmodernism (Foucault, 2002; Giroux, 1992; Heidegger, 1977; Wittgenstein, 1953) and constructivism (Glasersfeld, 1995b; Piaget, 1970; Vygotsky, 1978, 1986), the theory of probability (Kolmogorov, 1956), neural networks and Fuzzy Logic (Kosko, 1993; Zadeh, 1973).

Cognitive theories of learning made a significant contribution to the design and development of constructivist learning environments integrating new technologies, especially in the fields of inquiry training, hypermedia, discovery learning and simulation (Gillani, 2003). According to Gillani, cognitivists viewed technology as a tool for creating instructional materials and learning environments that allow children to "construct, test, and refine their own cognitive representations of the world" (p. 64).

In his book on Learning theories and the design of E-learning environments (Gillani, 2003), Gillani emphasised the contribution of Seymour Papert, Robert Davies, Duffy, and Jonassen. Papert, built on Piaget's work (with whom he worked for a number of years), and developed the LOGO project, a "computer-based discovery learning approach" (2003, p. 62), that enabled children to construct their own knowledge. He also created Microworlds, a learning environment which allows young children, to become designers, constructors and explorers. Robert Davies was another prominent figure in using technology to design constructivist learning environments. Davies made a significant contribution to the development of multimedia and hypermedia through his Plato project that combined text, graphics, animation and audio and the development of interactive textbooks. Gillani (2003) claimed that the Plato project inspired the development of multimedia authoring software such as Hyperstudio, Director, and Flash that enable teachers to create their own interactive, multimedia teaching material. Duffy and Jonassen's (Duffy & Jonassen, 1992) application of constructivist ideas to learning with new technologies provided an alternative framework to early computational views of cognition. According to Kerr (2004), this new epistemological framework redefined the role of the learner and interpretations of how knowledge is constructed.

2.3.2.3   *Moving forward on the constructivist continuum with ICT*

Constructivism has its foundations in philosophy, psychology, cybernetics (Winn, 2004), and in cultural history (Glasersfeld, 1989). The philosophical roots of constructivist thought relate back to Kant's idea of the human cognitive apparatus, Kuhn's analysis of scientific revolutions and paradigms, Dewey's conceptualisations of knowledge and knowing, Piaget's cognitive theories of personal development, and Vygotsky's interpretations of the impact of the social-cultural environment on learning.

Constructivism is an umbrella term for several schools of thought, such as social constructivism, radical constructivism and critical constructivism, that question

traditional notions of knowledge, knowing and knowledge production (Glasersfeld, 1989). According to von Glasersfeld (1995a), constructivism emerged "out of a profound dissatisfaction with theories of knowledge in the tradition of Western philosophy" (p. 6). This Western philosophical tradition is often referred to as objectivism. Kincheloe (2005) argued that "objectivism is grounded on the rationalist myth of cold reason" (p. 13) and exists as a "scientific discovery of external reality" (p. 13).

The following constructivist ideas relevant to new learning with ICT are reviewed in this section: Jonassen's model of constructivist learning environments, Lombardi's description of authentic learning experiences, Vygotsky's Zone of Proximal Development (ZPD) and its relevance to learning with new technologies, and Kincheloe's critical constructivist interpretation of teacher professionalism. These ideas provide the theoretical foundations for creating meaningful and relevant educational experiences for both students and teachers that will prepare them for the challenges and uncertainties of living, learning and working in a digital world.

Constructivist theories of learning are based on the premises that learning is both individually and socially constructed by learners through their interactions with the world (Jonassen, 1999b). Constructivist learning environments rest on these assumptions and represent an "antidote to reproductive learning" (Jonassen, 1999b, p. 1). Such learning environments engage learners in active, manipulative, intentional, complex, authentic, collaborative, conversational and reflective learning activities (Jonassen, 1999b, 2001). In Jonassen's opinion constructivist learning environments support the adoption of problem-based, project-based, case-based, and issue-based learning. In his opinion, new technologies, especially web-based resources provide valuable tools and resources, for scaffolding such learning experiences. His model of constructivist learning environments (Jonassen, 2001), shown in Figure 1, reflect these principles.
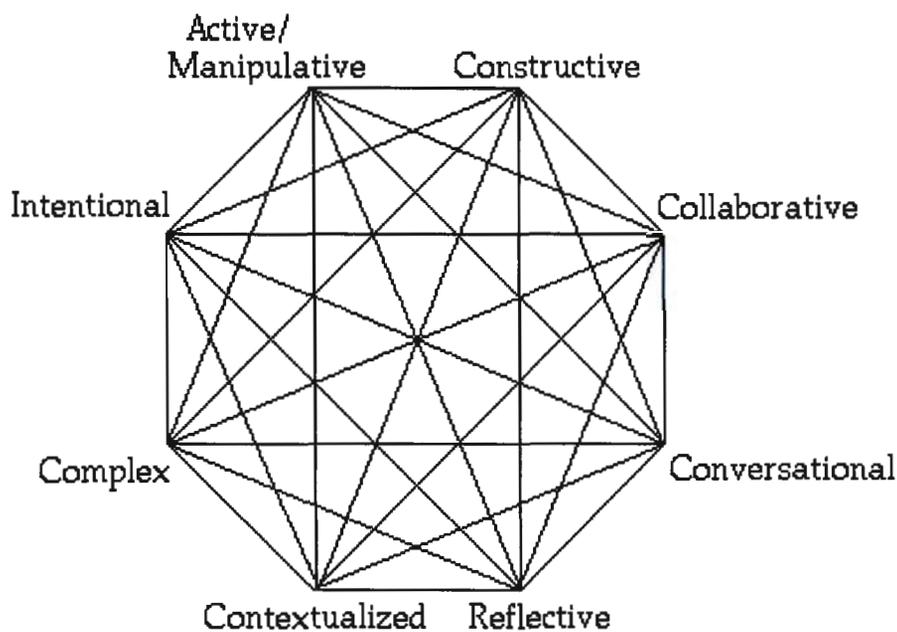
Figure 2.1 Jonassen's model of constructivist learning environments (2001)

Constructivist learning is authentic, that is, it makes meaning from practice related to learners' personal contexts, and is based on scaffolding and social interaction. Yet most learning in schools occurs in learning environments that are abstract and decontextualised (Brown, Collins, & Duguid, 1989; Kolb, 2000; Polly, 2003). Lombardi (2007) argued that new technologies facilitate new forms of authentic learning that bring students into "meaningful contacts" (p. 2) with the real world. In Lombardi's opinion: "authentic learning typically focuses on real-world, complex problems and their solutions, using role-playing exercises, problem-based activities, case studies, and participation in virtual communities of practice" (p. 2). She identified ten design elements that constitute the essence of authentic learning experiences. The ten design elements are presented in Table 2.3.

Lombardi (2007) argued that new technologies provide numerous tools that foster authentic learning such as web-based learning environments, social networking applications, intelligent tutoring systems, simulation, etc. However, she noted that access to these tools "may not guarantee an authentic learning experience without the most important factor: community" (p. 6).

Table 2.3 Design elements of authentic learning experiences

Real-world relevance	Authentic activities match the real-world tasks of professionals in practice as nearly as possible. Learning rises to the level of authenticity when it asks students to work actively with abstract concepts, facts, and formulae inside a realistic—and highly social—context mimicking "the ordinary practices of the [disciplinary] culture."
Ill-defined problem	Challenges cannot be solved easily by the application of an existing algorithm; instead, authentic activities are relatively undefined and open to multiple interpretations, requiring students to identify for themselves the tasks and subtasks needed to complete the major task
Sustained investigation	Problems cannot be solved in a matter of minutes or even hours. Instead, authentic activities comprise complex tasks to be investigated by students over a sustained period of time, requiring significant investment of time and intellectual resources.
Multiple sources and perspectives	Learners are not given a list of resources. Authentic activities provide the opportunity for students to examine the task from a variety of theoretical and practical perspectives, using a variety of resources, and requires students to distinguish relevant from irrelevant information in the process.
Collaboration	Success is not achievable by an individual learner working alone. Authentic activities make collaboration integral to the task, both within the course and in the real world.
Reflection (metacognition)	Authentic activities enable learners to make choices and reflect on their learning, both individually and as a team or community.
Interdisciplinary perspective	Relevance is not confined to a single domain or subject matter specialization. Instead, authentic activities have consequences that extend beyond a particular discipline, encouraging students to adopt diverse roles and think in interdisciplinary terms.
Integrated assessment:	Assessment is not merely summative in authentic activities but is woven seamlessly into the major task in a manner that reflects real-world evaluation processes.
Polished products:	Conclusions are not merely exercises or substeps in preparation for something else. Authentic activities culminate in the creation of a whole product, valuable in its own right.
Multiple interpretations and outcomes:	Rather than yielding a single correct answer obtained by the application of rules and procedures, authentic activities allow for diverse interpretations and competing solutions.

Note. Source: Lombardi (2007, pp 3-4)

The significance of communal learning was emphasised by Holmes, Tangney, FitzGibbon, Savage, and Mehan (2001), according to whom theories of social constructivism combined with new technologies open up new ways of learning within communities of learners. They argued that learning becomes a "social and collaborative activity that is facilitated rather than directly taught by the teacher" (p. 315). Such collaborative environments foster cognitive and social development and help learners extend their problem-solving skills.

One of the pioneers of recognising the implications of the social context for learning was Lev Vygotsky. He identified two levels of cognitive development: the actual developmental level, and the Zone of Proximal Development (ZPD) (Vygotsky, 1978). Learners' actual developmental level reflects their cognitive maturity related to the "development of mental functions that has been established as a result of certain already completed mental cycles" (Vygotsky, 1978, p. 85). Through social interaction, such as scaffolding or collaboration in multi-age settings, the boundaries of the actual developmental level related to problem-solving can be extended. In such situations learners move into a new zone of cognitive maturity, the ZPD, which, according to Vygostky, is the "distance between the actual developmental level as determined by individual problem-solving and the level of potential development as determined through problem-solving through adult guidance or in collaboration with more capable peers" (p. 86). Vygotsky's theory is highly relevant for learning in the information age (Holmes et al., 2001), with research studies (Masters & Yelland, 2002; Salomon, Globerson, & Guterman, 1989; Siraj-Blatchford & Siraj-Blatchford, 2006) showing that new technologies are tools and resources that provide opportunities for higher-order thinking, inquiry and problem-solving under guidance or in collaborative settings.

While theoretical perspectives discussed in this chapter are primarily concerned with the construction of knowledge by the learner and communities of learners, critical constructivists emphasise the links between teachers' professional knowledge and epistemological frameworks. As previously stated, knowledge is created through interactions and experiences within our socio-cultural reality. According to critical constructivists thought, understandings and sensations of individuals cannot be separated from their histories and social contexts (Kincheloe, 2005). Kincheloe argued that "critical constructivist knowledge emerges neither from subjects, nor from objects, but from the dialectic relationship between the knower (subject) and the known (object)" (p. 42) and is

subject to evaluation. Critical constructivism is organically related to teacher professionalism. It provides a platform for building a "new epistemological infrastructure" (p. 42) that "empowers teachers with a sense of purpose" (p. 66) and "responsibility for student learning" (p. 67). Kincheloe recognised the "socio-political and cultural dimensions of teachers as knowledge deliverers" (p. 68), and advocated for the inclusion of teachers in dialogues about educational reforms. He argued that central to critical constructivist notions of teacher professionalism is improving teachers' scholarship and pedagogical skills which, in turn, enables them to "take charge in constructing their own pedagogies" (p. 69). According to Kincheloe, "such empowered teachers will no longer need old models of pre-service and in-service training that seek to dictate their work" (p. 67), but will have the abilities to take responsibility for student learning.

Kincheloe's position on teacher professionalism is especially important for teaching and learning with ICT in the knowledge society. He proposes fundamental changes to the role of the teacher who will not only be able to scaffold the process of learning but will develop a critical understanding of the "information-saturated context" (p. 73) of living and learning in the digital world; "develop methods of studying the cultural pedagogy of hyper-reality and its corporate curriculum" (p. 73) and monitor its socio-cultural and political impact.

2.3.2.4 Connectivism and the importance of social networks for learning

Connectivism is a learning theory offered by George Siemens (2004) that is inspired by previous work done in the field of networks (Barabási, 2003) chaos theory (Gleick, 1988), as well as self-organisation and evolutionary systems (Rocha, 1998; Wiley & Edwards, 2002). In his seminal article, A Learning Theory for the Digital Age, Siemens (2004) provided a critique of the three dominant learning theories behaviourism, cognitivism and constructivism. He argued that these theories were conceived in times where digital technologies did not dominate the fabric of our cultures, and therefore they are not reflective of "underlying social environments" (p. 1). He maintained that the "half-life of knowledge" (p. 1) has changed, and that the amount of knowledge generated in the past years, as well as the rate at what new knowledge is being produced calls for "new methods of deploying instruction" (p. 1). While he used this somewhat old-fashioned vocabulary, he proposed innovative ways of understanding the relationships between learners, learning and learning environments.

Siemens drew attention to some significant trends that in his opinion called for new epistemic foundations and explanations of learning. According to Siemens, learners will not stay in a single field over the course of their life. As a consequence informal learning will become an important aspect of life-long education. In his view learning and work cannot be viewed as separate activities, as learning occurs not only in formal educational settings, but also in communities of practice where learners develop new skills and understandings through personal interactions and work-related tasks. Siemens also argued that new technologies were tools that shaped and defined our thinking processes; and devoted considerable attention to knowledge management and organisational aspects of learning.

In his critique of existing learning theories Siemens observed that current theories of learning focus on the process of learning and not on the "value of what is being learned" (p. 3). He argued that in the current context of change pressures and rapid knowledge expansion "the need to evaluate the worthiness of learning" (p. 3) becomes a valuable meta-skill that needs to be applied before the learning begins. Another important skill is connection making. In his opinion "we derive our competence from making connections" (p. 4).

Siemens also challenged constructivist interpretations of meaning-making. Building on the principles of Chaos theory he explained that "chaos states that meaning exists – the learners' challenge is to recognise the patterns which appear to be hidden" (p. 4). Thus in his opinion learning becomes a process of self-organisation, which can happen at a personal level, or within institutional and other social networks and/or environments. He adopted Barabási's (2003) explanation of networks as "connections between entities" (p. 5), and argued that social networks behave like computer networks and that their participants (representing nodes) can be connected to an "integrated whole" (p. 5). Siemens defined learning as "actionable knowledge" (p. 5) that can "reside outside of ourselves (within an organisation or a database), is focused on connecting specialised information sets, and the connections that enable us to learn more are more important than our current state of knowing" (p.5).

While the starting point of connectivism is the individual. Siemens emphasised the importance of organisations and or social networks and their collective capacity to access, nurture, and maintain information and knowledge flow. He identified eight principles of connectivism:

- Learning and knowledge rest in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known.
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision. (Siemens, 2004, p. 6)

Siemens claimed to generate "tectonic shifts" (p. 7) with his new theory that relocates the focus from learning as an internal process, and from the individual as a learner to organisational learning with new technologies.

2.3.2.4 Sociological and organisational interpretations of integrating ICT in teaching and learning

Sociological and organisational interpretations of new technologies have been often associated with economic progress and efficiency in the knowledge society. It has been assumed, that new technologies will bring to education "efficiency, order and productivity" (Kerr, 2004, p. 113), and facilitate educational change, including the transformation of existing structures and organisational forms (Orlikowski & Yates, 2006) as well as social practices, which according to Giddens (1984) represent individual or collective human action, and are "performed for social reasons" (Tuomela, 2002, p. 78).

Kerr (2004) argued that this "mechanistic enthusiasm" (p. 113) expected new technologies to bring solutions to all educational problems and challenges, that would with the implementation of the 'right program' run schools and classrooms smoothly. Kerr observed a dialectic relationship between educational organisations and new

38

technologies. He said that while the way technologies are integrated into schools depends on the "patterns of organization" (p. 119), at the same time new technologies affect the life of organisations and often "translate over time into unexpected organizational and social consequences" (p. 119).

To understand the human, social, and organisational consequences of technology integration with social practices it is important to look at the ontological and epistemological foundations of contemporary theoretical explanations in social theory and organisational science. According to Orlikovski and Robey (1991), technology deployment can be interpreted from two different perspectives: the objectivist and the subjectivist perspective. The objectivist view assigns technology the role of a "discrete object ... capable of having an impact on social systems" (p. 146), while the subjectivist interpretation is based on the premise of social action and human interaction. In Orlikowski and Robey's opinion objectivist interpretations seem to be mechanistic and do not allow us to foresee the consequences of technology integration with social practices because they do not take into account the contextual and temporal nature of social action.

Based on the above interpretations new technologies can be viewed as "hardware", the "equipment, machines, and instruments humans use in productive activities" (Orlikowski, 1992, p. 399), or social technologies that embrace "the generic tasks, techniques and knowledge utilised when humans engage in any productive activities" (p. 399). These philosophically contrasting interpretations assign different roles to technology. According to Orlikowski (1992), early organisational researchers have assumed technology to have "deterministic impacts" on organisational structures, which explains views related to the role of new technologies as "a catalyst" or "agent" of educational change and school structures. Other researchers have been focusing on "the human action aspect of technology, seeing it more as a product of shared interpretations and interventions" (pp. 399-400). Orlikowski (1992) argued that more recent studies have combined the two perspectives and drew inferences between technology as a resource and the agency of human actors in organisational contexts.

This new approach to understanding the consequences of technology integration is based on Giddens' Structuration Theory (Giddens, 1984), where the abstract structures and human actors are in constant interaction (Giddens, 1984; Orlikowski, 1992). Giddens' Structuration Theory has been instrumental in bringing the findings of this multi-stage research project together through understanding the interactions between

human actors (teachers and learners), the structures and social contexts within which they operate (schools, classrooms, communities), and the structures (including rules and resources created by governments and schools) that have been influencing the social practices of teaching and learning with new technologies.

Giddens (1984) argued that human actors and contexts of social interaction are "positioned' relative to one another" (p. xxv) along the coordinates of time and space that translate into the "character of the physical milieu of day-to-day life" (p. xxv), embracing resources, rules and routines. Giddens maintained that routines or habitual action constitute the foundations of social life and provide its recursive nature. In his opinion routinisation is vital to human actors, granting them a sense of "trust and ontological security" (p. xxiii). In Giddens' opinion human actors try to make meaning of their social practices within a particular social context situated in time and space by "reflexive monitoring" (p. 5) of their activities. Through reflexive monitoring they rationalise their practices and develop theoretical understandings or personal theories of action. Reflexive monitoring and meaning-making help actors become knowledgeable agents capable of transforming their competence from 'practical consciousness' to 'discursive consciousness'. In other words, actors transition from the ability to perform the action to the ability to "report discursively about their intentions in, and reasons for, acting as they do" (p. 6) which provides them with agency. Human agency is guided by intentions, which in turn provide human agents with the ability to "intervene in the world" (Giddens, 1984, p. 14), and/or the "ability to transform social relations to some degree" (Sewell, 1992, p. 20). The ability/power of agents to initiate change is both constrained and enabled by rules (or cultural schemas according to Sewell) and resources which constitute the structures within which they operate. Giddens' premise that resources are media through which power is exercised is particularly interesting from the perspective of this study. It helps us understand the multiple tensions between structures and individual or collective agency in teaching and learning with new technologies that can result in reproduction of existing social practices, or alternatively, through new practices it can lead to innovation, evolution and educational change.

2.3.3   Towards new pedagogies and connected communities of learners

Our ability to learn what we need for tomorrow is more important than what we know today. (Siemens, 2004)

The digital natives (Prensky, 2001a), millennials (Howe & Strauss, 2000; Yelland, 2007) or neomillennials (Dede, 2007) are comfortably navigating their ways through the new avenues of life, leaving behind their teachers, classrooms and schools. With their lack of interest in what school has to offer, these young people are clearly indicating that there is a disconnection between learning in schools and real life experiences. According to Yelland (2007) and Loveless (2003), our learners grow up in a world where the social, cultural and technological conditions are vastly different from that of earlier generations, yet their school experiences are anchored in pedagogical paradigms of previous worlds. These new learners are growing up digital (Brown, 2002; Tapscott, 1998), and according to Brown (2002), they are always multi-processing. They do several things at the same time: work on their computers, listen to music, and talk on their mobile phones. They are growing up in a different "epistemic landscape" (p. 20) and in new "learning ecologies" (p. 27), which is in Brown's opinion an "open, complex adaptive system comprising of elements that are dynamic and interdependent" (p. 25).

In order to prepare tomorrow's learners for these new learning ecologies (Brown, 2002) and social futures (Cope & Kalantzis, 2000), we need to rethink pedagogies and practices, and create new contexts for learning that will provide students with relevant skills and knowledge for the 21st century (Dakich, 2008b; Yelland, 2007, 2008). In Yelland's (2007) opinion we should depart from practices that map new technologies onto old pedagogies and curricula and create new learning that is embedded in new pedagogical thinking. Similarly to Yelland (2007; 2008), Loveless and Ellis (2001) argued that new technologies challenged current interpretations of pedagogy and curriculum. They redefined our perceptions of learning environments, roles as relationship in the classroom, and the purpose of teaching and learning. In the authors' view ICT opened up possibilities that contest traditional ways of knowing, and challenge the "construction of school subjects and the boundaries between them" (p. 4).

But what does ICT bring to the classroom and how can it support student learning? According to Loveless (2003), the presence of ICT in the classroom evokes interest and excitement. Its potential to store, retrieve, organise, manipulate, present and communicate

41

large amounts of data and/or information takes off the chores and allows "children to think about the implications of the information with which they are dealing" (p. 7). Furthermore multimedia and the Internet enable students to access and view artefacts from around the world through databases, newspaper archives, online libraries, virtual museums, and the like. Loveless maintained that ICT provide learners with:

- access to information and enables them to use it in relevant and purposeful ways,
- opportunities to make connections between familiar and new areas of knowledge,
- possibilities of presenting their work in various and dynamic ways, involving sight, sound and movement,
- provisionality, allowing students to manipulate, modify, rework and change their work, and
- challenging, active, interactive, open-ended and experiential learning. (Loveless, 2003, pp. 7-8)

New technologies also have an impact on the role of the teacher (Frankowicz, Kedzierska, & Mirecka, 2006; Smeets & Mooij, 2001; Wheeler, 2001). The attributes of ICT described by Loveless (2003) make it a medium conducive for creating learner-centred environments, where the teacher becomes more of a facilitator, a coach, a designer and evaluator of learning experiences. Sutherland et al. (2004) argued that ICT "often challenge an existing practice of teaching and threaten a well-established knowledge domain" (p. 424). The authors viewed ICT as creative tools that have the potential to transform practices and knowledge. However, they asserted that "knowing how to use these tools to transform learning in schools is not so straightforward" (p. 424).

Several researchers argued that the transformation of learning and changes in teachers' practices and roles are slow and often insignificant (Cuban, 2000a; Cuban 2000b; Cuban, 2001; Reynolds, Treharne, & Tripp, 2003). These observations are consistent with Hargreaves' (Hargreaves, 2001) view, according to which the "process by which teaching is changing and teachers are changed ... is systemically ironic" (p. 3). "Teachers teach in the way they do not just because of the skills they have or have not learned. The ways they teach is also grounded in their backgrounds, their biographies, in the kinds of teachers they have become" (p. ix). Hargreaves' opinion indicates that the challenges of transforming teaching and learning with ICT go beyond having access to

42

ICT in the classroom and beyond and knowing how to operate them. In his opinion these challenges encompass much more, such as teachers' underlying philosophies and pedagogical understandings of how new technologies could facilitate more engaging and effective practices of teaching and learning.

In recent years a number of publications initiated new pedagogical thinking and laid the foundations for new social practices of learning and teaching. This review focuses on those that have the potential to provide a pedagogical rationale for new learning in new contexts with ICT, and provide theoretical foundations for assumptions and findings emerging from this study. These new theoretical approaches include:

- The Pedagogy of Multiliteracies (Cope & Kalantzis, 2000; The New London Group, 1996),
- Productive Pedagogies (Education Queensland, 2000; Lingard, Hayes, & Mills, 2003),
- Learning by Design (Kalantzis, Cope, & and the Learning by Design Project Group, 2005), and
- New Learning (Kalantzis & Cope, 2001; Kalantzis & Cope, 2008b).

2.3.3.1   The Pedagogy of Multiliteracies

The Multiliteracies Project emerged from conversations about the future of literacy teaching amongst colleagues and friends in 1994 in New London, New Hampsire, hence the name of the group, The New London Group. According to Cope and Kalantzis (Kalantzis & Cope, 2001; Kalantzis & Cope, 2008b), the guiding principle of the Multiliteracies Project was not to introduce yet another grand literacy theory, but to "attempt to find ways to extend traditions and practices of literacy pedagogy" (p. 240). The Multiliteracies Project thus was a response to challenges in literacy education and pedagogy in general, induced by changes in our working, public, and personal lives. It is a socio-cultural interpretation of new literacies that builds its premises on "multiplicity and integration of significant modes of meaning-making" (p. 5) including the audio, visual and spatial patterns. According to Cope and Kalantzis, the Multiliteracies approach offers a "different kind of pedagogy that is supported by two main arguments: first, in which language and other modes of meaning are dynamic representational resources, constantly being remade by their users as they work to achieve their various cultural

purposes" (p. 5), and second, the importance of increasing local diversity and global connectedness in educational contexts.

According to the The New London Group (1996), "one of the key ideas guiding the notion of multiliteracies is the increasing complexity and inter-relationship of different modes of meaning" (p. 16). The authors identified six major design elements "in which "functional grammars ... describe and explain patterns of meaning" (p. 16). The six design elements of multiliteracies are: Linguistic Design, Visual Design, Audio Design Gestural Design, Spatial Design and Multimodal Design.

From epistemological and theoretical perspectives the Pedagogy of Multiliteracies has its foundations in contemporary understandings of the human mind and its situated and social nature. Rooted in Vygotskian principles it views knowledge as a product of "collaborative interactions with others of diverse skills, backgrounds and perspectives joined together in a particular epistemic community, that is, a community of learners engaged in common practices centred around a specific (historically and socially constituted) domain of knowledge" (The New London Group, 1996, p. 20). It identifies four key principles of contemporary pedagogical practice: situated practice, overt instruction, critical framing and transformed practice. These principles encompass pedagogies and practices that provide students with meaningful and relevant learning experiences in authentic social and cultural contexts, and are summarised in Table 2.4.

Table 2.4 A Pedagogy of Multiliteracies

Situated Practice:	Immersion in experience and the utilization of available discourses, including those from the students' lifeworlds and simulations of the relationships to be found in workplaces and public spaces.
Overt Instruction:	Systematic, analytic, and conscious understanding. In the case of multiliteracies, this requires the introduction of explicit metalanguages, which describe and interpret the Design elements of different modes of meaning.
Critical Framing:	Interpreting the social and cultural context of particular designs of meaning. This involves the students' standing back from what they are studying and viewing it critically in relation to its context.
Transformed Practice:	Transfer in meaning-making practice, which puts the transformed meaning to work in other contexts or cultural sites.

Note. Source: The New London Group (1996, p. 24)

2.3.3.2 Learning by Design

Learning by Design is an extension of the Pedagogy of Multiliteracies. According to Kalantzis et al. (2005), Learning by Design emerged from a series of research and development activities by a team of researchers working in Australia and Malaysia. The aims of these activities were to research the potential of new pedagogical approaches that would transform learning environments by harnessing digital technologies. The Learning by Design approach was based on the following key principles: diversity, knowledge processes, multiliteracies and knowledge producing communities. Learning by Design recognises the changing conditions of living and learning in the knowledge society and proposes changes to curriculum and practice. Kalantzis et al. defined pedagogy as "knowing in action" (p. 72). They identified four fundamental ways of knowing: experiencing, conceptualising, applying and analyzing. These four knowledge processes are interconnected and inform each other as depicted by the Learning by Design framework (p. 73) in Figure 2.2.
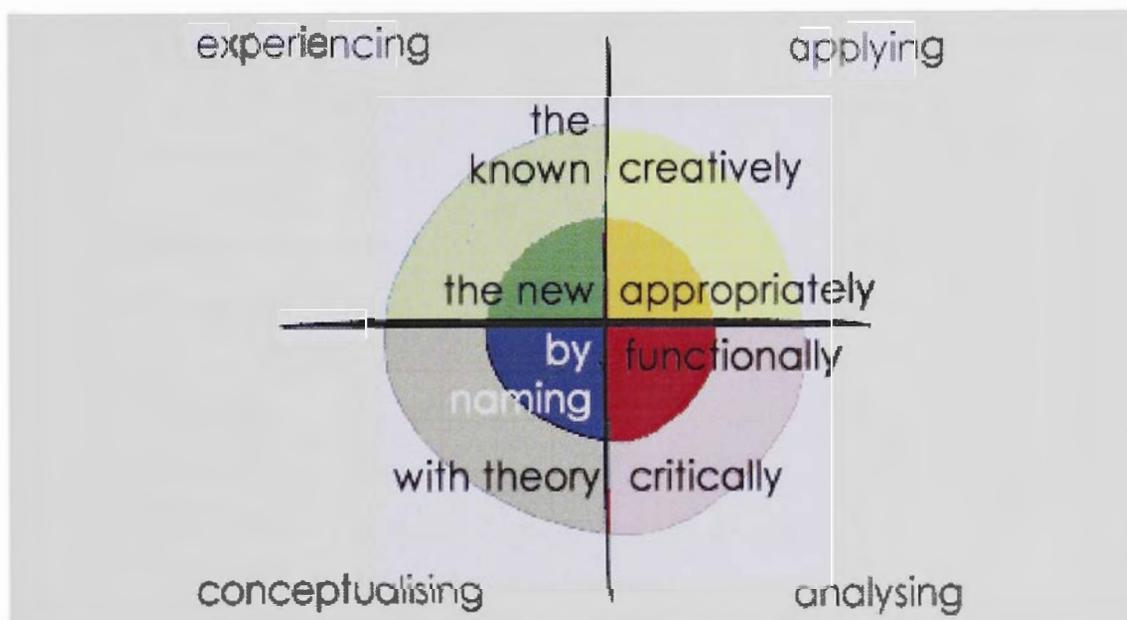
Figure 2.2 The Learning by Design framework

Kalantzis et al. related the four knowledge processes to multiliteracies curriculum orientations, Blooms' taxonomy, and Kolb's model of experiential learning. The relationships between learning by design and the Pedagogy of Multiliteracies are summarised in Table 2.5.

45

Table 2.5 Learning by Design and Multiliteracies equivalences

Learning by design: Knowledge processes	Multiliteracies Curriculum Orientations
Experiencing	Situated practice
Conceptualising	Overt instruction
Analysing	Critical Framing
Applying	Transformed Practice

Note. Source: Kalantzis et al. (2005, p. 73)

According to Kalantzis et al. (2005), the Learning by Design approach is not "a pedagogy in singular but a kind of a meta-pedagogy, a schema against which any possible pedagogy can be mapped" (pp. 87-88). Table 2.5 demonstrates how the Learning by Design approach can be mapped onto the Pedagogy of Multiliteracies. In the authors' opinion, unlike other models, such as Bloom's Taxonomy of Educational Objectives or Kolb's Inventory of Learning Styles, the Learning by Design model does not tell the teacher what to do. The purpose of this model is not only to offer prescriptive guidelines for teachers, but rather to provide them with choices and to expand their understanding of available knowledge processes that facilitate learning.

2.3.3.3 *Productive Pedagogies*

Productive Pedagogies (Education Queensland, 2000) was developed as part of the New Basics Project and the Queensland School Reform Longitudinal Study funded by the Queensland Government. It identifies twenty classroom practices that "support enhanced student outcomes of both academic and social kind" (Lingard et al., 2003, p. 400). In Lingard et al.s' opinion Productive Pedagogies offer a pedagogical framework that is rooted in contemporary theory and empirical research.

According to the Queensland Government, Productive Pedagogies is a "balanced theoretical framework enabling teachers to reflect critically on their work" (Department of Education Training and the Arts Queensland, 2002). The four dimensions of Productive Pedagogies are: Intellectual Quality, Supportive Classroom Environment, Recognition and Valuing of Difference, and Connectedness. They are summarised in Table 2.6.

Table 2.6 Productive Pedagogies

Intellectual quality	Higher-order thinking
	Deep knowledge
	Deep understanding
	Substantive conversation
	Knowledge as problematic
	Meta-language
Supportive classroom environment	Student direction
	Social support
	Academic engagement
	Explicit quality performance criteria
	Self-regulation
Recognition and valuing of difference	Cultural knowledge
	Inclusivity
	Narrative
	Group identity
	Active citizenship
Connectedness	Knowledge integration
	Background knowledge
	Connectedness to the world
	Problem-based curriculum

Note. Source: Education Queensland (2000)

Lingard et al. (2003) argued that the Productive Pedagogies model is not a prescriptive list of ingredients. Rather, it is a professional tool that helps teachers reflect on their pedagogical practices and develop a professional vocabulary that will enable them to share these reflections in professional conversations within their schools and other professional communities.

2.3.3.4 New Learning

New learning: A Charter for Australian Education was introduced by The Australian Council of Deans of Education (2001) with the aim to conceptualise a national strategy for change in education. According to the Council of Deans, eight propositions will shape the future of learning:

- education has a much larger role to play in creating socially productive persons,
- learning will be lifelong and lifewide,
- opportunity and diversity: education is one of the main ways to deliver on the promise of democracy,

- a 'New Basics' is emerging,
- technology will become central to all learning,
- the work of educators will be transformed,
- the place of the 'Public' and the 'Private' in education will be redefined, and
- the focus of education policy must change from public cost to public investment. (ACDE, 2001, pp. 2-3)

New learning brought together three significant parts of our social life: technology, economy and culture and examines their impact on our work, public and personal lives. It has a special emphasis on learning with new technologies in the digital world. The authors argued that the potential to transform learning needs to be harnessed. They also emphasised that in order to engage in new learning we have to stop learning about technologies and start engaging in new learning experiences through them. The Charter communicated to politicians, professionals and all Australian citizens "an urgent need to grasp this opportunity of new learning" (ACDE, 2001, p. 4). According to Yelland (2007), the Charter for New Learning provided a broad framework for reconceptualising knowledge for new times and offers a new skills base for the 21 century.

Building on the work of the ACDE, the Pedagogy of Multiliteracies and the Learning by Design project, Kalantzis and Cope further developed their theoretical stance on new learning in their latest publication entitled New Learning: Elements of a Science of Education (Kalantzis & Cope, 2008b). Kalantzis and Cope adopted a view that considers education a scientific discipline, which implies a "privileged kind of knowledge" (xiv), accompanied by rigour, integrity and intellectual quality. The authors claim to explore new territory and intend to "position education clearly and firmly as a meta-discipline or discipline of disciplines - whose concern is no less than the foundation of human knowledge and identity, and the source of all other disciplines" (Kalantzis & Cope, 2008a). Kalantzis and Cope proposed eight dimensions on which they ground their comprehensive theory of New Learning:

- Dimension 1: The social significance of education,
- Dimension 2: The institutional locations of learning,
- Dimension 3: The tools of learning,
- Dimension 4: The outcomes of learning,
- Dimension 5: The balance of agency,

- Dimension 6: The significance of difference,
- Dimension 7: The relation of the new and old,
- Dimension 8: The professional role of the teacher.

The theory of New Learning provides educators with a framework for understanding education as a situated historical, political and socio-cultural practice which assists them in understanding their own professional journeys. New Learning promotes teacher agency and teacher professionalism by encouraging educators to lead the transformation, "rather than fall victim to changes over which they have little or no control". The implications of this approach are particularly important for teaching and learning with new technologies where teachers have to navigate amongst corporate interests, national and /or state level educational standards, and their own pedagogical beliefs about what constitutes worthwhile and effective practices of teaching and learning with ICT in the 21st century.

2.4   Current practices and pedagogies with ICT

This section reviews empirical research related to the integration of new technologies. It looks at the pedagogy of learning and teaching with new technologies, reports on innovative practices, and identifies barriers to successful ICT integration.

2.4.1   Teachers' pedagogical understanding of ICT: The key to transformation of learning

Recent research indicates that teachers' pedagogical understanding of how to use new technologies is as important as access to them (Cox et al., 2003a; Kankaanranta, 2005). Cox et al. (2003b) found that ICT resources in schools proved to be beneficial only if they were "combined with good teaching" (p. 12). Cox et.al (2003a) argued that the "crucial component in the appropriate selection and use of ICT within education is the teacher and his or her pedagogical approaches" (p. 3). In the authors' opinion:

> Teachers' pedagogies have a large effect on pupils' attainment. They influence
> the selection of the ICT resource, the preparation of the lessons, the way the
> resource is used with pupils in lessons, the level of guidance and intervention,
> and the level of integration of ICT use within the teacher's subject. (Cox et al.,
> 2003a, p. 4)

49

Findings of other research studies indicate that teachers' beliefs, teaching philosophies and pedagogical ideas have significant influence on the way they integrate ICT in learning and teaching (Becker & Ravitz, 2001; Ruthven, 2006; Ruthven & Hennessy, 2002). As Ruthven, Hennessy, & Brindley, (2004) summed it up: "teachers' pedagogical discourses and practices shape teacher representations of ICT use" (p. 274).

An increasing body of research reports on innovative and effective practices of integrating ICT in learning and teaching. There are two types of studies that focus on the transformative power of ICT in education: large international or national studies initiated by governments and/or ICT corporations to promote innovative practice and evaluate the potential of new technologies for student learning (e.g. Ainley, Banks, & Fleming, 2002; Apple Computer Company, 1996; Dunbar, Clarkson, & Toomey, 2000; Hinostroza, Guzman, & Isaacs, 2002; Holden, 2003; Karpati, 2003; Kozma, 2003b; Lee & O' Rourke, 2006; Meredyth, Russell, Blackwood, Thomas, & Wise, 1999; O'Rourke & Harrison, 2004; Siraj-Blatchford & Siraj-Blatchford, 2006; Siraj-Blatchford & Siraj-Blatchford, 2004; Tubin, Mioduser, Nachmias, & Forkosh-Baruch, 2003), and individual case studies of innovative practices (e.g.Kilderry & Yelland, 2005; Kinnear, McWilliams, & Caul, 2002; Watts & Lloyd, 2004; Wheeler, Waite, & Bromfield, 2002).

An example of an international effort of creating a database of innovative practices with ICT is the SITES-M2 research project (Kozma, 2003b). Research teams representing national committees from 28 countries looked for and selected 174 case studies of transformative practices with ICT in schools. The study of those cases found significant changes in teaching and learning which were different from traditional classroom practices. In most cases students were engaged in constructivist learning experiences and collaboration with entities beyond the classroom walls. In his summary of implications for ICT-based educational change, Kozma (2003a) acknowledged that these innovative practices had limited influence-transfer to their surroundings and their viability was predicated by (financial) support provided from national programmes and school establishments.

The influence of new technologies on teaching and learning was studied in five Australian schools as part of the SITES-M2 project (Ainley et al., 2002). Data were gathered by interviews, document analysis, and observation of practices in technology-rich environments in secondary and primary settings. Innovative practices included the integration of a variety of ICT tools. Sound, image and animation were used to support

50

interdisciplinary learning combining English and History. Students and teachers were provided with just-in-time support as they progressed through their work. Each of the schools used different approaches to transform traditional learning environments with ICT. These innovative practices included:

- fostering students' learning styles with multimedia development tools,

- providing secondary school students with distance learning opportunities,

- building learning communities developed around "multi-age bands" (p. 397),

- working with a curriculum organised around themes in order to produce electronic portfolios built on shared expertise, and

- developing an online orientation programme for year seven students.

In their analysis of innovative cases of practice, Ainley et al. (2002) found that computers were used as information resource tools, authoring tools, knowledge construction tools, and knowledge reinforcement tools. The authors concluded that even though ICT-rich environments were vital to innovation, "pouring resources into IT infrastructure did not necessarily reflect the actual implementation of technology into schools" (p. 404). Their results confirmed the findings of Fluck's (2001) study about the implementation of technology in schools in England, USA, Australia and Canada. Fluck argued that the provision of infrastructure in schools should be accompanied by other changes including a shift from traditional curricula to flexible learning supported with ICT. He also called for establishing frameworks of student and teacher competencies for the integration of ICT across the curriculum.

Some of the most innovative practices of the SITES-M2 research were observed in Chilean schools (Hinostroza et al., 2002). Using a qualitative case study approach Hinostroza et al. found innovative practices with ICT such as:

- implicit teaching through video games,

- using ICT to support learning experiences in Maths through educational software,

- real life experiences (e.g. tabulating and calculating expenses after visiting the local supermarket),

- creating a virtual orchestra, and

51

- facilitating international collaboration.

The cross-case analysis revealed that, while there was no evidence to support that student outcomes have improved based on descriptions in the national curriculum, students have learnt valuable skills related to real life experiences.

The literature suggests that similarly to the SITES-M2 project successful technology integration was achieved by a number of initiatives when governments and/or the corporate world such as Apple Computers Inc, or IBM had invested in 'making the future of student learning happen'. Such examples are Apple Classrooms of Tomorrow project (Apple Computer Company, 1996), the Victorian Navigator Schools project (Dunbar et al., 2000) and the international KidSmart Programme by IBM (Siraj-Blatchford & Siraj-Blatchford, 2004). These projects have been orchestrated examples of providing students and teachers with state of the art ICT infrastructure (with no compatibility issues attached), just in time technical support, and professional development tailored to the context and intended outcomes of the programme.

As with individually reported cases of effective practices with ICT (Kilderry & Yelland, 2005; Kinnear et al., 2002; Watts & Lloyd, 2004; Wheeler et al., 2002), literature suggest that these successful initiatives lose their momentum, when funding or other support decreases as teachers find it difficult to cope with the demands of new technologies on their own. Demetriadis at al. (2003) argued that teachers demonstrate considerable interest in innovative practices with ICT but they need consistent support and ongoing training. According to Koehler and Mishra (2005) and Law (2006), teacher training should go beyond the acquisition of technical skills and "technologisation of education". Koehler and Mishra (2005) argued that teacher knowledge is multifaceted and complex and that "understanding the role of technology in pedagogy is more than the accumulation of technology skills, and that skilful teaching is more than finding and applying the right tool" (p. 99).

Effective transitions in practice can be fostered by providing teachers with "context-specific professional development" (Rasku-Puttonen, Eteläpelto, Lehtonen, Nummila, & Häkkinen, 2004, p. 47) shared planning and collaborative reflection carried out in ICT-rich environments (Rasku-Puttonen et al., 2004, p. 47). In their study that used a multi-method approach Rasku-Puttonen et al. found that team-teaching and collaborative practices helped teachers develop an increased awareness of their own practices with ICT.

52

Demetriadis et al. (2003) also acknowledged the situational character of teacher knowledge and expertise and the possible benefits of learning within the context of the school culture. He argued that in order to transform their practices teachers need to be connected to extended learning communities and shift from the "single context epistemologies of the traditional school" to a "multiple learning context perspective" (p. 36). This relates back to Wenger's (Wenger, 1999; Wenger, McDermott, & Snyder, 2002) powerful idea of communities of practice that was further explored by Krumsvik (2005) in ICT-rich learning environments. Krumswik, using action research methodology found that teachers working in communities of practice are more likely to use ICT to facilitate collaborative work amongst their students. These collaborative activities include problem-based learning (PBL) and theme or project work, where the role of ICT shifts from a "primary artifact to a secondary artifact at school" (p. 41). He also found that an important condition of teacher engagement with new technologies is their access to ICT both at home and at the school.

While the studies described above illustrate the potential of new technologies to facilitate educational change, Goodson and Mangan's (1995) argument is still valid: "we find evidence of reshuffling the pack of cards, but little evidence of anybody trying a new game" (p. 623). A large body of research echoes Larry Cuban's (2000a, 2001) observations, according to which computers in education are oversold and underused, and teaching is still 'low-tech in high-tech schools'(Cuban, 1998). The techno-optimistic view that providing teachers with technology would bring about changes in school was contested by Cuban in this still relevant observation dating back to 1996:

This persistent dream of technology driving school and classroom changes has continually foundered in transforming teaching practices. Although teachers have slowly added a few technologies to their repertoires, techno-reformers have seldom been pleased with either the pace of classroom change or the ways that teachers have used new machines. (Cuban, 1996)

In other words it appears, that when "computers meet classroom, classroom wins" (Cuban, 1993, p. 185). In Cuban's opinion (Cuban, 1996, 2001; Cuban et al., 2001) dominant beliefs about teaching and learning and traditional school structures hinder effective integration of computers into school education. His analysis has been supported by fellow educational theorists and contemporary thinkers (Apple, 2004a; Saul, 1997), as well as numerous studies from all over the world (Bauer & Kenton, 2005; Chaptal, 2002;

53

Condie & Simpson, 2004; Conlon & Simpson, 2003; Cuban et al., 2001; Kozma & Anderson, 2002; OECD, 2006; OFSTED, 2001; Reynolds et al., 2003; Robertson, 2002; Selwyn & Bullon, 2000). These studies show that computers and ICT in general have not lived up to universal expectations of radically changing the ways we teach and learn. Even one of the opponents of Cuban's pessimistic portraits of technology adoption by teachers, Becker (1998), noted that "students still spend most of their school day as if these tools and information resources had never been invented" (p. 24).

Large national and international studies indicate that mainstream educational practice does not benefit sufficiently from current student computer ratio in schools. Based on the findings of the Second Instructional Technology in Education Study: Module 2 (SITES M2) involving 28 countries in 174 qualitative case studies of innovative pedagogical practices using ICT, Kozma & Anderson (2002) concluded that in most countries there is a "a relatively small number of schools and teachers who are taking the lead in using technology to make changes in pedagogical practices that prepare students for the future" (p. 387).

Lack of effective and meaningful ICT integration for improved student learning has been a concern even in affluent countries such as the United Kingdom, France and US. According to the 2001 annual report of Her Majesty's Chief Inspector of Schools (OFSTED, 2001) on the use of ICT in primary schools, teachers "lack the skills to use ICT effectively", and ICT is one of the 'Achilles' heels' of UK schooling:

> The quality of teaching in information technology (Charts 10 and 11), although improving, remains the weakest of the National Curriculum subjects. The impact of the New Opportunities Fund initiative has not yet fully worked through, but the early signs are encouraging. More teachers are now more confident and proficient users of ICT, but not all have yet received the expected additional training. (OFSTED, 2001)

Even though the latest OFSTED report (2005) painted a much brighter picture, noting significant improvements in the use of ICT in two thirds of schools, student achievement in ICT continued to be unsatisfactory in one in ten schools. Efficient school assessment of student ICT capability and discrepancies across schools in effective use of ICT resources across the curriculum are identified as areas for improvement.

The OFSTED study echoed some of the findings of Selwyn and Bullon's (2000) study of 267 primary school children in South and Mid Wales, UK, that used a focus group method to inquire about patterns of students' computer use in schools. The authors found that even though almost all students (98.9% of the stratified sample) used computers in schools their engagement with ICT was rarely sustained and varied.

In a major survey of over two hundred Scottish primary and secondary schools Conlon and Simpson (2003) assessed the impact of government initiatives promoting technology use on student learning, teachers' practices and skills with information technologies (IT), as well as students' IT skills. The authors compared their findings to those published by Cuban (2001). They concluded:

> Cuban's finding that teaching and learning in Silicon Valley schools has not significantly changed as a consequence of the introduction of technology, broadly applies to Scottish schools too...Teachers were hastened into cyberspace without sharing any clear educational vision of change. The result is that schools have been rewired but schooling has not been significantly transformed. (Conlon & Simpson, 2003, pp. 148-149)

In their opinion questions about educational purpose, pedagogy and curriculum ought to be answered first.

In a comparative study, Chaptal (2002) compared official statistics about ICT investments in schools and students computer use in the US and France. He observed the following:

> Globally, a critical mass of equipment enabling pervasive use seems about to be reached but the situation remains fragile and full of uncertainty. Significant risks do exist if the use of technology does not develop quickly, accompanied by a resulting backlash in both perception and purposes. A comparison of the French and US situations leads to the same conclusions, beyond the great differences between the two educational systems. (Chaptal, 2002, p. 89)

In his opinion even though the process of technology adoption is very slow, we should not blame teachers as they have to face "double innovation: using new technologies and changing their practices at the same time." (p. 96). Chaptal argued that teachers desperately needed support services and time in order to change their practices and teaching philosophies. He believed that if policy makers want to build successful

55

strategies for ICT implementation in schools they need to accommodate the "cultural clash between the rapid pace of technology and the slow times of education" (p. 96).

The 2005 PISA study (OECD, 2006) is another large scale international study to suggest that the benefits of new technologies are not being harnessed enough in schools. According to the report entitled Are Students Ready for a Technology-Rich World?, access to computers and to the Internet in schools significantly improved between 2000 and 2003, however students were more likely to use computers at home than in the classroom. The report was based on the 2003 PISA studies that utilised the survey method to assess student performance in mathematics, reading, science and cross-curricular problem-solving skills in 41 OECD and partner countries. The findings also suggested that the educational gains of ICT went beyond the traditionally perceived benefits of purely educational software and included Internet search engines, ICT-aided communication and entertainment.

Even though there is widespread belief in the educational benefits of ICT, there has been little empirical evidence showcasing the impact of ICT on learning outcomes (Becta, 2006; Cuban, 2001). In Cuban's words:

> The billions of dollars already spent on wiring, hardware, and software have established the material conditions for frequent and imaginative uses of technology to occur. Many teachers and students have acquired skills and have engaged in serious use of these technologies. Nonetheless, overall, the quantities of money and time have yet to yield even modest returns or to approach what has been promised in academic achievement, creative classroom integration of technologies, and transformations of teaching and learning. (Cuban, 2001, p. 189)

Some authors however have argued that it is difficult to establish causal links between ICT deployment and learning outcomes (Becta, 2006; Wellington, 2005), and that there is need for new measures in order to evaluate the effectiveness of ICT integration on student outcomes (Becta, 2006; Finger et al., 2003; Finger, Jamieson-Proctor, & Watson, 2005; Wellington, 2005; Yelland, 2005).

However, patient and optimistic educators are, the grim reality is that apart from success stories reported in the research literature, such as the International ACOT project (Apple Computer Company, 1996), the Australian Real–time Computers (Meredyth,

56

Russell, Blackwood, Thomas, Wise et al., 1999) , the Victorian Navigator Schools project (Education Victoria, 1998), and the ongoing European Leonardo da Vinci and Socrates projects, ICTs are still not as ubiquitous in daily practices of teaching and learning in mainstream schools as they are part of other aspects of our lives.

Even though our technology-rich society and the popular media culture brings up new generations of students with very different needs and expectations, computers still remain "aliens in the classroom" (Green & Bigum, 1993, p. 119). Green and Bigum's argument is reflected in O'Malley's (2005) observation:

> Outside the walls of the classroom, however, there are significant changes in how we think about digital technologies – or, to be more precise, how we don't think about them, as they disappear into our clothes, our fridges, our cars and our city streets. This disappearing technology, blended seamlessly into the everyday objects of our lives, has become known as 'ubiquitous computing'. Which leads us to ask the question: what would a school look like in which the technology disappeared seamlessly into the everyday objects and artefacts of the classroom? (O'Malley, 2005, p. 1)

2.4.2 What hinders effective practices with ICT?

The slow uptake of new technologies has been associated with a combination of the following factors: limited access to hardware and/or software, lack of just-in-time technical support, insufficient support from school structures, lack of time, and limited opportunities for on-going professional learning that could help teachers build competence and confidence in making ICT ubiquitous in student learning (Bauer & Kenton, 2005; Cuban et al., 2001; Green & Bigum, 1993; Jones, 2004; Mumtaz, 2000; Osborne, 2003).

Access to ICT infrastructure still seems to be one of the major barriers to technology use in schools. For example the findings of the 2005 PISA report revealed that according to school principals participating in this large scale international study, shortage or inadequacy of hardware and software hindered schools to take advantage of the promises of ICT (OECD, 2006). However, there are studies (Bauer & Kenton, 2005; Cuban et al., 2001; Pierson, 2001) that illustrate that even in well-resourced schools, ICT integration lags behind expectations. Cuban et al. (2001) found by observing, interviewing and surveying teachers, students and school staff of two high schools located in Silicon

Valley that access to ICT does not always guarantee its widespread use in the classroom, and that teachers typically use new technologies to sustain rather than transform their teaching practices. According to the main findings of Cuban et al.'s study, teachers did not have sufficient time to experiment with new technologies; available training was not specific to teachers' needs and was not offered to them at convenient times. The authors emphasised the importance of the organisational context and the cultural/historical aspects of teaching and schooling over individual teacher characteristics, such as age and gender. They also recommended changes for the hardware and software industry that would make their products more user-friendly. In Cuban's opinion:

> Most software that has been used in schools and universities was initially made for businesses. There haven't been enough pieces of software that have been designed for teachers and kids that meet the requirements of the curriculum or that have at least been beta-tested on students at all. So you get all of these bugs that develop in the software, and as a consequence it turns a lot of people off. (Carlson, 2001)

In a mixed methods study of thirty 'tech-savvy' teachers from technology rich elementary, middle and high schools in the United States, Bauer and Kenton (2005) revealed that true integration of computer technologies (CT) did not happen, and that even technologically skilled and innovative teachers did not integrate CT consistently into their practices as a "teaching and learning tool" (p. 519). Similarly to Cuban et al. (2001), one of the key obstacles appeared to be time, along with outdated hardware, lack of software, and discrepancies in student skill level. The authors asserted that the real issue for schools was not so much the number of computers available to students but how they were being used by the teachers. As the evidence from empirical studies demonstrates digital divide goes beyond "simple binaries of technology haves and have nots" (Warschauer, 2003a, p. 42). It includes new forms of divide such as mastery of new technologies (International ICT Literacy Panel, 2007) and access to relevant and new learning experiences with or through ICT (Warschauer, 2003b, 2006; Warschauer, Knobel, & Stone, 2004).

Wood, Mueller, Willoughby, Specht and Deyoung (2005) also emphasised the pivotal role of teachers in successful technology integration. They asserted that most research aiming to understand the barriers to effective integration of ICT drew their conclusions from survey data and occasional observational work. In their opinion such studies do not

provide a "context-rich consideration of how these variables are perceived by teachers and how teachers believe that these variables impact on practice" (p. 184). Wood et al. (2005) found it critical to allow teachers to reflect and elaborate from their own perspective on what could be the barriers of successful technology integration. By utilising questionnaires and focus group discussions with a randomly selected sample of 54 Canadian elementary and secondary teachers the authors concluded that in coherence with previous research by Hadley and Sheingold (1993), and Becker (2000), comfort with technology was the most significant variable influencing successful technology integration. Wood et al.(2005) also found that time seemed to be a persistent barrier, as teachers were struggling to keep abreast with technological novelties, technical glitches and curriculum planning for technology-rich learning. The authors argued that under the mounting workload teachers tend to concentrate on their own skills in using ICT rather than on its impact on the learner and learning outcomes. Teachers, they claimed, are in the role of a "perpetual novice" (p. 202) and may never become experts in effective integration of ICT.

The situation in Australia is similar. Despite being one of the OECD countries with the highest rates of computers and Internet connectivity (Venkatesan, Eversole, & Robinson, 2004), new technologies have not changed significantly the social practices of teaching and learning in mainstream schools. Even though recent policy documents such as Learning in an Online World: Contemporary Learning (MCEETYA, 2005b) or the Victorian Blueprint and the Victorian Essential Learning Standards (VCAA, 2005) represent a noticeable change in direction, rhetoric, and pedagogical rationale, they still are framed by neoliberal discourses of accountability, standardisation, measurable professional performance and learning outcomes. Consequently they show little coherence with the paradigm of new learning.

Unfortunately the casualties of tensions between regulation and innovation are the teachers and their students. According to Moyle (2005), policy documents communicate a 'passive mindset' that positions teachers, students and other members of the school community as users and clients, which in her opinion indicates "their level of control or choice over the technologies and their deployment" (p. 6). In such contexts "teachers are no longer the drivers of reform, but the driven" (Shirley & Hargreaves, 2006, p. 1). The importance of teacher "control or choice over new technologies" (Moyle, 2005, p. 8) and their integration in student learning was overlooked in the initial rollout stages of ICT in

59

most developed countries. Teacher training and professional development was dominated by a techno-determinist vision of prioritising technology skills over wider educational benefits (Conlon & Simpson, 2003). Reductionist approaches to functional techno-literacy ignored the critical, cultural and human dimensions (Lankshear et al., 2000; O'Rourke, 2005) of technology integration. They contributed to the so-called 'technification' of the teaching profession that alienated teachers and generated yet another form of digital divide leaving out many teachers from educational decision making and design (Spector, 2001).

So what should teachers know about teaching and learning with ICT? How can they effectively integrate ICT with their pedagogies in order to create new learning environments and prepare learners for the digital age? In spite of the recognised potential of ICT to provide context for new pedagogies and new learning experiences, the failure to effectively integrate ICT in schools has drawn attention to teachers' ICT-related skills and knowledge or ICT literacy. The following section emphasises the importance of teachers' ICT literacy for pedagogic change. It examines the evolving nature of these skills, evaluates recent ICT competency standards and ICT literacy frameworks, and discusses those that influenced the emergence of the new Framework of Teachers' ICT literacy described in this dissertation.

2.5 Teachers' ICT literacy

The discourse on teachers' ICT related knowledge and skills has more often been dominated by corporate agendas than a genuine interest in pedagogic transformation. The links between ICT literacy and economic prosperity have been emphasised worldwide (Lonsdale & McCurry, 2004; Markauskaite, 2006; Oliver & Towers, 2000b), often overlooking broader educational benefits. Recently, however, a need to support teachers in developing new practices and pedagogies with ICT was articulated. An excerpt from the report on Monitoring and reporting on Australia's national goals on schooling and ICT (MCEETYA, 2003c) demonstrates this new direction:

> As teachers develop the necessary competencies, the emerging challenge is to
> develop and promote new teaching practices that maximise student learning, but

there is limited quantitative information for 2003 on teacher competency in embedding the use of ICT in their pedagogy. (MCEETYA, 2003c)

2.5.1 *From computer competencies to ICT literacy: Evolution of terms and definitions*

A number of terms have been used to describe or define skills and knowledge related to the use of new technologies in education and in general: computer literacy (Hoffman & Blake, 2003), IT skills (Piccoli, Ahmad, & Ives, 2001), learning technologies capabilities (State of Victoria, 1998), computer competencies (Scheffler & Logan, 1999), ICT competencies (DEST, 2002), media literacy (Potter, 2005), technological fluency (Resnick, Rusk, & Cooke, 1998), among others.

Similarly, a number of definitions have been created that conceptualise these new skills, competencies or literacies. Definitions and interpretations of new literacies, including ICT literacy are linked to changing social contexts and practices, dominant discourses, and rationales for the integration of ICT in education (Cope & Kalantzis, 2000; Lankshear & Knobel, 2003; Lonsdale & McCurry, 2004; Markauskaite, 2005; Petrina, 2000; The New London Group, 1996). Markuskaite (2005) identified three distinct rationales that impact on conceptualisations: the economic rationale that focuses on vocational aspects of ICT literacy that enables professionals to effectively perform their tasks, the social rationale that focuses on uses of ICT in our social, cultural and political lives, and the educational rationale that "recognized present and future roles of ICT in learning and teaching" (p. 7), and focuses on providing the learner with skills for life-long learning.

Current interpretations of ICT literacy often reflect the economic rationale and are related to benchmarks and standards (DEST, 2002; Oliver & Towers, 2000a). Their focus is on the acquisition of functional techno-literacy, and have limited or no emphasis on cultural and critical dimensions of ICT literacy (Lankshear et al., 2000). According to Oliver and Towers (2000a) most definitions include a breakdown of skills into categories in order to facilitate some form of measurement or assessment. The authors offer their own definition as a basis for creating benchmarks, according to which ICT literacy is a "set of skills and understandings required by people to enable meaningful use of ICT appropriate to their needs" (p. 383).

In 2002 The Australian Department of Education, Science and Training (DEST, 2002) launched a proposal for raising the standards in education the aim of which was to identify a set of ICT skills relevant for teachers. DEST adopted a more comprehensive approach and defined ICT competence as "technical and higher order cognitive knowledge, skills, understandings and attitudes related to professional knowledge, professional practice and professional attributes" (p. 3).

Recently the International ICT Literacy Panel (Educational Testing Service, 2007) emphasised the contribution of ICT literacy to the development of human capital. In their proposal for a new framework for ICT literacy the following definition of ICT literacy was constructed:

> ICT literacy cannot be defined primarily as the mastery of technical skills. The panel concludes that the concept of ICT literacy should be broadened to include both critical cognitive skills as well as the application of technical skills and knowledge. These cognitive skills include general literacy, such as reading and numeracy, as well as critical thinking and problem solving. Without such skills, the panel believes that true ICT literacy cannot be attained. The panel views ICT literacy as a continuum of skills and abilities. Just as we no longer think of general literacy as an either/or proposition in which an individual is either literate or not, ICT literacy ranges from simple uses of technology in everyday life to uses in performing complex tasks. (Educational Testing Service, 2007, p.1)

2.5.2 ICT competency standards and ICT literacy frameworks

This section provides an overview of recently published ICT competency standards, ICT literacy frameworks and instruments for measuring teachers' ICT capability. The frameworks are summarised in Table 2.6 using the following points of comparison: audience/beneficiary, dominant paradigm informing the construction of the framework, technological dimension, pedagogical dimension, socio-cultural dimension, and professional learning dimension.

As Table 2.7 demonstrates, a number of frameworks and proposals have emerged in the last ten years. Analysis of these frameworks suggests that most of them have been created with the aim to measure teachers' technical proficiency in using new technologies. The target audience of these frameworks varied from pre-service teachers to teachers, school leaders and teacher educators. Apart from the Scheffler and Logan

(1999) list computer competencies for secondary school teachers, none of these frameworks was generated through and validated by empirical research. They have emerged from literature reviews, or are compilations of ICT skills related to popular technologies of their time.

Table 2.7 ICT competency standards and ICT literacy frameworks

Name or description of framework or instrument	Date	Author & country of origin	Audience/ beneficiary	Dominant paradigm	Technological dimension	Pedagogical dimension	Social / cultural dimension	Professional Learning dimension
Learning technology teacher capabilities	1998	DE&T, Victoria, AU	Teachers School leaders	Instructivist/ behaviourist	Operating hardware and using software for word processing and presentation	Approaches to teaching; Classroom management, Curriculum planning		Developing ICT skills through collaboration with colleagues
Scheffler and Logan ICT competencies framework	1999	Scheffler & Logan, USA	Secondary school teachers	A shift towards constructivism	Operating hardware and using software for word processing and presentation, Using email and the WWW	Integration of ICT in the curriculum, using ICT to support problem - solving and higher order thinking	Understanding the impact of computers on the society	
European Pedagogical ICT licence	1999	EU (professional certification body)	Teachers	Economic rationalism	Word processing, WWW, Email,	ICT and learning styles, School innovation	Games and learning, Digital rights	

(table continues)

Table 2.7 ICT competency standards and ICT literacy frameworks (continued)

National Educational Technology Standards for Teachers	2000	ISTE, USA	K-12 Teachers	Standardisation	Know concepts, Be able to operate software and hardware	Planning for learning, Effective teaching, Curriculum development	Ethical and Legal Issues Health and Diversity	Life-long learning, Professional Efficiency
ICT proficiency measure	2002	Pearson, Hong Kong	Teacher educators	Techno-rationalism	Focus on technical skills: Word processing, WWW, email, ppt, file management	Concepts, library(research and information management) skills		
Benchmarking Tertiary ICT skills	2000	Oliver	Pre-service teachers		Operating basic applications, Browsing the internet	Creating ppt and web pages		
Auditing Pre-service Teachers ICT Experiences	2004	Finger, Lang, Proctor& Watson AU	Pre-service teachers	Techno-rationalism	Operating standard applications, Including web browsers			
A Dynamic Model of ICT Literacy	2005	Markauskite AU	Pre-service teachers	Instrumentalist/ Situated cognition	standard applications, Internet	Cognitive capabilities	Coping skills	Self-directed learning , e-learning
A Framework for ICT Literacy (work in progress)	2007	International ICT Literacy Panel		Economic rationalism	Technical proficiency	Cognitive proficiency		

As Table 2.7 indicates, many of these frameworks represented top-down approaches to ICT integration and adopted techno-rationalist/ instrumentalist and/or cognitivist views. They had limited or no focus on the pedagogical, critical and socio cultural dimensions of ICT integration into teaching and learning. However, three of the frameworks included in Table 2.7 influenced the development of the new Framework of ICT Literacy for Primary School Teachers, generated in this research project. These were the Victorian Learning Technologies Capabilities Guide (1998), the American National Educational Technology Standards for Teachers (2000), and the Scheffler and Logan list of Computer Competencies (1999).

2.5.2.1 *Learning Technologies Teacher Capabilities Guide*

The Learning Technologies Teacher Capabilities Statement was developed by the Victorian Department of Education and Training (State of Victoria, 1998) for teachers and school leaders, and was accompanied by a skill development matrix. It included 17 teacher capabilities related to teaching and learning and identifies five areas for the use of new technologies:

- approaches to teaching and learning,

- classroom management and practice,

- curriculum planning and development,

- monitoring and reporting student progress, and

- learning technologies skills for administrative purposes.

The skill development matrix was constructed around these five areas, and its purpose was to support teacher professional development. Compared to other frameworks the Learning Technologies Capabilities Guide had a strong pedagogical value. The Learning Technologies Capabilities Guide was related to the aims and goals of the Victorian Curriculum and Standards Framework (CSF) (Board of Studies, Victoria, 1995), however, its assumptions about using ICT for teaching and learning were largely influenced by behaviourist interpretations of technology adoption.

2.5.2.2 *National Educational Technology Standards for Teachers (NETS)*

The American National Standards (NETS) (ISTE, 2000) were first released in 2000 and identified important concepts and skills for applying new technologies in educational

settings. They accompanied the NETS for students released in 1998. The NETS for teachers 2000 identified 23 competencies belonging to six areas of professional practice with ICT:

- technology operations and concepts,

- planning and designing learning environments and experiences,

- teaching, learning, and the curriculum,

- assessment and evaluation,

- productivity and professional practice, and

- social, ethical, legal, and human issues.

Since then the NETS 2000 have been adopted by 48 of the 50 states in the US and have been successfully used for technology, curriculum and assessment planning as well as teacher certification and licensure (ISTE, 2000). The new National Technology Standards are planned to be released in 2008.

Compared to other frameworks the NETS 2000 for teachers offers a comprehensive schema of skills necessary for operating technology and using them for educational purposes, however it emerges from discourses of economic rationalism, standardisation and is used for professional performance profiling.

2.5.2.3   *The Scheffler and Logan List of Computer Competencies*

The Scheffler and Logan (1999) list of computer competencies was published in a peer reviewed research article, entitled Computer Technology in Schools: What teachers should know and be able to do? The article provided a summary of the context of computer infusion into schools and highlighted some pertinent issues related to "teacher computer training and experience" (p. 2). The authors compared the findings of their study with several other studies and competency standards. In their research they compiled an initial list of 127 competencies based on previous research studies, and further developed it through a three-round Delphi process. The importance of the 67 computer competencies emerging from the Delphi process was reviewed in a survey study, by 437 technology coordinators, teacher educators, and secondary school teachers. A five-point Likert-type scale (not important (1), somewhat important (2), moderately important (3), important (4), and very important (5)) was used to assist the ranking. The

authors grouped their computer competencies in two sections: General Computer Competencies and Computer Competencies Unique to Education. Section 1 described general computer competencies, and consisted of four groups:

- Group 1: Acquire basic understanding of computer operation for personal and business use (six competencies),
- Group 2: Acquire knowledge on the impact of computers on the society (five competencies),
- Group 3: Operate and maintain the components of a computer system for home and business use (seven competencies),
- Group 4: Develop and execute a personal plan for computer competency (five competencies).

Section 2 described computer competencies unique for teachers and consisted of six groups:

- Group 1: Evaluate and assemble components of a computer for use in instructional applications (five competencies),
- Group 2: Identify carrier fields related to microcomputer use (four competencies),
- Group 3: Develop a plan for using computers within instruction (twelve competencies),
- Group 4: Implement a plan to integrate computers into curricula (twelve competencies),
- Group 5: Use computers in classroom management (six competencies),
- Group 6: Use computer information resources (five competencies).

The Scheffler and Logan study was chosen to be the starting point for the current research. At the time of the commencement of this research project the Scheffler and Logan list of computer competencies had several advantages when compared to other frameworks and standards. It was based on a review of previous developments in the area, and contrary to most top-down approaches (usually based on literature review only), this framework emerged from a multi-stage research project. The researchers consulted a Delphi Panel and surveyed secondary teachers, technology coordinators and university

teacher educators about "what teachers should know and be able to do" when it comes to integrating technology into secondary schools.

The Scheffler and Logan list of computer competencies raised some important pedagogical issues related to ICT integration: teacher awareness of the impact of computers on society, planning for the integration of technology into teaching and learning, using computers as a problem-solving tool and for developing higher-order thinking, assessing students needs when planning for the integration of computers, using the Internet as a personal and professional tool, and developing and following a personal plan for computer competency. According to the Australian Council for Computers in Education (ACCE, 2000) the findings of the Scheffler and Logan study demonstrated the need for "skills and knowledge to make computers an integral part of the school environment had increased importance" (ACCE, 2000).

2.6 Summary and conclusions

This chapter provided a context for the study by reviewing contemporary theory, policy and research related to the integration of ICT in learning and teaching. The literature review indicated that the infusion of ICT has not resulted in significant changes to the social practices of learning and teaching in public schools. One of the barriers to successful technology integration appeared to be teachers' lack of confidence and competence in using new technologies as tools of the profession. Lack of support provided at a structural level further hindered the acquisition of skills and knowledge necessary to make ICT ubiquitous in student learning. Competency frameworks and technology standards created in the recent past did not seem to provide teachers with a tool that would help them evaluate, reflect on and plan for their own professional growth related to ICT integration. Furthermore, they did not adequately account for the complexity of pedagogical knowledge required for effective ICT integration. As a response to these issues this research has created a new framework of teachers' ICT literacy that was used to identify and portray teachers' ICT –related knowledge and skills in Victorian government primary schools, explore the situated nature of ICT integration in learning and teaching, and interpret the relationship between primary teachers' ICT literacy and pedagogical practices. The next chapter describes the research design that facilitated this research.

Chapter 3.

Research design

Methodology is best understood as the overall strategy for resolving the complete set of choices or options available to the inquirer. Far from being merely a matter of making selections among methods, methodology involves the researcher utterly – from unconscious worldview to enactment of that worldview via the inquiry process. (Guba & Lincoln, 1989, p. 183)

At the time of the commencement of the project, mixed methods research was still in the phase of establishing itself as a legitimate research paradigm, prompting researchers to search for new methodological solutions and explanations. Consequently, Chapter 3 dedicates considerable attention to the emergence of mixed methods research, and explores philosophical and methodological issues related to the use of mixed methods in educational research. It also provides a detailed description of the research design, supported by relevant literature on methods and procedures utilised in this study.

3.1 Frameworks and methods of human inquiry

When deciding on a research design, the researcher's worldview, including positions related to ontology, epistemology and axiology, is central to the selection of research methodology. It is vital to understand the nature of the researched phenomena and choose the supporting frameworks, strategies and methods of inquiry accordingly.

The literature usually talks about two major frameworks of human inquiry, or research paradigms that provide the philosophical matrix of a methodological design. These two major paradigms represent the quantitative and the qualitative research traditions, each with a unique perspective on the world and its processes. The quantitative research tradition is embedded in the positivist worldview. It is focused on the objective

nature of research, the understanding of truth and reality, and searches for explanations that are generalisable. According to this paradigm, "educational researchers should eliminate their biases, remain emotionally detached and uninvolved with the object of study and test or empirically justify their hypotheses" (Johnson & Onwuegbuzie, 2004, p. 14). The logic of inquiry is deductive, with a focus on explanation of causality, correlations and predictability. The findings of a research carried out within this paradigm usually undergo the scrutiny of numerous tests of validity and reliability.

On the other hand, supporters of the qualitative paradigm, also referred to as constructivist, interpretivist, or "ideologically oriented inquiry" (Guba, 1990, p. 23), including critical theory, feminism and participatory action research, believe that truth is a human construction, and as such is open to interpretations. There are multiple realities that are based on individual or collective perceptions, experiences and aspirations. As a consequence the research process cannot be value free. The axiological stand of the researcher and participants is of vital importance to the interpretation of findings. The nature of inquiry is inductive. The focus is on exploration and discovery. The researcher is closely involved with the researched phenomena, trying to voice the perspective of those participating in the research process. The findings emerge as shared or socially constructed meaning(s), and are not subject to traditional verification. The emphasis of inquiry is more on in-depth understanding, reflexivity and possible transformations, rather than on predictability, generalisability and application.

These two major research paradigms based on the researchers' "weltanschauung", meaning 'world view' or 'philosophy of life'(Scott & Marshall, 2005), a concept fundamental to German philosophy and epistemology, informs the methodological design, and plays an important role in the choice of the methods and techniques of participant selection, data collection, data analysis and interpretation of findings.

Both research traditions have their strengths and weaknesses. Before elaborating on one or the other, it is important to acknowledge, that what can appear as strength to one researcher, may seem to be a weakness to another. Again, it is a matter of deeper philosophical and theoretical affiliations, rather than simplified classifications.

Johnson and Onwuegbuzie (2004) argued that the advantages of the quantitative methods are that they allow researchers to test and validate theories, and produce findings that are generalisable to larger populations. According to the authors, such studies can be

replicated and their results can be compared. Data collection is relatively quick and the results are "relatively independent of the researcher" (p. 19). On the other hand, they argue that findings of quantitative studies may not always reflect the understandings of 'local constituencies' and researchers may overlook emerging phenomena while focusing on hypotheses and theories. Consequently findings may be too general and have limited applicability to local contexts and individuals. In Weinreich's (1996) opinion, the quantitative paradigm "breaks down when the phenomenon under study is difficult to measure or quantify" (p. 53). She believed that: "the greatest weakness of quantitative approach is that it decontextualises human behaviour in a way that removes the event from its real world setting and ignores the effects of variables that have not been included in the model" (p. 53).

According to Johnson and Onwuegbuzie's (2004), classification of research traditions, the strengths of the qualitative paradigm are that it is useful for researching complex phenomena, such as data based on the "participants' own categories of meaning" (p. 20), as it provides a rich description of the studied phenomena and considers both the individual and the context. Data in such studies are collected in natural settings, and tentative theories are generated inductively, usually using a grounded theory approach. In the authors' opinion:

> ...qualitative approaches are responsive to local situations, conditions, and stakeholders' needs. Researchers working within the qualitative paradigm 'are responsive to changes that occur during the conduct of a study ... and may shift the focus of their studies as a result. (Johnson and Onwuegbuzie, 2004, p. 20)

Weinreich (1996) argued that the methods used by qualitative researchers, such as observations, in-depth interviews and focus groups, allow them to connect with their target audience through "immersion in a culture or situation and direct interaction with people under study ... [which leaves] participants' perspectives intact" (pp. 53-54). According to Weinreich, the only major disadvantage of qualitative research is that data collection and analysis is "labor intensive and time-consuming" (p. 54). Johnson and Onwuegbuzie (2004) recognise this shortcoming, and highlight some other weaknesses. In their opinion findings of qualitative studies may not reflect other populations or settings, and may be "more easily influenced by the researcher's personal biases and idiosyncrasies" (p. 20).

For quite a few decades protagonists of each paradigm believed that the differences between the two research traditions were irreconcilable (Datta, 1994; Gage, 1989; Gardiner & Thorpe, 1994; Guba & Lincoln, 1994; Tashakkori & Teddlie, 1998). The polarised views about philosophical assumptions related to the nature of inquiry, the role of the researcher, the methods of data collection and analysis and the interpretation of findings created a dichotomy between the two research traditions and resulted in "paradigms wars" (Gage, 1989, p. 4) fought in all disciplines of social and behavioural sciences (Tashakkori & Teddlie, 1998). According to Gardiner and Thorpe (1994), contemporary educational research has often been subject to such paradigm wars. This problem was magnified by the fact that concepts and statements representing one paradigm were not easily translated into the other paradigm (Gardiner & Thorpe, 1994; Phillips, 1987). Gardiner and Thorpe offered the following options to resolve the tension between the paradigms: choosing one paradigm for all research, learning about all paradigms so that communication is consistent within whichever paradigm the discourse occurs, or developing a way to work above paradigmatic influences. In their opinion:

> ...the first would be counterproductive to educational research and the second not possible for most researchers. Hence commensurability of research findings must be achieved by assuming a meta-paradigmatic level. (Gardiner & Thorpe, 1994)

Nowadays many researchers support this argument and believe that that there is a need for a dialogue between the two paradigms (Tashakkori & Teddlie, 1998), and that the differences between the two research traditions can complement each other. Supporters of this dialogue believe that combining quantitative and qualitative methods can result in research designs that provide a more balanced perspective of the researched phenomena. Some take it further, and argue that mixing methods in order to arrive at new understandings may contribute to the emergence not only of new research designs but of a new research paradigm.

3.2 Catching the wave of mixed methods research

Mixed method research has a long-standing empirical tradition, and the methodological debate unfolding and intensifying in the last two decades generated valuable contributions to its theoretical and philosophical foundations.

The emergence of mixed method research has played an important role in the reconciliation of differences between the two major research paradigms (Goering & Streiner, 1996). According to Guba and Lincoln (1994), resolution of differences between dominant paradigms happens "when a new paradigm emerges that is more informed and sophisticated than any existing one" (p. 116). The authors argue, that it is "more likely to occur if and when proponents of several points of view come together to discuss their differences" (p. 116).

So is mixed methods the new paradigm that has the sophistication Guba and Lincoln (1994) had envisaged? Creswell, Clark, Gutmann, and Hanson (2003) asserted that "there are a number of arguments for why mixed methods research might be considered as a separate research design in the social sciences" (p. 211). Similarly, Johnson and Onwuegbuzie (2004) argued that mixed methods research is the "third research paradigm" (p. 22), "a research paradigm whose time has come" (p. 22). However, not everyone shared these views. According to Datta's (1994) earlier critique, mixed-model studies still lacked worldview, paradigm, and theory. In her words "such a theory has yet to be fully articulated" (p. 59).

Tashakkori and Teddlie (2003), who called mixed methods "the third methodological movement" (p. ix), were more concerned about the "lack of conceptual clarity" (Tashakkori and Teddlie 1998, p.ix) and distinct nomenclature that would include basic terminology and definitions of mixed methods research (Teddlie and Tashakkori, 2003). According to Creswell et al. (2003) because of the lack of distinct nomenclature, finding mixed methods studies "requires some creative searching of the literature" (p. 212), since authors refer to them in many different ways. Terms include: multitrait-multimethod research, multimethodological research, multhimethod designs, mixed model studies and mixed method research, integrating qualitative and quantitative approaches, interrelating qualitative and quantitative data, using methodological triangulation, linking qualitative and quantitative data, and combining qualitative and quantitative research, (Creswell et al., 2003).

In an attempt to strengthen the foundations of this new research tradition Tashakkori and Teddlie (1988) offered a "logically exhaustive typology" (p. ix) of mixing qualitative and quantitative methods, and defined the distinctive features of "mixed method" (1998, p17) and "mixed model" (p. 19) studies. According to the authors, unlike the 'purist' monomethod research tradition, mixed method studies combine quantitative and qualitative approaches in a single study or "multiphased" (p. 18) research. On the other hand "mixed model studies" represent a distinct type of mixed method research embedded in the pragmatist paradigm, which combines "qualitative and quantitative approaches within different phases of the research" (p. 19). In a later publication Tashakkori and Teddlie (2003) suggested the use of mixed methods designs as a "cover term for mixed method and mixed model research" (p. 11), which has been since the accepted term used by the mixed methods research community.

Other researchers have also joined the debate and offered their explanations of mixed methods research. According to Creswell (2003), mixed methods research included the collection or analysis of both quantitative and/or qualitative data in a single study, and involved the integration of the data at one or more stages in the process of research (p. 212). Similarly to Creswell, Johnson and Onwuegbuzie, (2004) viewed mixed methods as "a class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language in a single study" (p. 17). Johnson and Onwuegbuzie argued that methods can be mixed within a stage, which they called intra-method mixing, and across the stages of a research process, which they referred to as inter-method mixing.

Johnson and Turner (2003) suggested that the fundamental principle of mixing methods is to use multiple strategies of data collection and analysis in a way that has "complementary strengths and non-overlapping weaknesses" (p. 299). According to Johnson and Onwuegbuzie (2004), the effective use of this principle makes mixed-method research superior to mono-method studies. They maintained that the fundamental criterion for the selection of research methods was the research question. They support their argument with a pragmatic view that rejects the traditional dualism between objectivism and subjectivism, by replacing "the historically popular epistemic distinction between subject and external object with naturalistic and process-oriented organism-environment transaction" (p. 18). According to the authors, this view endorses pluralism where "current truth and knowledge is tentative and changing over time" (p. 18).

Sandelowsky (2000) however argued that mixed methods studies "are not mixtures of paradigms of inquiry per se, but rather paradigms are reflected in what techniques researchers choose to combine, and how and why they desire to combine them" (p. 247). While in her opinion mixed methods research "is a dynamic option expanding the scope and improving the analytic power of studies" (p. 254), it should not be used "because of some misguided assumptions that more is better, or because it is a fashionable thing to do" (p. 254). Mixed methods studies "must have a clear view of their viewing positions and what dynamic mixes they suggest or permit" (p. 254). Contrary to some the authors who viewed mixed methods as the new research ideology, Sandelowski, defended the integrity of each paradigm. In her opinion "the completeness of any individual study, no matter what kind it is, must be judged without resorting to fads or fetishes" (Sandelowski, 2000, p. 254)

This so-called dialectical position (Greene & Caracelli, 1997) has been adopted for this particular study. And while supporting Johnson and Onwuegbuzie's (2004) pragmatist vision of pluralism and inclusiveness in research, the idea of merging the two major research traditions in order to arrive to a new research paradigm has been found less attractive. The "differences between philosophical paradigms or logics of justification for social scientific inquiry not only exist but are important" (Greene & Caracelli, 1997, p. 8). According to Green and Caracelli, "the differences should be deliberately used both within and across studies toward a dialectical discovery of enhanced understandings, of new and revisioned perspectives of meanings" (p. 8). The marriage of the two paradigms (Goering & Streiner, 1996) is seen possible only, if both 'partners' searching for meaning can keep their identities and work together towards common goals, new and better understandings of the world we live in and share those understandings with each other. As Miles and Huberman (1994) put it: "at bottom we have to face the fact that numbers and words are both needed if we are to understand the world" (p. 40).

3.2.1 Advantages and limitations of mixed methods designs

As any other research design mixed method research has its strengths and limitations. The strengths of mixed method studies are their ability to:

- facilitate a pluralism in research (Johnson & Onwuegbuzie, 2004),

76

- provide the researcher with greater flexibility to adapt the methods to the specific needs of the inquiry (Chen, 1997; Creswell et al., 2003),
- explore multiple approaches to data collection in the study,
- allow the researcher to make generalisations and in-depth exploration of ideas at the same time,
- allow for the integration of data at different stages of the inquiry (Creswell et al., 2003),
- provide an environment of "double hermeneutic" (Giddens, 1993, p. 9) and "paradigm proliferation" (Lather, 2006) that allows for fresh perspectives, creative solutions and paradoxes to emerge,
- open new horizons for validity, reliability and trustworthiness of human inquiry, by drawing on different paradigms and triangulating data at multiple levels (method, strategy, technique), and
- contribute to the democratisation of the research process.

In summary, researchers utilising mixed method designs can improve both the process and the outcomes of the inquiry "by blending and integrating the strengths of methods and neutralising the weaknesses" (Creswell, 2005, p. 511).

Some of the limitations (Creswell, 2005) of mixed methods designs are: lengthy periods of data collection, difficulties in analyzing discrepancies arising from different sets of data, the need for the researcher to be familiar with different research paradigms and methods of inquiry. However, these limitations often carry hidden benefits:

- long data collection allows the researcher to be more involved with the process and /or participants in the inquiry,

- difficulties in analyzing different data sets provide opportunities for finding new and creative ways (methods and techniques) for integrating and interpreting data,

- working with diverse paradigms empowers the researcher with new skills and understandings.

Furthermore these limitations may also benefit the research process and the researcher by extending the researcher's analytical skills, sense of inclusiveness, critical thinking,

and the ability to utilise fuzzy logic (Kosko, 1993) when interpreting the complexities of the researched phenomena.

3.3 The mixed methods design applied in this research

A mixed methods design containing three sub-studies was designed to guide data collection, analysis and integration. As described in Chapter 1, the aims of the study were to explore the situated nature of ICT integration into student learning, and to portray the skills and knowledge teachers need to facilitate new, ICT-rich social practices of teaching and learning in the contemporary primary school. The research questions were as follows:

Main question:

- How does teachers' ICT literacy influence the integration of ICT in learning and teaching in primary schools?

Sub-questions:

- What are the dimensions of teachers' ICT literacy?
- What factors influence teachers' ICT literacy?
- How do teachers integrate ICT in the everyday social practices of teaching and learning?
- To what extent are they transforming student learning with ICT?

Data were collected from three different samples: an international panel of experts (Delphi panel), a random sample of primary school teachers teaching in Victorian government schools and a purposeful sample drawn from the same target population.

The research project has adopted a sequential exploratory design (Chen, 1997; Creswell et al., 2003) employing both inter-method and intra-method mixing (Johnson & Onwuegbuzie, 2004), or using multiple methods both across and within the first stage of the research project as presented by Figure 3.1. Although the sub-studies followed each other in a sequential manner, the survey and fieldwork were conducted parallel to each other, due to delays in survey data collection (Creswell, 2005).
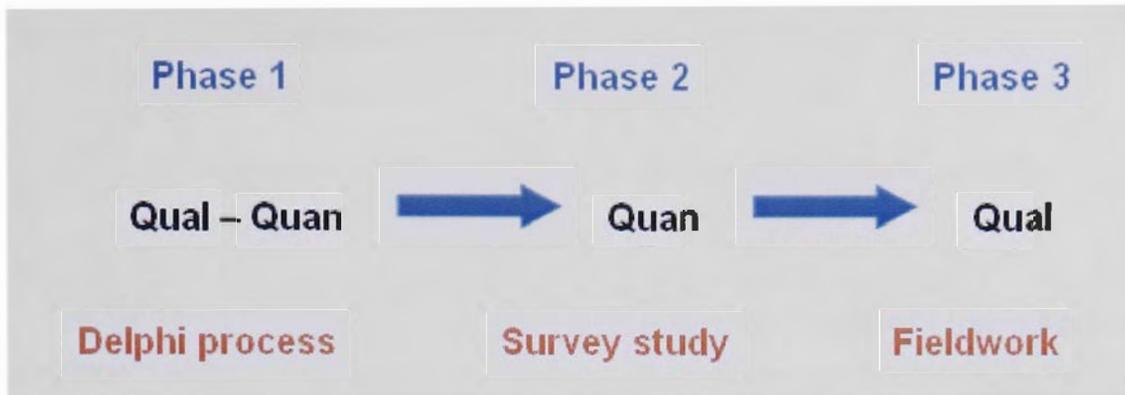
Figure 3.1 Conceptual model of the research design

The Delphi method was employed in the first stage of the research to harness expert opinion and generate a Framework of ICT Literacy for Primary School Teachers. It was designed to yield answers to the first sub-question: What are the dimensions of teachers' ICT literacy?

In the second stage of the project, a survey method was implemented. The aim of the teacher survey was to validate the framework of ICT literacy developed by the Delphi process, and to address the first and second sub-questions by collecting teachers' self-reports:

- What are the dimensions of teachers' ICT literacy? and
- What factors influence teachers' ICT literacy?

In the third stage of the study qualitative fieldwork was conducted in two Victorian government primary schools. The qualitative fieldwork employed naturalistic classroom observations and semi-structured teacher interviews to inquire about the practices of four primary school teachers. The aim of the fieldwork was to collect qualitative data that would triangulate the findings of the first two stages of the project in response to sub-questions one and two, and yield responses to sub-questions three and four:

- How do teachers integrate ICT in the everyday social practices of teaching and learning? and
- To what extent are they transforming student learning with ICT?

The individual stages of this mixed methods study informed and complemented each other and provided opportunities for triangulation and validation of findings, which enabled the researcher to respond to the main question of this study:

- How does teachers' ICT literacy influence the integration of ICT in learning and teaching in primary schools?

The following sections of Chapter 3 provide a detailed description of each stage of the research project. The chapter concludes with a section on bringing together the findings of the three sub-studies. In this section methods of triangulation and strategies of consolidating and linking qualitative and quantitative findings are discussed (Creswell, 2005; Creswell, Fetters, & Ivankova, 2004; Johnson & Turner, 2003).

3.4 The Delphi process

The initial aim of the Delphi process was to develop a framework of ICT competencies for learning and teaching with ICT in primary schools by modifying a peer-reviewed instrument created by Scheffler and Logan (Scheffler & Logan, 1999). The framework would then be used in the next stage of the research project to survey teachers teaching in government primary schools across Victoria about their confidence and competence in integrating new technologies into learning and teaching. However, as will be described in Chapter 4, the Delphi process took an unexpected turn, which necessitated modifications to the originally proposed research design and introduced innovative processes to the Delphi method itself. As a result of these changes the initial instrument developed by Scheffler and Logan (1999) was abandoned and a new Framework of ICT Literacy for Primary School Teachers (Dakich, 2008b) was constructed.

3.4.1 About the Delphi method

The Delphi method was developed by Helmer and Dalkey in the 1950s. It was first utilised by the RAND Corporation as a forecasting technique. The method was designed to help foresee and assess future trends in the areas of scientific breakthroughs, population growth, space and military research, and predict their possible effects on society (Linstone & Turoff, 1975). Under the leadership of Helmer and Dalkey, the RAND Corporation produced fourteen documents between 1948 and 1963, in which they

laid down the foundations of the Delphi method (Linstone & Turoff, 1975). Following their pioneering work, a solid body of literature emerged in the 1970s around theoretical and methodological issues related to the Delphi method and its applications, making it a reliable and legitimate tool for research and inquiry. Since then it has been employed as a generic strategy for developing consensus, and group–based decision-making in a variety of fields, such as social policy, business, science, medicine and other areas (Clayton, 1997). It has been often used as a tool for predicting future educational needs, especially in the areas of curriculum planning, course design, and mapping professional competencies. Despite the popularity of applying the method to explore educational issues of an administrative nature, it has been rarely considered as an educational tool (Linstone & Turoff, 2002). However, a study conducted by Turoff et al. (2006) on Online Collaborative Learning Enhancement through the Delphi method proved that the Delphi method, apart from its previously known applications, can be successfully used to scaffold collaborative idea generation and evaluation in both face-to-face and distance learning settings. This feature of the Delphi method proved to be of particular value for the Delphi process described in this dissertation.

The Delphi method has been defined in the literature in many different ways. It has been described as a method for predicting future events, a survey to collect information, a method for quantifying human judgment in group settings, and/or a method for generating a quick consensus by a group (Turoff & Hiltz, 1996). Turoff and Hiltz warned that these statements can create misconceptions about the real nature of the Delphi exercise. They maintained that the primary Delphi method is not about "forcing a quick compromise" but about producing "detailed critical examination and discussion" (p. 57).

One of the most widely accepted definitions of the method was given by Linstone and Turoff (1975), who described the Delphi method as a "method for structuring a group communication process, so that the process is effective in allowing a group of individuals, as a whole, to deal with complex problems" (Linstone & Turoff, 1975, p. 3). This structured group communication was usually realised through a series of questionnaires, where questionnaires were introduced in each round built upon responses originating from the previous round. The process concluded when consensus was reached among participants, or "when sufficient information exchange has been obtained" (Delbecq, Van De Ven, & Gustafson, 1975, p. 83). Ziglio (1996) highlighted some other important features of the method, which he viewed as a tool for knowledge building. In his opinion

the Delphi method facilitates "heuristic decision-making" (p. 3), and opens up the possibility of "generating new insights and future scenarios" (p. 4), which can contribute to more informed and more effective problem-solving and decision-making. Cuhls (2001) described the Delphi as a process as a method with explorative, predictive, even normative elements that delivers both quantitative and qualitative results by drawing on "intuitive available information of the participants who are mainly experts" (p. 96) . According to Rockwell, Furgason, and Marx (2000), "by utilizing the knowledge of experts, combining it and redistributing it, the study opens up doors and forces new thought processes to emerge." (p. 1).

The metaphoric connection of the method to the ancient Greek town of Delphi, where Pythia, the oracle of Delphi, and priestess of Apollo, was interpreting and revealing the rules of gods in regards to future events, created some confusion. As Turoff and Hiltz (1996) observed "the image of the priestess, sitting on a stool over a crack in the earth, inhaling sulphur fumes, and making vague and jumbled statements that could be interpreted in many different ways, did not exactly inspire confidence in the method" (p. 56). Even one of the founders of the method, Dalkey (1968), noted that the oracular and somewhat occult nature of the name was completely opposite to the method's primary aim, which was "making the best you can of a less than perfect fund of information" (Dalkey, 1968, p. 8). Dalkey argued that different types of information can be represented as points on a continuum. Knowledge, supported by strong empirical evidence is placed at one extreme of the continuum, and speculation with little or no evidence on the other. He also claimed that there was a grey area between knowledge and speculation and called it opinion, previously referred to as "wisdom", "insight" or "informed judgment" (p. 4). Dalkey argued that opinion was fundamental to the Delphi method.

The fuzzy nature of the method made it a very attractive tool for research and inquiry. Indeed the Delphi method proved to be the most suitable research method in circumstances when one or more of the following characteristics described by Linston and Turoff (2002) could be applied to the research problem:

- the problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis,
- the individuals needed to contribute to the examination of a broad complex problem have no history of adequate communication and may represent diverse backgrounds with respect to experience and expertise,

82

- more individuals are needed than can effectively interact in a face-to-face exchange,

- time and cost make frequent group meetings infeasible,

- the efficiency of face-to-face meetings can be increased by supplemental group communication process,

- disagreements among individuals are so severe or politically unpalatable that the communication process must be refereed and /or anonymity assured, or

- the heterogeneity of participants must be preserved to assure validity of results, i.e., avoidance of domination by quantity or by strength of personality ("bandwagon effect"). (Linstone & Turoff, 2002)

3.4.1.1 Essential features of the method

The essential features of the traditional Delphi method are: anonymity and confidentiality of information for all respondents, iteration of responses with controlled feedback, and statistically interpretable group response (Linstone & Turoff, 2002). However, the concept of anonymity as an essential feature of the method is contested in this study. Although the anonymity of the information provided by the participants is guaranteed throughout the process, and panellists remain anonymous within the Delphi Panel, their identity is known to the facilitator, hence we can only talk about the anonymity of participant input/opinion rather than that of participants (Dakich, 2004, 2008a).

Another important feature of the Delphi method is that it can facilitate interaction among geographically dispersed experts (Adler & Ziglio, 1996), making it a less time-consuming and more cost-effective research tool. This feature has been accentuated with the use of ICT to facilitate communication between experts. The Delphi method also helps minimise the undesirable effects of traditional group dynamics such as interpersonal conflicts, tunnel vision perceptions and the social pressure of the majority or influential individuals (Turoff & Hiltz, 1996; Wedley, 1980).

3.4.1.2 The Delphi process

The Delphi method focuses on evolving trends rather than existing conditions. When applied to a particular research problem the Delphi method generates a Delphi process. According to Kennedy (2004), the Delphi process provides an opportunity to the panellists to communicate their opinions and knowledge anonymously about a complex

problem, to see how their evaluation of an issue aligns with others, and to change their opinion, if desired, after reconsideration of the findings of the group's work.

The participants of the process are the members of the Delphi Panel, usually selected by purposeful (Kramer, Walker, & Brill, 2007; Manca et al., 2007) also called as targeted sampling (Akins, Tolson, & Cole, 2005), and the facilitator, who facilitates the process. The role of the facilitator is to introduce the aims of the process and the procedures to the participants, collect and analyse responses and provide feedback to the Delphi Panel. In some instances facilitators may choose to nominate a steering committee (Schütz, Herbst, & Koller, 2006), also called a review panel (Rockwell et al., 2000), or Advisory and Monitoring Team (Dakich, 2008a), whose members monitor the Delphi process and advise the facilitator on issues related to expert nomination, data analyses and feedback to experts.

There are several steps involved in conducting a Delphi process. A traditional Delphi process includes the assembly of the panel in the preparatory stage, and the publishing of the results in the final stage of the process. The exploration of subject, analyses of responses and report to the group is an iterative process and it is repeated through several rounds until consensus has been reached.

Linstone & Turoff (2002) argued that while Delphi seem to be a research method that is relatively simple to employ, it needs to be carried out with careful consideration. They identified some common reasons which can contribute to the failure of a Delphi process:

- imposing monitor's views and preconceptions of a problem upon the respondent group by over-specifying the structure of the Delphi and not allowing for the contribution of other perspectives related to the problem,
- assuming that Delphi can be a surrogate for all other human communications in a given situation,
- poor techniques of summarizing and presenting the group response and ensuring common interpretations of the evaluation scales utilized in the exercise,
- ignoring and not exploring disagreements, so that discouraged dissenters drop out and an artificial consensus is generated,
- underestimating the demanding nature of a Delphi, the fact that tired respondents should be recognized as consultants and properly

compensated for their time if the Delphi is not an integral part of their job function. (Linstone & Turoff, 2002)

3.4.1.3   Limitations and weaknesses of the Delphi method

According to Kennedy (2004), "depending on the person's worldview of credible knowledge" (p. 505), strengths of the method can be viewed as limitations and vice versa. One of the typical examples of this is Sackman's (1974) critique of the weaknesses of the Delphi method. Sackman argued that despite the technique's vast popularity in technological and social forecasting there had been virtually no "seriously critical literature" (p. vii) published on the method. He developed his critique by analysing almost 150 Delphi studies conducted by RAND and others. His objective was to fill in an existing gap by providing a critical and scientific appraisal of the Delphi as a methodology. In Sackman' opinion even the conventional Delphi did not satisfactorily meet the "methodological standards cited for test design, item analyses, subject sampling, reliability, validity, administration, interpretation of findings and warranted social use" (p. v). He believed that the scientific nature of Delphi is compromised by its technical shortcomings, such as:

> ...untested and uncontrolled halo effects in the application of Delphi questionnaires; unsystematic and nonreplicable definition, sampling and use of "experts"; manipulated group suggestion rather than real consensus; ambiguity in results stemming from vague questions; acceptance of snap judgments on complex issues; and the virtual absence of vigorous critical methodological literature, even though hundreds of Delphi studies have been published. The accuracy of the technique, in generating forecasts and other "expert" estimates is necessarily suspect as long as Delphi questions are not empirically linked to objective and independently verifiable external validation criteria. (Sackman, 1974, p. v)

Sackman concluded his analyses arguing that the Delphi was fundamentally an unreliable and scientifically invalidated method, and therefore the results of most Delphi studies are likely to be unreliable and invalid. He recommended the replacement of the Delphi method with scientifically rigorous questionnaire techniques associated with the procedures of experiments with human subjects. His final recommendation was dropping the Delphi method from institutional government and corporate use until its foundations are further developed and underpinned by scientific principles.

85

Two decades later Clayton (1997) argued that these concerns have not yet been appropriately addressed by the Delphi literature. In his paper he made an attempt to tackle several issues raised by Sackman (1974) such as the scientific tenability of the Delphi method, the superiority of group over individual opinion, the authenticity of the Delphi consensus, and questions related to anonymity. He was also interested whether the Delphi encourages or discourages adversary and exploratory thinking.

Others like Skumanich and Silbernagel (1997), departed from the scientific tradition and raised quite different issues which included:

- the quality of expert opinion,
- personal factors (such as: subject expertise, personal characteristics, ability to estimate future events, decision making ability, etc),
- group dynamics, such as "the tendency to drop the outliers in order to arrive at a position that everyone can agree with, and the 'built-in' bias against ideas that are cutting edge" (Skumanich & Silbernagel, 1997, p.6)
- zeitgeist (Schnaars, 1989) or spirit of times, that is the influence of popular and dominant thought,
- lack of context, such as focusing on a specific area without taking into account factors that may affect the outcomes being predicted, and
- the time consuming nature of the method.

Linstone and Turoff (2002) have recently recognised three virtual problems as possible limitations of the method. One of these is the problem of the quality of the respondent group, the second is appropriateness of the Delphi design with a particular research problem, and the third virtual problem is the honesty of those who facilitate the process. However, the authors emphasised that these problems are not unique to the Delphi method and are likely also to affect other methods of inquiry.

In order to avoid difficulties in utilising the Delphi method, Linstone (2002) created a checklist of eight basic pitfalls that a researcher should consider. These are:

- discounting the future,
- the prediction urge,
- the simplification urge,

- illusory expertise,

- sloppy execution,

- optimism-pessimism bias,

- overselling, and

- deception.

In summary the Delphi method does not follow the principles of the positivist research paradigm and "does not provide truth" (Wedley, 1980, p. 16), but careful planning and understanding of the limitations and possible pitfalls of the method can transform it into a powerful research tool, the usefulness of which has been proved through six decades of application.

As previously indicated in Chapter 1, this research project has contributed to existing body of knowledge on the Delphi method by addressing a number of weaknesses or limitations as outlined above. These include the question of anonymity, the influence of group dynamics over group opinion, the acceptance of adversary or exploratory thinking as well as the validity and trustworthiness of the Delphi findings. These issues will be discussed further and theorised in Chapters 4 and 7.

3.4.2   The Delphi method utilised in this research

A modified computer-based Delphi method (Turoff & Hiltz, 1996) was utilised in the first stage of this research project. As indicated previously, a semi-structured (Clayton, 1997; Delbecq et al., 1975), electronic mail Delphi was designed to update and modify a list of computer competencies published in a peer-reviewed journal article by Scheffler and Logan (1999).

Two groups of experts were invited to participate in the Delphi process: the Delphi Panel, and the Advisory and Monitoring Team (AMT). Both groups were selected by purposefully following guidelines proposed by Akins, Tolson, and Cole (2005) and Ziglio (1996). Akins, Tolson, and Cole (2005) suggested that the selection criteria should depend on the context, scope and aims of the particular study, while Ziglio (1996) outlined the following criteria for expert selection:

- knowledge and practical engagement with the issue under investigation,

- capacity and willingness to contribute to the exploration of a particular problem,

- assurance that sufficient time will be dedicated to the Delphi exercise, and

- experts' skills and knowledge need not necessarily be accompanied by standard academic qualifications or degrees.

In the preparatory stage of the Delphi process eight lecturers from Victoria University were invited to become members of the AMT, also known in the literature as steering committee (Rockwell et al., 2000), or review panel (Clark & Wenig, 1999), to assist, monitor and advise the facilitator throughout the process, and help reduce researcher bias (Linstone & Turoff, 1975). Members of the AMT were selected by a purposive sampling technique (Brockhoff, 2002; Clark & Wenig, 1999; Delbecq et al., 1975; Goldschmidt, 1996; Ratcliffe, 2000), based on professional expertise in the field of ICT, ICT pedagogies, educational change and research design (Table 3.1). The supervisors of this PhD research were also members of the AMT that attended regular meetings prior to each round of the Delphi process. The AMT nominated and selected the members of the Delphi Panel, advised and monitored the facilitator with regards to data collection, data analysis, participant withdrawal and methodological procedures applied to the Delphi process.

Table 3.1 The Advisory and Monitoring Team by field of expertise

Field of expertise	No of panellists	%
Educational theory/educational change	3	37.5%
ICT and its applications to teaching and learning	4	50.0%
Research methodology and design	1	12.5%

The international Delphi Panel comprised of ten experts (eight experts from Australia, one expert from North America, and one expert from Europe) with expertise in the following fields: (1) educational theory and educational change, (2) ICT pedagogy, (1) teacher education, (4) primary school teachers known for their exemplary use of ICT in the classroom, and (2) school technology coordinators and/or consultants (Table 3.2). In addition to Akins et, al. (2005) and Ziglio's (1996) criteria , purposeful selection of panellists was based on expertise in the field and professional reputation as recommended

by the literature (Akins et al., 2005; Delbecq et al., 1975; Goldschmidt, 1996; Scheffler & Logan, 1999).

There is no agreement in the literature on the size of the panel. The number of experts can range from small to large samples (Akins et al., 2005; Brockhoff, 2002), depending on the context of the study and the capacity of the facilitator. There has been no positive relationship found between group size and group performance (Brockhoff, 2002) Similarly to the Scheffler and Logan study (1999), this Delphi study opted for a small sample of ten experts with national and international reputation in their field of expertise, as illustrated by Table 3.2.

Table 3.2 The Delphi Panel by field of expertise

Field of expertise	No of panellists	%
Educational theory/educational change	1	10%
ICT-pedagogies	2	20%
Teacher educators	1	10%
Primary school teachers	4	40%
Technology coordinators/consultants	2	20%

Members of the Advisory and Monitoring Team were invited in person while Delphi Panellists were approached by both postal mail and email. Both the members of the AMT and the Delphi panel received the information about the research project, information about the Delphi method, documents detailing the procedures and techniques to be applied as well as a consent form for voluntary participation in the Delphi process. Participation in the research was confirmed by email.

The role of the facilitator in this research was comprehensive. Tasks included designing the Delphi process, communicating with panellists, analyzing data, making decisions and providing reports to the AMT.

3.4.2.1   The instruments used in the Delphi process

Two instruments were introduced in this Delphi process, one in the first round and one in the third round. As indicated previously, the first round of the Delphi process utilised a

peer-reviewed list of computer competencies for secondary school teachers created by Scheffler and Logan (1999). The 67 computer competencies for secondary school teachers were organised into two broad categories: general computer competencies and computer competencies unique tor teachers. As described in Chapter 2, the list of competencies was developed in a Delphi process and over 400 educators rated the importance of the competency statements on a five point Likert-type scale. According to ACCE (2000), the findings of this study indicate the importance of pedagogical skills, and that issues related to teaching and learning are "foremost in teachers' minds" (p. 2) when it comes to computers. Since data used to design this list of competences were collected in 1995/1996 there was a need to revise and up-date the list by taking into account educational change and technological developments especially in the area of communication technologies and emerging mobile technologies.

Even though the instrument was available for peer review and expert opinion from the candidature stage of the research project, it was first criticised in the first round of the Delphi process by two members of the Delphi panel. As a result of decisions based on group consensus, the Scheffler and Logan (1999) list was abandoned, and a new questionnaire was developed. The new questionnaire was based on qualitative and quantitative data emerging from the first round of the Delphi process, interviews with individual panellists, and a comprehensive literature review. The questionnaire contained 45 statements describing teachers' ICT literacy in the contemporary primary classroom. The 45 teacher capabilities were grouped into five categories:

- Operational Understanding and Application of Information and Communication Technologies (ICT),

- Designing ICT-rich Learning Environments and Curriculum for Improved Student Learning,

- Classroom Management, Assessment and Evaluation,

- ICT for Professional Learning and Engagement,

- Socio-cultural, Ethical, Legal, and Health-related Issues in the Use of ICT.

The new instrument was reviewed by the Advisory and Monitoring Team prior to implementation as recommended by Clark and Wenig (1999).

3.4.2.2   The structure of the Delphi process

The Delphi process implemented in this project comprised of five distinct phases: the preparatory stage and four consecutive rounds. Prior to and concluding each Delphi round a meeting was held with the members of the AMT. The aims of these meetings were to assist the facilitator with issues related to process design, procedures of data collection and analysis, and communication with experts.

3.4.2.2.1   Preparatory stage

In the preparatory stage the facilitator designed a detailed plan of activities which included:

- designing the process, informed by an extensive literature review,

- obtaining the approval of the Human Research Ethics Committee of Victoria University,

- selecting the members of the AMT,

- organising the first meeting with the AMT,

- nominating the members of the Delphi panel,

- contacting the potential Delphi panellists, and

- sending out the Delphi information package which contained the invitation to participate, information about the project, and the consent form.

After accepting the invitation to participate in the Delphi study, members of AMT received folders containing information about study design, tasks and responsibilities of AMT members, and the information planned to be sent to the experts in the first round of the Delphi process. Once selected AMT members had accepted the invitation and signed the consent form, the first meeting was announced. The meeting agenda was to:

- discuss details about the study design, and the roles and responsibilities the members of the AMT would take up during the process,

- nominate and select the participants of the Delphi panel, and

- establish procedures for ensuring anonymity and confidentiality throughout the process.

At the first meeting of the AMT a list of seventeen nominations for the Delphi Panel was created. Ten experts were selected to participate in the work of the Delphi Panel based on the sampling criteria described in the sampling procedure. Members of the AMT were requested to maintain the confidentiality of the disclosed information according to the Information Privacy Act: Schedule 1: The information privacy principles (The Parliament of Victoria, 2000). Each member received a hard copy of this document.

Following the first meeting with the AMT, the facilitator invited the selected panellists both by traditional and electronic mail to participate in a three round electronic-mail Delphi process. Each invitation was accompanied by information on the project, a consent form and the first Delphi questionnaire (Appendix A) based on the list of computer competencies by Scheffler Logan (1999). All institutions employing the experts received a letter of request for supporting staff participation, and the information about the proposed project.

Due to other commitments, two of the selected panellists could not participate in the Delphi process, so two other experts were approached from the list of the seven remaining nominees. After the two nominees expressed their interest for participation and signed the consent form, the first round of Delphi process commenced. Communication with the expert panel was conducted via the Internet, using email (Turoff & Hiltz, 1996).

3.4.2.2.2   First Round

According to the initial research design, a three-round Delphi process was planned. In the first round the Delphi panellists were requested to examine the Scheffler and Logan (1999) list of computer competencies and recommend changes, additions and deletions to it. Participants were provided a two-week response period. Nine of the ten panellists responded on time. Both qualitative and quantitative data were analyzed and a report was generated using Crystal Reports (a business intelligence software tool created by SAP for analyzing and presenting data). The findings of the first round together with the feedback from the experts were presented to the AMT. Following the meeting with the AMT the tenth panellist submitted a response. This panellist expressed irreconcilable disagreement with the Scheffler and Logan list and compiled a new list of competencies containing 45 statements (Appendix B). Content analysis (Miles & Huberman, 1994) was used to search the two lists for differences and similarities. Analysis showed that many of the new statements were similar to the Scheffler and Logan (1999) competencies but were

paraphrased using the vocabulary of critical pedagogy (Appendix B). In many instances the statements were too complex and included more than one competency. An individual face-to-face interview was conducted with the panellist aimed to better understand the diverse point of view and reach common ground by exploring ways of bringing together the input of the individual panellist with the contribution of other experts participating in the first round of the Delphi process. This panellist declined to follow the initial research design, which left the facilitator with a challenge of whether to serve the "dogmatic drive for conformity" (Linstone, 2002, p. 567), or incorporate the outlier in order to facilitate the emergence of new understandings and creative solutions. According to Linstone:

> ...the "tyranny of the majority," sometimes threatens to swamp the single maverick who may actually have better insight than the rest of the "experts" who all agree with each other. This is not unknown in science; it is, in fact, a normal situation in the arduous process of creating new paradigms, i.e., scientific revolutions. In short, a consensus of experts does not assure good judgment or superior estimates (Linstone, 2002, p. 567).

After consultations with the AMT it was decided that the outlier's view would be incorporated into the feedback, which resulted in significant changes to the original design of Delphi process.

3.4.2.2.3 Second round

In the second round the facilitator opened up the Delphi process to collaborative decision-making, by asking the experts to vote about how the process should be continued (Appendix C). The experts were asked whether they would like to:

- remain with the Scheffler and Logan list,

- continue with the list of competencies submitted by the outlier, or

- develop a new framework of ICT literacy.

A consensus was reached about adopting the third option. Since developing a new framework required additional workload, experts were also asked to confirm their participation in the study. Due to the changes occurring to the Delphi process, two Delphi panellists withdrew their participation. The dynamics and outcomes of the second round are discussed in Chapter 4.

3.4.2.2.4　Third round

Based on a further review of literature, as well as qualitative and quantitative analyses of data submitted by all Delphi panellists, including the outlier, a proposal for a new framework of ICT literacy comprising of forty-five teacher competencies was introduced to the Delphi Panel (Appendix D). As described earlier in this chapter, the competencies were grouped into five categories. Similarly to the first round Delphi panellists were given the opportunity to accept, omit and edit existing competencies and suggest modifications or new ones. The third round concluded with all eight panellists remaining on board.

3.4.2.2.5　Fourth round

Following a meeting with the AMT, a summary of third round responses (including a copy of the statistical analysis and a copy of the original responses) was fed back to the experts. Delphi panellists were asked to rate the ICT capabilities on a four point Likert-type scale (Akins et al., 2005; Wedley, 1980): Not important (0), Somewhat important (1), Important (2), Very important (3). The facilitator and the AMT chose to adopt a scale without a mid-point to avoid the neutral response category (Garland, 1991; Turoff & Hiltz, 1996). Garland (1991) argued that while scales without a midpoint may alter the intensity of the opinion, they help minimise the social desirability bias. His view was consistent with that of Wedley (1980), who argued that the lack of neutral point promotes debate and makes the respondent consider the detailed implications of each suggestion.

All eight panellists participated in the fourth round of the Delphi process. As a result of the voting process consensus was reached about the inclusion of 37 teacher capabilities in the new Framework of ICT Literacy for Primary School Teachers.

3.4.2.2.6　Post-Delphi evaluation

Following the fourth and final round of the Delphi process, Delphi panellists received a full report on the fourth round. Experts were also invited to fill in a post-Delphi evaluation form (Appendix E). The questionnaire contained 10 items, eight of which were Likert-type scale items. The values on the scale were: Strongly Disagree (0), Disagree (1) Agree (2) and Strongly Agree (3). Two of the questionnaire items were open-ended and inquired about the most and the least attractive features of this particular Delphi process. Four panellists returned the evaluation forms. The results of the post Delphi evaluation are presented in Chapter 4.

3.4.2.3 Data analyses

The Delphi process generated both qualitative and quantitative data. According to Keeney et al. (2006), little guidance is offered by the Delphi literature on how to analyse qualitative data. Qualitative data generated by this study were analysed by content analysis in order to identify major themes (Hasson et al., 2000; Powell, 2003). New competencies or teacher capabilities were organised by themes. Similar suggestions were compiled and redundant items were eliminated (Clark & Wenig, 1999).

Simple statistical procedures (Hasson, Keeney, & McKenna, 2000; Keeney, Hasson, & McKenna, 2006), such as measures of central tendency (mean) and dispersion (standard deviation) were used to analyze quantitative data (Scheffler & Logan, 1999). Quantitative data were stored in a Visual Fox Pro database. Data were analyzed and presented in Crystal Reports, providing participants easy-to-read statistics, illustrated by bar graphs. Participants were also provided with collections of original responses in each round, so they could track individual responses. Individual responses were numerically coded to protect the anonymity of information and confidentiality of participants (Dakich, 2004).

An important aspect of data analyses was determining the level of consensus. The Longman Dictionary of English Language and Culture defines consensus as "a general agreement, the opinion of most of the people in the group" (p. 268). According to Powell (2003), many Delphi studies failed to "offer an interpretation of the meaning of consensus" (p. 379). Although there are no firm rules established in the Delphi literature about the level of consensus, which is often determined by arbitrary judgment, according to Powell (2003), it may range from 55% to 100%. Some authors recommended a 75% level of consensus amongst the Delphi panellists (Hasson et al., 2000; Keeney et al., 2006), however according to Hasson et al (2000) and Keeney et al. (2006), no scientific rationale supported their decision. Given the small panel size, in this study an arbitrary level of consensus of 66% (two-thirds) was determined at the first meeting of the AMT.

3.4.2.4 Validity and reliability of the findings of the Delphi process

When conducting research it is important to consider issues related to reliability and validity (Hasson et al., 2000). While it is evident that the scientific criteria of rigour and the traditional notion of reliability and validity do not apply to the Delphi method (Sackman, 1974), different researchers and authors highlight different facets of the Delphi

method that can increase its validity and reliability. According to Clayton (1997), one aspect of validity of the Delphi outcomes lies in the process of selecting experts that "serves to authorise the Delphi's superiority and validity over less painstaking and rigorous survey procedures" (p. 5). This corresponds with Mitroff and Turoff's (1975) opinion that: "an empirical generalisation or communication is judged objective, true or factual if there is sufficient widespread agreement on it by a group of experts" (p. 21). Annels et al. (1997) and Hassson et al. (2000) suggested using Lincoln and Guba's (1985) criteria for qualitative studies to help ensure credible interpretation of findings for Delphi studies. According to Hasson et al. (2000), these criteria include "credibility (truthfulness), fittingness (applicability), auditability' (consistency), and conformability" (p. 1013).

Several processes were put in place to increase the validity and reliability of findings of the Delphi study described in this dissertation. The framework of ICT literacy was tested for reliability by establishing the score of internal consistency (Creswell & Clark, 2007). According to Borg and Gall (1989), reliability "may be defined as the level of internal consistency or stability of the measuring device over time" (p. 257). The coefficient alpha or the Cronbach's alpha, named after L.J. Cronbach (1916-2001), is used to determine the internal consistency of items with regards to a single underlying idea, trait or construct. Cronbach's alpha can be viewed as an index of reliability, and "refers to the degree to which the items that make up the scale 'hang together'." (Pallant, 2005, p. 90). The value of Cronbach's alpha ranges from 0 to 1. Scores above 0.7 indicate the reliability of the scale. The closer the score is to 1.0, the greater the internal consistency of the scale is (Gliem & Gliem, 2003). The Cronbach's reliability index for this Delphi study was $\alpha = .952$.

External validity, or the replicability of the study in other contexts (Wiersma & Jurs, 2005), was enhanced by several important factors that included sample characteristics, methods of data collection minimising researcher bias, and applying the findings to another research context. Following Clayton's advice (1997), the heterogeneous group of experts was carefully selected based on expertise in the field. Data collection was carried out in an online environment providing Delphi panellists with anonymity thus minimising the bandwagon effect and the likelihood of the socially desirable responses (Wedley, 1980). The Delphi process was monitored by an Advisory and Monitoring Team to avoid researcher bias, simplification of processes and sloppy execution (Linstone, 2002). The

findings of the Delphi study were also tested for external validity in second sub-study, the teacher survey. The validation process is described in Chapter 4.

Finally this research has contributed to the discourse on issues related to validity and reliability of the Delphi method in general, by observing that the use of the Delphi method in mixed methods research designs provides opportunities for validation and triangulation of the Delphi results thus increasing their validity and reliability (Dakich, 2008a).

3.5 The teacher survey

The teacher survey was designed to gather primary data (Arleck & Settle, 2004) from teachers teaching in a randomly selected sample of 350 Victorian government primary schools. The aims of the survey study were to validate the findings of the Delphi study and to paint a profile of primary teachers' ICT literacy by gathering data about their self-reported competence in learning and teaching with new technologies. The following research questions focused the study:

- What are the dimensions of teachers' ICT literacy?
- What factors influence teachers' ICT literacy?

The design of the teacher survey involved the development of the survey instrument, selection and recruitment of participants, procedures and techniques of data collection, and methods of data analyses. A sound ethical framework was crafted to protect participants' rights and privacy. The research ethics was based on state and national guidelines and current literature on ethical conduct of research involving human participants.

3.5.1 Survey instrument development

The survey instrument was developed through several phases which included the transformation of the framework of ICT literacy into a survey instrument, an expert review and a pilot study.

3.5.1.1 *Preparatory stage*

In the preparatory phase the framework of ICT literacy was transformed into a survey instrument. The framework comprised the core (Arleck & Settle, 2004) of the survey instrument, and was planned to be used for validating the findings of the Delphi study and for collecting data about teachers' ICT literacy. In order to gather data about factors influencing teachers' ICT literacy, a section of nine items on teacher demographics or general background information and professional characteristics was included. The survey instrument/questionnaire concluded with two open-ended questions that allowed teachers to make comments and suggestions. A codebook was created with all the variables and pre-coded values (Fink, 2006). The survey was then turned into an online survey instrument. The online questionnaire was constructed in PHP (Hypertext Preprocessor) open-source server-side, HTML embedded scripting language, and was placed on a secure website of the School of Education at Victoria University (Dakich, 2005a).

Data entered by survey participants was automatically saved into a database linked to the online questionnaire. Data were then transferred in plain .txt file format to a Microsoft Excel table containing all the pre-coded variables, from which it was imported into SPSS for the purposes of descriptive and inferential statistical analysis. Prior to the pilot study the functionality of the web survey (including data input and data transfer) was tested to ensure that the online survey instrument was fully operational.

3.5.1.2 *Expert review of the survey instrument*

Two lecturers from the School of Education at Victoria University, and a portfolio leader from the Victorian Schools Innovation Commission were invited to review the survey instrument. In this cognitive pre-test of the instrument (Fink, 2003d), the reviewers were asked to comment on the structure of the questionnaire, the wording of individual items and on the Likert-type scales designed to pre-code participants responses. Reviewers suggested changes to the wording of items belonging to the demographic section, the cover letter (Arleck & Settle, 2004), and instructions to survey participants. In consultation with the reviewers and research supervisors, the debated notion of ICT competencies was replaced with the concept of ICT literacy which was more aligned with the content of the new framework. The titles of Dimensions 2 and 4 were found to be too long, and were reworded. The title of Dimension 2 changed from Designing ICT-rich

Learning Environments and Curriculum for Improved Student Learning to a shorter title communicating the same (or very similar) meaning: ICT-rich Pedagogies and Learning Environments. Similarly the title of Dimension 4 changed from Socio-cultural, Ethical, Legal, and Health-related Issues in the Use of ICT to The Social Ecology of Living and Learning with ICT.

3.5.1.3   Pilot study

The survey instrument was piloted following the expert review. The aim of the pilot study was to help fine-tune the survey instrument and to simulate the use of the questionnaire in its intended setting before it was finalised (Fink, 2003d). According to Tourangeau, Rips and Rasinski (2000), semantic problems, unfamiliarity and vagueness can lead survey participants to interpret questions in variable ways. To avoid this problem, participants were requested to provide feedback on the structure of the questionnaire, clarity of the items and possible deficiencies such as: ambiguous language, misunderstandings and difficulties related to instructions (Creswell, 2005). The pilot study provided an opportunity to test both the printed and the online survey instrument. It also enabled the researcher to monitor the time and ease of completion, and helped "obtain information about possible patterns of results" (Wiersma, 2000, p. 172). As recommended by Creswell (2005), the participants of the pilot study and their survey responses were not included in the survey sample.

A group of practising primary school teachers aged 25-39, attending a post-registration Bachelor of Primary Education course, were targeted for the pilot study on July 19, 2004. Eleven teachers agreed to participate in the pilot study by signing the consent form and eight of them responded by filling in the questionnaire. The eight respondents had no major concerns with regards to the structure of the questionnaire and found the instructions easy to follow.

Since the literature recommends piloting the survey on at least 10-20 individuals similar to the sample, in order to test the clarity of its format (Wiersma, 2000), there was a need for conducting a second pilot study, targeting at least ten primary school teachers. For this purpose amendments were made to the initial ethics application submitted for this stage of the study, and an approval was granted for approaching a second group of potential participants for the pilot study.

On September 7, 2004, a second group of primary teachers, attending in-service professional development was approached at a local school. On this occasion four individuals responded to the invitation, which made it possible to proceed with preparations for the final survey study. Although hard copies of the questionnaire were provided to both groups of teachers participating in the pilot study, all responses were submitted on-line. This may be explained by the fact that both groups of teachers were engaged in professional development related to integrating ICT in teaching and learning.

Following the analysis of written responses, comments and suggestions submitted by the pilot participants, modifications were made to Section 1 of the survey instrument (Appendix F). Questions aiming to collect general background information were slightly rephrased and some of them were completely changed: for example, questionnaire item No. 1 *Please indicate your Like School Group, if known* (Like School Group stands for a socio-economic category assigned to each school by the Victoria Government for the purpose of performance review), was replaced with: a) *The postcode of your school*, b) *Student population*. Open-ended questionnaire item No. 3: *Please indicate your teaching qualifications*, was replaced with a closed question: *Your most recent teaching qualifications: a) less than 4 year course (e.g. Diploma in Teaching); b) 4 year course (e.g. B.Ed/B.A + Dip Ed etc.); c) postgraduate studies (e.g. M.Ed/M.A + Dip Ed/B.Ed etc.)*. And finally, in item No. 7, *What grade levels do you teach in 2004? (Please tick all that apply.)*, *grade prep* was included.

3.5.2 The questionnaire

One of the most important elements of gathering reliable and valid information from survey participants is a well-constructed survey instrument (Nardi, 2006), where the sections, individual survey items (or questions), scales, and other elements are flawlessly organised into a single questionnaire (Arleck & Settle, 2004). The survey instrument (Appendix F) consisted of two sections: Section 1: General background information, and Section 2: Teaching and learning with ICT.

3.5.2.1 Section 1: General background information

Section one consisted of nine items, which were designed to collect general background data, including information about school location, student population, age group and gender, teaching qualifications and experience, grade levels taught, computer usage and forms of professional development related to ICT. Data collected through this section of

100

the survey allowed the researcher to portray the nature of the sample (Arleck & Settle, 2004), and to identify some of the factors that may have an influence on teachers' ICT literacy.

3.5.2.2 Section 2: Teaching and learning with ICT

Section two contained the 37 teacher capabilities developed by the international Delphi panel, as well as two open-ended items, reserved for teachers' comments and suggestions. The 37 teacher capabilities (items 10-46) were divided into four sub-sections (Table 3.3), according to the four dimensions of the framework.

Table 3.3 The four sub-sections of Section 2 of the questionnaire

Dimensions of teachers' ICT literacy	Subsections of Section 2: teaching and learning with ICT
D1:Operational Understanding and Application of ICT	When integrating ICT into teaching and learning, in your opinion, how relevant is it for the teacher to: *Includes questionnaire items: 10-13*
D2:ICT-rich Pedagogies and Learning Environments	When thinking about designing ICT-rich learning environments and curriculum for improved student learning, in your opinion, how important is it for a teacher to: *Includes questionnaire items: 14-33*
D3:ICT for Professional Learning and Engagement	When thinking about professional learning and engagement related to ICT, in your opinion how essential is it for teacher to: *Includes questionnaire items: 34-41*
D4:The Social Ecology of Living and Learning with ICT	When considering socio-cultural, ethical, legal and health-related issues in the use of ICT, in your opinion, how important is it for a teacher to: *Includes questionnaire items: 42-46*

Each of the 37 items were accompanied by two Likert-type scales (Appendix F), to help teachers rate the perceived importance of each capability for student learning, and indicate their competence and confidence in applying the capability.

The following instructions were included:

- Please rate the importance of the items below for designing learning in the primary classroom.

- Indicate the level of your competence and confidence in applying them to your teaching.

The two open-ended items aimed to collect qualitative data were as follows:

- If anything that you would find important has been left out from the above framework, please include in the textbox below.

- Other comments and suggestions, if any.

3.5.3 Question types

According to Babbie (2004), the format and the layout of the questionnaire is just as important as the type of the questions we ask and the wording we use. The way questions are asked can affect the information provided by the participants of the survey (Fink, 2003a). Therefore it is very important to carefully structure and word the questionnaires to minimise bias, misunderstandings, and unnecessary cognitive burden (Tourangeau et al., 2000) on participants. Questions need to be clearly and precisely worded and have to be "logically related to the survey's objectives" (Fink, 2003a, p. 22). It is recommended that survey questions are pre-tested and piloted (Arleck & Settle, 2004). There are many different types of questions used in surveys. This particular survey study has utilised the three different question formats: response choices, matrix questions and open-ended questions.

Response choice or multiple choice questions are structured questions, and provide the survey participants with choices from which they can select their answers (Arleck & Settle, 2004; Fink, 2003a). Response choice questions were used in Section 1 of the survey instrument and they included: numerical, categorical or nominal, ordinal response questions, and "check all that apply" questions as presented by the examples below:

- Numerical questions, such as Q1: *The postcode of your school_____,*
- categorical or nominal questions, such as Q5b: *Your gender: male _; female_,*

- ordinal response choice questions such as Q5a: *Your age group: _ under 25; _25-39_40+*, and

- "check all that apply" questions, such as Q6b: *What subject areas do you teach? (Please tick all that apply) __ Visual Arts, __ Language __, Music, __ Science__ ICT, __PE, __Library, __ Non-teaching/Administrative, __ Other (Please specify).*

The second type of questions used in the survey were matrix questions (Fink, 2003a). According to Fink, structured questions with the same choices can be organised into matrices. One of the reasons for using matrix questions was their 'space smart' nature which makes them ideal for online surveys. Babbie (2004) observed that one of the disadvantages of using such question formats is that participants may develop a pattern of answers.

According to Babbie (2004), matrix questions are widely used with Likert and Likert-type scales. The matrix question format was used in Section 2 and included questionnaire items 10 – 46. Two four-point Likert-type scales accompanied each item. Likert-type scales are often used in educational research. The literature indicates that the number of the Likert scale points may influence the accuracy of findings and may result in information loss (Garland, 1991; Owour & Zumbo, 2001), and that fewer number of Likert scale points can result in larger biases (Owour & Zumbo, 2001). Although it is commonly believed that five to seven point scales are the optimal choice for the majority of surveys instruments, in a study investigating the effect of Likert data in a linear regression models Owour and Zumbo (2001) found that while fewer number of Likert scale points resulted in larger biases, there was little or no substantial gain in information results when using more than four point Likert scales.

An important question when constructing scales is whether to use the mid-point or neutral response category or not. Fink (2003a) argued that "conclusive evidence for the superiority of either odd-or even-numbered scales is unavailable" (p. 57), and that the use of one or the other depends on the survey's needs. She also suggested using the neutral response category only if a valid response could be obtained. In his study Garland (1991) compared the use of five-point and four-point scales. His findings indicate that although using a four-point scale can alter the intensity of the opinion, it helps minimise the social desirability bias without changing the direction of the opinion.

As teachers' ICT literacy is an area that can be affected by the social desirability bias, in order to help minimise its effects a four-point scaling was chosen. Each of the thirty-seven questionnaire items in Section 2 was accompanied by two four-point Likert scales. The purpose of the first scale was to assist the validation of the findings of the Delphi process, while the second scale was included to collect teachers' self-reports about the level of their confidence and competence in integrating ICT in learning and teaching (Appendix F).

Participants in the teacher survey were requested to rate the perceived importance of the items for designing ICT-rich learning experiences in the primary school settings, by responding to the first scale the values of which were identical to the scale used in the Delphi study: very important (3), important (2), moderately important (1), and not important at all (0). They were also requested to indicate the level of their own confidence and competence in applying the described capabilities to their teaching practices and pedagogical approaches on a by filling in the second scale, the values of which were: beginner (1), intermediate (2), advanced (3), and expert (4). Data entered into the first scale helped the researcher to add to the rigour of the Delphi process by validating its findings as reported in Chapter 4, while data entered into the second scale, provided valuable information on primary teachers' ICT literacy which is presented in Chapter 5.

The third type of question in this survey instrument was open-ended (Fink, 2006), or unstructured (Arleck & Settle, 2004). The two open-ended questions in Section 2 of the questionnaire offered participants the freedom to provide their own answers in their own words. The two open-ended questions yielded valuable qualitative data also reported on in Chapter 5.

3.5.4 *Instructions to participants*

Both the online and the printed version of the survey were accompanied with a cover letter (Arleck & Settle, 2004). The cover letter introduced the topic of the questionnaire and the aims of the study, and highlighted the significance of the information for the broader educational community. It also informed potential respondents about the voluntary and anonymous nature of participation, and stressed the importance of participants' contribution to the research project (Creswell, 2005).

Even though the cover letter and instructions to participants are not considered formallyto be part of the survey instrument (Arleck & Settle, 2004) they are a rather important component of self-administered questionnaires. Following Arleck & Settle's advice the instructions used in this survey instrument were simple and provided clear directions on how to respond to survey items.

3.5.5 *Validity and reliability of the survey instrument*

Reliability and standardization are means to an end rather than ends in themselves. (Aiken, 1996, p. 89)

Validity and reliability of a survey instrument are important criteria for obtaining high quality data. To ensure the validity and reliability of the survey instrument utilised in this research project, several tests of validity and reliability have been performed.

3.5.5.1 *Validity*

Validity is commonly defined as a criterion that refers to the quality of research, in terms of its trustworthiness and credibility (Borg & Gall, 1989; Johnson & Turner, 2003). Valid research instruments generate data that allow the development of meaningful and representative conclusions about the sample drawn from the target population (Creswell, 2005). In general terms, validity refers to the ability of the instrument to measure the variables under consideration (Glenberg, 1988; Utts, 2005). There are several types of validity measuring strategies which include content validity, face validity, predictive validity, and construct validity. These strategies are employed to establish that the instrument of data collection measures what was intended to be measured. Since the survey study has utilised a newly developed framework of ICT literacy for primary school teachers there was a need for testing the instrument for validity. A widely accepted approach to establishing validity (Creswell, 2005) was utilised, which was to measure and discuss content validity, criterion-related validity and construct validity.

Content validity is the degree to which the survey items represent the content the questionnaire intends to measure (Borg & Gall, 1989). Aiken (1996) argued that content validity is based on reasoning, and therefore it is often called rational validity where the reasoning is based on the knowledge of the variables or constructs and the underlying theoretical concepts. In his opinion content validity measures more than "a simple matter of superficial appearance or face validity. It involves a careful, systemic analysis of the

content of the instrument by experts who are familiar with the variables or constructs purportedly measured by it" (p. 90).

Content validity of the survey instrument utilised in this research project was established in three separate stages: the process of instrument development, the expert review of the survey instrument and the pilot study. Firstly the content validity of the individual items belonging to Section 2 of the survey instrument was established in the four-round consensus–building process utilising the Delphi method. The framework was developed by an international panel of experts with expertise in the area of learning and teaching with ICT. The Delphi process generated "careful definitions of the variables which the instrument is intended to measure" (Aiken, 1996, p. 91). Additionally, the involvement of geographically dispersed experts representing different educational systems, sectors and institutions contributed to a valid judgment about the adequacy of the survey instrument (Wallen & Fraenkel, 2001). Secondly, as described in the section on expert review, the survey instrument was reviewed by three experts, who provided feedback on the content, structure, instructions and layout of the survey instrument prior to the commencement of the pilot study. Thirdly, the instrument was fine-tuned in the pilot study by two groups of primary school teachers involved in professional development related to innovative teaching and learning with ICT. The second and the third phases of validation slightly redefined the "relationships and interactions" (Aiken, 1996, p. 92) among the variables, by regrouping some of the items in both sections of the survey instrument.

Criterion-related validity is considered to be another strategy for assessing the validity of the survey instrument. According to Aiken (1996), criterion validity shows the empirical validity of an instrument, in other words the extent to which the measures are related to the real world. A common approach to establishing criterion-related validity is the method of contrasting groups (Aiken, 1996). This method allows us to compare the performance of two or more groups of people on a rating scale. In this study the performance of three groups of participants was compared in order to establish criterion-related validity. They were the Delphi panel, the participants of the pilot study and the participants of the teacher survey.

Construct validity is established when data obtained by the survey instrument are meaningful, useful and assist with understanding the sample representing the target population (Creswell, 2005). Even though construct validity of the instrument was not

106

statistically tested as recommended by Creswell (2005), it is believed that the construct validity of the survey instrument was enhanced by the mixed methods approach. First, the constructs in Section 2 of the instrument (the 37 teacher capabilities) were developed by a heterogeneous group of experts in a rigorous consensus-building process, second, the constructs were empirically tested on two different samples, which included the participants of the pilot study and a random sample of primary school teachers from Victorian government primary schools.

3.5.5.2 *Reliability*

According to Creswell (2005), good quality research is characterised by measures and observations that are reliable. Within the quantitative paradigm reliability of the research depends on "the replicability and consistency of the methods, conditions and results" (Wiersma & Jurs, 2005, p. 9). There are standard procedures that help establish the external reliability and the internal consistency of instruments (measuring devices) used to collect data from a sample.

External reliability refers to the replicability of the study in similar settings (Wiersma & Jurs, 2005). This criterion was satisfied by administering the survey to two independent samples belonging to the target population during the pre-test/pilot study and the implementation of the survey.

According to Borg and Gall (1989), reliability "may be defined as the level of *internal consistency* or stability of the measuring device over time" (p. 257). Similarly to the test of internal consistency performed in the Delphi study, the coefficient alpha or the Cronbach's alpha was calculated for all thirty-seven items with Likert-type scales (survey items 10-46), contained by Section 2. Calculations were performed in SPSS for both scales. The values of the first scale were: not important (0), moderately important (1), important (2), and very important (3). The values of the second scale were: beginner (1), intermediate (2), advanced (3), and expert (4).

The first scale was measuring the importance of each item belonging to the framework of teachers' ICT literacy, while the second scale was measuring teachers' competence in implementing the described capabilities in their teaching. The Cronbach's reliability index was $\alpha = 0.966$ for the first scale, a result similar to the reliability index ($\alpha = 0.952$) of the same scale obtained by calculations performed on the data generated by the Delphi process. The alpha coefficient for the second scale was $\alpha = 0.980$.

3.5.6 Sampling and participant recruitment

This section provides information about the sampling procedures and methods of participant recruitment used in the pilot study and the teacher survey. Table 3.4 provides an overview of sampling and recruitment methods.

Table 3.4 Sampling methods for the pilot and the teacher survey.

Data collection phase	Sampling	Sample size	No. of participants	Contact methods / recruitment	Methods of administration of the survey
Pilot study Phase 1	Non-probability	11	8	In person Email	Online
Pilot study Phase 2	Non-probability	Approx. 20	4	In person Email	Online
Survey	Probability	350	35	Mail Email Telephone	Online Mail
Survey Follow-up I	Probability	350	63	Mail Email Telephone	Online Mail
Survey Follow-up II	Probability	Less than 350	26	Fax	Online Fax

3.5.6.1 Sampling procedure

As suggested by (McMillan, 2004; Wiersma & Jurs, 2005), the pre-test was conducted on individuals similar to the target population sampled in the survey study. Two groups of primary school teachers (volunteers, aged 25-40+) were invited to participate in the *pilot study*. The first group of practising teachers attended a post-registration course on ICT in education as part of the Bachelor of Primary Education degree at the School of Education, Victoria University. The second group of practising teachers were from schools located in the Western Metropolitan Region of Melbourne. They were attending in-service professional development in teaching and learning with ICT organised by the Victorian Department of Education Western Pedagogy Network at a local primary school. Both groups of participants were selected by purposeful sampling (Arleck & Settle, 2004; Babbie, 2004; Creswell, 2005), based on their teaching experience and engagement in professional learning related to facilitating student learning with ICT.

The sample for the teacher survey comprised of teachers from 350 schools randomly selected from an online database of 1239 Victorian government primary schools (DE&T, 2004). The random selection was aided by a simple software application created for this purpose.

3.5.6.2 Contact methods and recruitment of participants

In accordance with the ethical guidelines of the Victorian Department of Education for conducting research in government schools, school principals from selected primary schools were posted a letter to invite teachers in their school to participate in the survey study. Although all potential survey participants were invited to fill in the online survey, individuals with no access to the internet, and those feeling more comfortable with traditional forms of literacy were offered a hard (printed) copy of the survey instrument (Appendix F).

3.5.7 Data collection

As described in the previous section, the survey was designed to collect data using an online questionnaire (Arleck & Settle, 2004). Participants were invited to self-administer the questionnaire available at a secure website hosted by the School of Education (http://education.vu.edu.au/survey/survey.php). To counterbalance issues related to digital divide, such as limited access to networked computers or limited competence and/or experience in using web-based applications, each school received three printed copies of the survey instrument with self-addressed envelopes attached. Teachers were also provided with the alternative of responding to the survey by fax. According to Schonlau, Ronald Fricker, & Elliott (2002), the number of studies that allow respondents to choose between submitting their responses by postal mail or via Web is relatively small, however it is important, because statistics of the reviewed studies prove that in the past significantly more responses have been submitted by mail. Schonlau et al.'s (2002) observation has been supported by this survey study, with a considerable proportion (26%) of survey response submitted by mail.

3.5.7.1 Administering the survey

As a requirement set by the Victorian Department of Education and Training, principals of 350 randomly selected state primary schools were contacted by mail to approve the participation of teachers in their school in the survey study by signing an informed

109

consent (Appendix G). While this was an appropriate and ethical approach, it proved to act as a factor hindering the response rates and the gathering of valuable data. A number of school principals acted as 'gate keepers' and made decisions about the participation of teachers in 'their' schools without including teachers in the process of decision making.

The survey was launched on the November 22, 2004. Envelopes containing the above documentation were mailed to each school. School principals were given a week to approve staff participation. The online survey concluded on the December 15, 2004. The first round of data collection generated 35 responses 26 of which were submitted online, while nine responses were posted back to the researcher.

3.5.7.2 Follow-ups

The low response rate to the first round of data collection made it necessary to send out follow-up notes (de Vaus, 2002) to schools. Two follow-ups were carried out. The first follow-up was conducted between February 28, 2005 and March 15, 2005. Schools that had not responded to the first round of data collection in the survey study were sent an envelope, similar to the one mailed out in the first round of data collection. This time five fliers, and two hard copies of the survey were enclosed in the invitation. In this second round of data collection teachers submitted 60 responses, 24 online, and 36 by mail. The second follow-up was conducted between June 20, 2005 and July 30, 2005. This time a follow-up note was faxed to schools belonging to the random sample that had not submitted any response in the first two rounds of data collection. In the second follow-up 17 responses were submitted online, while two responses were faxed back.

Table 3.5 Distribution of survey responses by phase and response method.

Data collection phase	Online	Mailed	Faxed
Teacher survey	26	9	0
1st follow-up	24	36	0
2nd follow-up	17	0	2
Total	67	45	2

3.5.8 Data analyses

All questionnaires were numbered and coded (Fink, 2006). Questionnaires were also labelled according to the time of data collection. Following the conclusion of the survey study, data were cleaned and were transferred from the Excel table to SPSS file. (SPSS version 12 was used in this study as a tool for data analyses). Data cleaning included searching for errors and item non-responses. Item non-responses were treated as missing values and were labelled 99, as suggested by Jackson (1988). Some variables needed to be recoded (Fink, 2003c) order to avoid errors in data analyses. All decisions made regarding data entry, data transfer and data cleaning were documented.

The survey collected both quantitative and qualitative data from the target sample. The majority of survey items (45) were structured, and only two of the 47 items were open-ended. The structured items were pre-coded and were processed and analyzed using descriptive statistics (Best & Kahn, 1998; Fink, 2003c; Nardi, 2006). Descriptive statistical analysis was used to report on the demographic and professional characteristics of survey participants. As described in the section on validity and reliability, statistical procedures were also used to establish the internal consistency of survey items and to estimate the external validity, or the generalisability of findings to the target population. Inferential statistics including comparison of means and analysis of variance (ANOVA) were utilised to investigate the factors influencing teachers' ICT literacy. The two open ended items were analyzed by strategies for content analysis (Miles & Huberman, 1994). The findings of the survey study have been reported on in two refereed publications (Dakich, Cherednichenko, Vale, & Thalathoti, 2008; Dakich, Vale, Thalathoti, & Cherednichenko, 2008).

3.5.9 Limitations of the survey study

One of the limitations of this survey study was a relatively low response rate (124 valid responses), which may limit the external validity or the generalisability of the survey findings to the target population of all primary school teachers teaching in Victorian government primary schools or other similar populations and settings (Fink, 2003b). Yet the representative nature of the sample (see Chapter 5) permitted the observation of some patterns about factors that influence teachers' ICT literacy, which enabled the researcher to draw inferences for teacher professional learning and engagement.

3.6 Qualitative fieldwork

I think metaphorically of qualitative research as an intricate fabric composed of
minute threads, many colors, different textures, and various blends of material.
This fabric is not explained easily or simply. (Creswell, 1998, p. 13)

The qualitative fieldwork was the third and last stage of the study. The aim of the fieldwork was to explore the relationship between primary school teachers' ICT literacy and pedagogical practices, and to gather rich data about teachers' experiences of integrating new technologies into student learning. The qualitative fieldwork was used to explore ICT-rich pedagogical practices of four primary school teachers situated in authentic educational contexts. The following research questions guided the inquiry:

- How do teachers integrate ICT in the everyday social practices of teaching and learning?

- To what extent are they transforming student learning with ICT?

- How does teachers' ICT literacy influence their teaching practices and pedagogical approaches?

From a theoretical perspective the inquiry focused on contextualising conceptions of "human being and doing" situated in time and space, by looking at the active, reflective nature of human action and the capacity of human beings - agents to understand and know about what they do and why they do it (Giddens 1984). Furthermore there was an intention to observe and interpret the context of ICT-rich practices and pedagogies (or lack of them), by looking at the relationship between structure and agency as it is framed by resources, co-ordination of human agents and the position-practice relations associated with them (Giddens, 1984). These included school context, material resources related to ICT including technical support, learning structures, teacher collaboration and learning, classroom culture and relationships with the community. These connections will be discussed in Chapter 7.

3.6.1 *Planning and design stage*

Contrary to what you may have heard, qualitative research designs do exist.

(Miles & Huberman, 1994, p. 16)

Despite the apparent spontaneity of qualitative research it relies on rigour and complexity. It is a form of bricolage" (Denzin & Lincoln, 2000; Kincheloe & Berry, 2004) where the researcher, the bricoleur is similar to a "handyman or handywoman who, makes use of the tools available to complete the task" (Kincheloe & Berry, 2004, p. 1). Several steps were taken to ensure the quality of the bricolage in this research project. In the planning stage of the field study the research design established in the process of candidature proposal was fine-tuned, methods and procedures of participant recruitment and data collection were finalised, and strategies for the analysis and interpretation of qualitative data were identified. The planning and design stage for field inquiry involved:

- finalisation of procedures and techniques for participant recruitment,

- ethical considerations related to this stage of data collection and analysis,

- further literature review on teacher's use of ICT in the primary classroom,

- further literature review on methods and techniques used for classroom observations and individual interviews,

- further literature review on strategies for qualitative data analysis,

- development of the semi-structured classroom observation protocols to be used in the classroom and during the teacher interviews,

- extending the semi-structured classroom observation protocol for the purposes of data analysis, and

- identification of theoretical and conceptual frameworks to support the analysis and interpretation of findings.

Despite the careful preparations, Rubin and Rubin's (2005) notion of the iterative nature of qualitative interviewing was applied to the field inquiry as a whole: nothing was 'locked in stone', the inquiry and the questioning were redesigned throughout the process of data gathering and data analysis to enable a better understanding of the researched phenomena.

3.6.2 Sampling and recruitment of participants

Participants in the field inquiry were selected by a purposeful sampling procedure driven by the purpose of study (Babbie, 2004; Creswell, 2005), which was to observe the social practices of teaching and learning with ICT in Victorian government primary schools.

Primary school teachers attending the Western Pedagogy Network 2005 organised by the Victorian Department of Education were targeted. The teachers engaged in a series of seminars and workshops, based on contemporary thought and research related to educational practice and theory, aiming to facilitate and support transformation of teaching and learning. Apart from being actively engaged with contemporary theoretical perspectives related to teaching and learning such as multi-literacies, learning styles, multiple intelligences, and implications of brain research for teaching and learning. Teachers were also involved in an action research project inquiring into and about their own practice as part of this professional learning programme.

Permission was obtained from the organisers of the Western Pedagogy Network 2005 to contact the teachers during one of the above mentioned workshops, and to collect contact details of those interested in participating in the study. Potential participants were provided with detailed information about the aims of the field inquiry, methods of data collection as well as the consent form detailing the ethical considerations related to the study. A week later all potential participants were contacted by phone in order to confirm voluntary participation in the project. Although potential participants were provided with detailed information about the aims of the fieldwork, during the preliminary phone calls most of them said that they did not use ICT in the classroom on a regular basis. One teacher said "We only have two computers in the classroom, and they do not always work". It was especially difficult to find a teacher who would invite the researcher to a numeracy class, where ICT were integrated into the learning process. Finally, four teachers from two schools agreed to participate in the qualitative classroom observations and teacher interviews. In order to protect the anonymity and safeguard confidentiality, pseudonyms are used (Silverman, 2005) when referring to teachers, students or schools participating in this research.

3.6.3 Methods of data collection

The qualitative fieldwork was conducted between March 22, 2005 and May 19, 2005. In this period practices of four primary school teachers were observed in two different government primary schools. Kate and Maria were team-teaching grade 3 and 4 students at a primary school located in the inner suburbs, while Gina and Joanne were teaching grade five and six at a well-resourced primary school in the outer western suburbs of Melbourne.

The field study included naturalistic classroom observations (Reed & Bergemann, 2005; Wallen & Fraenkel, 2001; Woods, 1986, 1996) and semi-structured teacher interviews (Bogdan & Biklen, 2003; Creswell, 2005; Rubin & Rubin, 2005). Several visits were made to each site, which included establishing contact with school leadership, teachers, students and parents, multiple classroom observations and teacher interviews. Maria and Kate' teaching practices with ICT were observed during a block integrated session with a literacy focus, while both Gina and Joanne's approach to technology integration was observed during a literacy and a numeracy lesson. Following each classroom observation semi-structured interviews and follow-up conversations were conducted with the teachers. From the data yielded by the qualitative framework three cases of practice have been selected for the description, discussion and interpretation of teachers' pedagogical practices with ICT.

3.6.3.1 Classroom observations

Observations gather "open-ended, firsthand information about people and places at a research site" (Creswell, 2005, p. 211). According to Wragg (1999), the methods of classroom observations should serve the purpose and aims of the observation. As the classroom observations employed by this research project were exploring the integration of ICT in teaching practices and pedagogies utilised by the teacher, non-participant naturalistic classroom observations (Wallen & Fraenkel, 2001) were chosen as a method of data collection and inquiry. Woods (1986) argued that non-participant observations allow the researcher to "observe things as they happen, naturally, as undisturbed by his/her presence" (p. 36). However, as Bogdan and Biklen (2003) pointed out that it is difficult to be on either extreme of the participant/observer continuum. Even when the researcher does not intend to participate in the observed educational settings, it is almost impossible to avoid spontaneous questions asked by students.

115

Prior to the observations, an initial contact was established with the school principals, participating teachers and their students within the school context (Wallen & Fraenkel, 2001). This helped develop an initial understanding of the field and fine-tune the study design. Teachers were observed in natural/typical educational settings in their classrooms and in the school computer labs (laboratories). According to Reed and Bergemann (2005), observations need to be focused in order to gather as much data as possible about the observed phenomena during several observations. In order to focus the observations data collection was guided by a semi-structured observation protocol (Appendix H) based on the literature and findings emerging from previous stages of the research project. Immediately after the observations, observational notes were transformed into observation logs (Falus, 1996; Reed & Bergemann, 2005), a detailed portrayal of the teaching and learning practices observed. The logs included observations about ICT integration, teachers' practices and pedagogical approaches with new technologies, teachers' ICT literacy, and student engagement/the role of the student, the overall learning environment and the immediate outcomes of the learning process. The classroom observations were followed by semi-structured interviews with the teachers which helped making links between the two data sets (Atkinson & Coffey, 2003).

3.6.3.2 *Teacher interviews*

Semi-structured or focused qualitative interviews (Bogdan & Biklen, 2003; Creswell, 2005; Rubin & Rubin, 2005; Seidman, 2006) were used to collect data from the four primary school teachers participating in the field research. According to Babbie (2004), qualitative interviewing is "based on a set of topics to be discussed in-depth rather than based on the use of standardized questions" (p. 300). The conversations were initiated by revisiting small cases of practice, recorded during the classroom observations by the researcher. These small cases of practice prompted spontaneous responses from teachers that helped the researcher establish good rapport and a relaxed conversation about the realities of teaching and learning with ICT.

The conversations were guided by a semi-structured interview protocol (Appendix I), informed by the literature review and previous stages of data collection. The themes included: importance of ICT for student learning, factors that facilitate or hinder teachers' practices with ICT, changes to classroom relationships, roles and the learning environment, as well as future plans and vision related to the integration of ICT.

116

Even though the interview protocol helped explore topics of interest there was no rigid control of the conversation, certain issues initiated by participants were picked up (Bogdan & Biklen, 2003) during the conversations. It is interesting to mention that according to the initial research design, all four teacher interviews were planned as one-on-one interviews (Creswell, 2005); however, two of the teachers expressed their preference to be interviewed together. The interviews were audio-taped and transcribed (Babbie, 2004; Bogdan & Biklen, 2003).

3.6.4 Tools used for data collection

The qualitative fieldwork used loosely structured protocols to facilitate data collection during the classroom observations and teacher interviews. The protocols were based on the review of literature, the new framework of teachers' ICT literacy generated by the Delphi process and the preliminary findings of the survey study. The observation protocol (Appendix H) helped focus on specific aspects of teachers' ICT-rich practices, and their possible influence on student learning and the learning environment. The two semi-structured protocols also facilitated data analysis and provided topics and themes for anticipatory data reduction as described by Miles and Huberman (1994). The themes included in the classroom observation protocol (Appendix H) were:

- subject matter/area /and intended learning objectives,
- ICT used (software and hardware utilised),
- student engagement and the role of the student,
- teacher's pedagogical approaches (including teacher's role, teaching style, teaching and learning strategies, degree of responsiveness to learner diversity),
- the role of technology in the classroom,
- teacher's ICT literacy,
- outcomes of the learning process,
- overall description of the learning environment, and
- other resources used by the teacher.

The themes included in the teacher interview protocol (Appendix I) were:

- importance of ICT for student learning (as perceived by the teacher),

117

- factors that facilitate and hinder teacher's successful integration of ICT in teaching and learning,
- changes to learning and teaching relationships, roles, learning environment, thinking/teaching philosophies,
- factors contributing to changes,
- connections between teachers' ICT literacy and practices (as perceived by the teacher), and
- vision/ future plans with regards to integrating ICT and pedagogy.

The fieldwork yielded substantial amounts of data, collected in the form of field notes (Appendix S) and audio-recordings of teacher interviews (Appendix T). These forms of data were not accessible for immediate analysis, hence they required some processing (Miles & Huberman 1994). Observation or field notes were typed up, and interviews recorded both on audio-tapes and in a digital format were transcribed. Digital recordings of the teacher interviews were transferred to a PC and were stored in MP3 file format. An open access software application (audio editor and recorder), Audacity 1.2.4 (Audacity Development Team, 2002-2009), supported the process of transcribing. It allowed the researcher to listen to particular segments and to repeat them if necessary.

3.6.5   Data analysis

As most authors writing about qualitative data analysis state, there are no set rules or prescriptions for analyzing qualitative data (Creswell, 2005; Miles & Huberman, 1994), although a number of guidelines exist by Creswell (2005), Miles and Huberman. (1994), and Silverman (2005). While incorporating recommendations of several authors regarding particular techniques or approaches, this research followed Creswell's (2005) guidelines for qualitative data analysis.

According to Creswell (2005), data analysis is a process of making sense of texts and images in order to respond to the research questions. The way we make sense/meaning of our data and the words we attach to the meaning related to our field experiences are "inevitably framed by our implicit concepts" (Miles & Huberman 1994, p. x). Creswell (2005) argues that qualitative data analysis is an inductive "bottom up" (p. 231) process, which usually consists of "developing a general sense of the data, and then coding and description of themes about the central phenomenon" (p. 231). According to Creswell (2005), in the qualitative process of data analysis the researcher:

- collects data in the form of field notes, transcripts or other artefacts ,
- prepares for data analysis (transcribes interviews, organises field notes),
- reads through data to obtain a "general sense of material" (Creswell, 2005, p. 231),
- codes the data by locating segments and assigning code labels to them, and
- organises codes into themes to be used in the research report.

These steps are iterative and simultaneous and cycle back and forth between data collection and analysis. As the analysis proceeds the researcher may return for more information to fill in the gaps in their stories. In Creswell's words:

> Qualitative researchers analyse their data by reading it through several times and conducting analysis each time. Each time you read your database you develop a deeper understanding about the information supplied by your participants. (Creswell, 2005, p. 232)

Creswell (2005) also mentioned that in the initial phase of this inductive process of going from the particular (the details) to general codes and themes, the researcher aims to simplify and reduce data, the final aim is to arrive at a broader understanding of an issue or phenomenon. In this research project data reduction techniques and strategies for qualitative data analysis included threading themes and coding, to facilitate meaning making (Cherednichenko et al., 2001; Creswell, 2005; Miles & Huberman, 1994).

3.6.5.1   Working with field notes

Data analysis of field notes was conducted in several layers (Creswell, 2005; Emerson, Fretz, & Shaw, 1995; Van Manen, 1988). In the first layer the researcher focused on the general interpretation of the context, teaching and learning activities, integration of ICT in learning and teaching, and classroom relationships. The second layer of analysis transformed these interpretations into codes. According to Creswell (2005), "coding is the process of segmenting and labelling to form descriptions and broad themes in the data" (p. 237). "Code labels" (p. 235) were associated with the categories, themes and sub-themes of the extended observation protocol (Appendix J).

3.6.5.2 *Searching for meaning - deconstructing teachers' voices*

The post-observational teacher interviews provided rich data about the realities of teaching and learning with ICT in two Victorian government primary schools. The interviews revealed teachers' views and perceptions about the importance of ICT for student learning, identified facilitators and barriers of successful technology integration, as well as changes in classroom relationships, learning environment, and teachers thinking about learning and teaching.

The analysis of teacher interviews was quite different from the analysis of the field notes. While the researcher intended to follow Creswell's (2005) model of the coding process (p. 238) half-way through the analysis some issues emerged. Data were read through and listened to many, many times in the quest for searching for meaning not only in words, but in pauses and the tone of teachers' voices (Rubin & Rubin, 2005) The transcript was then divided into broad segments of information, which were then labelled with codes (Cherednichenko et al., 2001; Creswell, 2005). It appeared that there were too many codes carrying different meaning. Even the ones that showed similarities were varying in intensity, value and direction. A legitimate question emerged: to what extent is qualitative data quantifiable? In other words: How to compare and contrast meaning (Appendix K)? This dilemma urged the researcher to focus on the semantic weight of codes, rather than the frequency of their occurrence, and use other strategies of conceptual data reduction. Mind maps were chosen as a form of "semiotic clustering" (Feldman, 1995, p. 22). They helped bring together codes and facilitated the connection of patterns (Seidman, 2006), layering of the themes (Creswell, 2005) and the interpretation of the data (Seidman, 2006). The mind maps were created in Microsoft Visio (Appendix L).

3.6.6 *Presenting the findings: The case and commentary approach*

The case and commentary approach (Cherednichenko et al., 2001; Cherednichenko, Hooley, Kruger, & Moore, 1999; Shulman, 1992) was used to present the findings of the qualitative fieldwork. The case and commentary approach has been used as a method of praxis inquiry (Kruger & Cherednichenko, 2005) in pre-service education at Victoria University. The approach allows pre-service teachers, teachers and researchers to draw inferences from rich descriptions of practice and arrive at personal theories by linking emerging explanations to relevant literature and theoretical stances. In this research

120

project the cases of practice served to describe learning and teaching with ICT in authentic classroom settings. Cases of practice were explained and interpreted in the commentaries. The commentaries were structured around the following topics: teaching practices and learning experiences, the learning environment, the role of ICT in facilitating student learning, and teachers' ICT literacy. The commentaries were accompanied with teachers' reflections on learning and teaching with ICT.

3.6.7   Issues of validity or trustworthiness

Positivist interpretations of validity and reliability cannot be applied to qualitative research. Yet there are several guidelines that help establish research practices that will yield valid, trustworthy interpretations of qualitative data. (Creswell & Miller, 2000; Guba & Lincoln, 1981; Lincoln & Guba, 1985).

In this research Creswell and Miller's (2000) two–dimensional model was utilised to ensure the validity of the interpretations emerging from qualitative research. The following procedures were employed: triangulation and audit trail or peer review. Within this stage of the research project findings of the qualitative fieldwork were triangulated by using multiple sources of data (teacher interviews and field notes), and by using multiple sites for data collection. Triangulation also occurred at another level by triangulating the findings of previous stages of the research (Delphi process and teacher survey) with those of the fieldwork, which brought in multiple paradigms, multiple samples, multiple methods of data collection analysis and interpretation. Audit trail or peer review was also used to strengthen the validity of interpretations. This included peer-review and debriefing by the supervisors of this dissertation throughout the study.

Creswell (1998) and Creswell and Miller (2000) recommend member checking (or taking data back to participants) as the third process of validation, which includes sharing interview transcripts, and analytical thoughts and/or drafts with the participants of the research process. However, there are conflicting opinions about this criterion in contemporary qualitative research literature. Bowden and Walsh (2000) as well as Harris (2008) argued that member-checking produces "a new set of data, unable to confirm the original set even though they are likely to be similar" (Harris, 2008, p. 1). The authors' view was adopted in this research and member-checking was not included in the process.

Validity and trustworthiness of the findings of the qualitative fieldwork were further enhanced by the integration and triangulation of findings emerging from the first two sub-studies, which will be explained further in the next section.

3.7 Bringing together qualitative and quantitative findings

Findings of the three sub-studies were consolidated, triangulated and integrated in order to respond to the main research question: How does teachers' ICT literacy influence the integration of ICT in learning and teaching in primary schools? The width of quantitative inquiry offered by the survey study was brought together with the depth of the qualitative inquiry represented by the Delphi process, and the qualitative fieldwork as shown in Figure 3.3. Bringing together quantitative and qualitative findings enabled confirmation and corroboration of findings through triangulation (Sandelowski, 2000). The three apparently independent data sets had offered a lot of potential for communication between qualitative and quantitative findings. Analyses were first conducted separately for each sub-study, however key findings and recommendations emerged after the triangulation and integration of findings generated by each sub-study.

Triangulation is frequently associated with mixed methods. According to Denzin & Lincoln (2000), using multiple methods is in fact triangulation that "reflects an attempt to secure an in-depth understanding of the phenomenon in question"(p. 5). It helps overcome the limitations and biases of individual methods (Greene & Caracelli, 1997). This environment of double hermeneutic (Giddens 1993) allows the researchers to move back and forth between stages and sift through the data generated in those different stages in order to arrive at creative interpretations and new meanings. In this iterative process, it is not only the data that 'matures' as Miller (1971) suggested but at the same time the researcher's understanding of the researched phenomena, and his or her ability to reach beyond the explicit meanings suggested by raw data and arrive at higher levels of theoretical sophistication. Todd, Nerlich, McKeown, and Clarke (2004) argued that there were a number of different forms of triangulation which involve working with multiple methods, multiple data sets, multiple researchers, and multiple theories. Sandelowski (2000) extended the possibilities, and talked about combining different sampling procedures, instrumental data collection and data analyses techniques.

In this study the process of triangulation involved utilising multiple methods, working with different samples, using different instruments, working with both quantitative and qualitative data generated by three sub-studies, using different methods of analysis, and drawing on different, yet complementary theories and frameworks to support the analysis and interpretation of data. Findings from the sub-studies were triangulated not only for the purposes of cross-checking and validation but for the purpose of merging multiple perspectives related to the researched phenomenon in order to arrive at new knowledge. These multiple perspectives emerged from the professional discourse represented in current literature, views and responses of those participating in the study, and mental processes utilised by the researcher. According to Sacks (1998):

> ...the mental processes that constitute our being and life are not just abstract and mechanical but personal as well – and as such, involve not just classifying and categorizing, but continual judgement and feeling also. (Sacks, 1998, p. 20)

The methodological map in Figure 3.2 provides a conceptual structure for data consolidation and triangulation integration used in this study.
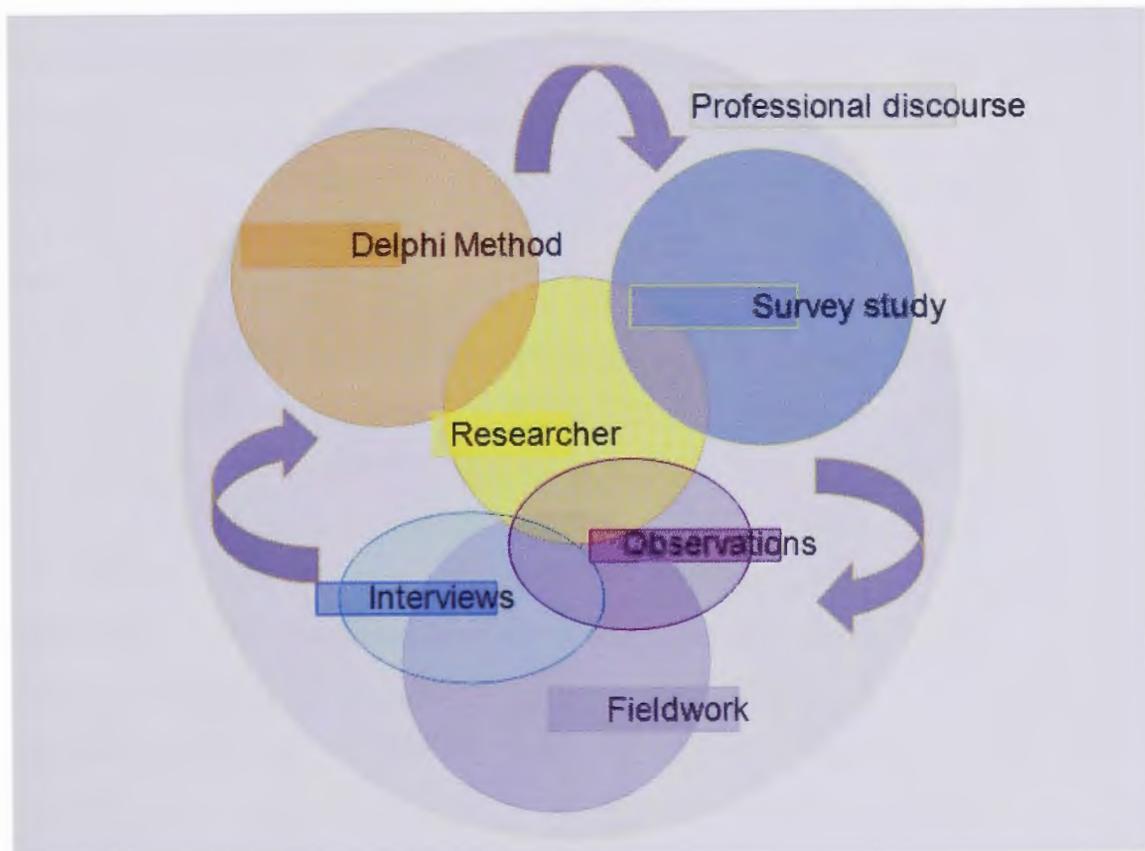
Figure 3.2 Consolidation, triangulation and integration of findings

123

The figure depicts the central role of the researcher in the process of data analyses and interpretation. It acknowledges the degree of involvement by the researcher in the process of meaning-making in each sub-study, as well as in the research project as a whole.

The new framework of ICT literacy developed in the Delphi process was utilised to scaffold meaning–making, interpretation and theorisation of findings. The four dimensions of ICT literacy (Figure 4.1) served as a platform for making connections between teachers' ICT-related knowledge and skills and pedagogical practices.

3.8 Ethical considerations

One of the highest priorities of this research project was to ensure ethical conduct throughout the process. This included research design, participant selection and recruitment, voluntary participation, data analysis and interpretation and publication of findings. Due to the complexity of the research design, two ethics approvals were granted by the Victoria University Human Research Ethics Committee (HREC) prior to the conduct of the study. The first application was submitted prior to the instrument development stage, the Delphi process. The second application was handed in before the commencement of the teacher survey and the qualitative fieldwork. After gaining the approval of the University HREC, an approval was sought from the Victorian Department of Education of Training for the conduct of research in Victorian government primary schools.

The applications included a detailed description of the research design for each sub-study with a particular emphasis on human participation. As part of the standard process potential risks were identified and adequate safeguards were created. Potential risks generally included psychological, social and legal risks and were slightly different for each sub-study. Potential risks were dealt with in accordance with ethical guidelines recommended in the literature (Mauthner, 2002; Sales & Folkman, 2000; Schamoo & Resnik, 2003) and in the National Statement on Ethical Conduct in Research Involving Humans (Commonwealth of Australia, 1999).

3.8.1 The Delphi process

The following potential risks were identified for the participants of the Delphi process:

- additional workload and time-related stress,

- privacy issues, confidentiality and potential loss of anonymity, and

- power issues related to the facilitation of the process and the possible effects of the 'presence' of the facilitator on data collection, data analyses and dissemination of results.

In order to minimise the negative impact of the indicated potential risks on the participants of the Delphi process, the following safeguards were implemented. Firstly to decrease stress factors triggered by additional workload and coordinated timelines, participants were provided with sufficient time for submitting their responses. Extensions were negotiated generously. Secondly, safeguards were created to ensure confidentiality and anonymity. By design the Delphi method minimises social risks related to loss of anonymity by maintaining the confidentiality of panellists' identity, their participatory anonymity in the Delphi process, and the anonymity and confidentiality of the disclosed information. Panellists were also assured that there would be no social risks associated with their withdrawal from voluntary participation in the process at any time in the study. Furthermore in accordance with standard practices of the Delphi method the questionnaires did not contain any information referring to the identity of the respondents. Each questionnaire had a numeric identification code that guaranteed the anonymity and confidentiality of information disclosed to the Advisory and Monitoring Team.

Power issues related to the facilitation of the process were minimised by the presence and active involvement of the Advisory and Monitoring Team whose members oversaw the research process, participated in decision making, and reviewed feedback to the experts. In this particular Delphi process, panellists were also involved in important decision-making regarding the continuation of the process as described in Chapter 4. This enhanced the collaborative nature of the Delphi and increased both collective and individual agency of those participating in the process.

3.8.2 Teacher survey

An application was submitted to the Victoria University HREC to gain approval for the conduct of the second and third sub-study, the teacher survey and the qualitative

fieldwork. This included piloting and conducting the survey. During the pilot stage amendments were made to the application, to include a second group of pilot study participants. In order to gain access to teachers from Victorian government Primary schools, approval was also sought from the Victorian Department of Education and Training. The applications and amendments provided the members of the Ethics Committees with an overview of the aims of the research, methods and techniques to be utilised, and identified potential risks and safeguards (Pryor, 2004; Sales & Folkman, 2000). Potential risks included:

- stress related to additional workload and tight timelines,

- difficulties in filling in the online survey (access to networked computers, levels of ICT literacy),

- low response rates that can endanger the integrity of the study and the validity of the findings, and

- legal risks related to anonymity and confidentiality.

In order to minimise the negative impact of the potential risks on the participants and the research process itself, safeguards have been created and implemented. First to decrease time-related stress, survey participants were provided sufficient time for their responses. Second to counterbalance the possible effects of the digital divide, participants not having access to the Internet or feeling more comfortable with traditional forms of literacy were provided with hard copies of the questionnaire. Third in order to counterbalance low response rates, two follow–up letters were sent out to participating schools to encourage participation (Wallen & Fraenkel, 2001). Fourth the study design ensured full anonymity of participation eliminating any legal risks related to breach of privacy and confidentiality. As indicated earlier in this chapter, one of the requirements set by the Victorian Department of Education and Training was that all communication with potential participants of the teacher survey must be conducted via the school principals. This requirement of ethical conduct had quite significant consequences for data collection as school principals in a number of instances decided not to participate in the study without consulting the teachers, thus limiting the potential number of participants in the teacher survey.

3.8.3 Qualitative fieldwork

As a requirement set by the Victorian Department of Education and Training, approval was sought from school principals of the two schools for the conduct of the qualitative fieldwork. An appointment was made with the School Principal and /or the Assistant School Principal of both schools to discuss details of the field inquiry including research design and ethical conduct. In this sub-study the following risks were identified:

- potential negative effects of classroom observations on students and teachers, and

- legal risks related to anonymity and confidentiality of participants and participating schools.

In order to minimise potential negative effects of classroom observations on students and teachers a number of safeguards were implemented: non-participant observations were chosen as a method of inquiry, timing of observations and interviews was negotiated with the teachers, and consent was obtained from the parents of students. To protect anonymity and confidentiality, names and all identifying details were removed from confidential data at the earliest stage of the study as recommended by Israel and Hay (Israel & Hay, 2006), and pseudonyms were chosen for participating teachers and schools when reporting on the findings of qualitative fieldwork.

In all three sub-studies participants were provided with detailed information about the aims of the research and the methods and techniques to be used. They were informed about the potential risks and how they would be minimised. In order to prevent adverse effects, all potential risks were managed in accordance with the National Statement on Ethical Conduct in Research Involving Humans (1999).

Participation was voluntary allowing participants to withdraw from the research process at any stage. Personal details of participants (if any), and data contributed by them were treated in accordance with the rules and regulations outlined in the Information Privacy Act: Schedule 1: The information Privacy Principles (The Parliament of Victoria, 2000, pp. 28-34) information was collected only for the specified purpose:

- information submitted by participants was dealt with in accordance with research guidelines approved by the HREC of Victoria University,

- data were not (and would not be) disclosed for any other purpose without the participant's consent (unless otherwise authorised by law),
- data has been stored securely, protected from unauthorised access, improper use, alteration, unlawful or accidental destruction and accidental loss,
- data will be retained for the period authorised by the Public Records Act (The Parliament of Victoria, 1973), and
- participants have been provided with the right to seek correction.

Participants were also provided with contact details of the Counselling Services of Victoria University, in case they experienced any problems or inconvenience caused by the research process, or had any concerns related to it. No such incidents have been reported to date and corrections have not been sought.

3.9 Summary

Chapter 3 provided an introduction to the emerging mixed methods research paradigm. It described the research design utilised in this study that consisted of three distinct research phases: the Delphi process, the teacher survey, and the qualitative fieldwork. A detailed account of each sub-study was provided including a description of the selected research method, details of participant selection and recruitment, instruments and tools used for data collection, strategies of data analysis, and issues related to validity and trustworthiness of findings. The chapter also devoted considerable attention to matters related to responsible and ethical conduct of research. The findings of the sub-studies described in Chapter 3 will be discussed in Chapters 4, 5 and 6, starting with the Delphi process in Chapter 4.

Chapter 4.

Drawing on the wisdom of the Oracle:

Rethinking teachers' ICT literacy

I can count the sands, and I can measure the ocean;
I have ears for the silent, and know what the dumb man meaneth...
Pythia, the Oracle of Delphi, in Herodotus I-21

This chapter is a report on the first sub-study, the Delphi process. The aim of the Delphi process was to develop a framework of ICT competencies for learning and teaching with ICT in primary schools by modifying a peer-reviewed list of computer competencies created by Scheffler and Logan (1999). However, following the inclusion of a strong divergent view, the Delphi process departed from its original methodological design and generated a new Framework of ICT Literacy for Primary School Teachers. The chapter is an account of the dynamic relationship between the process and the outcomes of the inquiry. It shows how the outcomes of each round interacted with the methodological design, demanding changes and adjustments. Hence the Delphi process described in this chapter demonstrates the flexibility of the Delphi method, and provides evidence that underpins its reflexive democratic and collaborative nature.

The chapter consists of three sections. Section 1 takes the reader through the preparatory stage and the four Delphi rounds. It includes a discussion on the emergence of a new framework of ICT literacy, dedicates considerable attention to the role of the outlier and to the underlying dynamics amongst key agencies participating in the Delphi process. Section 2 reports on the validation of the new framework and Section 3 provides a discussion of the new framework.

4.1 Outcomes of the Delphi process

The Delphi process consisted of a preparatory stage and four consecutive Delphi rounds. It concluded with a post-Delphi evaluation, providing the experts on the Delphi Panel with an opportunity to offer feedback on the process and make suggestions for future applications of the Delphi method.

4.1.1 Preparatory stage

The preparations for the Delphi process included fine-tuning the study design, organising the first meeting with the Advisory and Monitoring Team (AMT), and nominating the members of the Delphi panel. A peer-reviewed list of computer competencies developed by Scheffler and Logan (1999) was selected to focus the study. The Scheffler and Logan list of computer competencies had several advantages when compared with other frameworks: it was peer-reviewed, its findings emerged from empirical research, and they were validated by nearly 500 teacher educators, technology coordinators and secondary school teachers. As discussed in Chapter 2, the Scheffler and Logan list of computer competencies identified 67 teacher competencies distributed across 10 groups. The list was endorsed by the International Society for Technology in Education (ISTE), and at the time it was considered to be amongst the first frameworks positioning computers as an integral part of the school environment by the Australian Council for Computers in Education (ACCE, 2000). Given the fast–evolving nature of ICT and the current context of educational change, there was a need to update and modify the Scheffler and Logan list of computer competencies. The need for changes was foreseen by the authors themselves: "changes shown by this study underscore the importance of periodic studies of computer competencies for school personnel" (Scheffler & Logan, 1999, p. 6). Changes and modifications were required for the following reasons:

- since data were collected in 1995/96 there was a need to revisit the set of competencies and modify them so they reflect developments in ICT and changes in pedagogical thinking,
- the Scheffler and Logan list was based on the needs of teachers in secondary school settings, while the focus of this study was on primary school teachers' ICT –related skills and knowledge,

- data were collected in the United States, which raised the possibilities of socio-cultural differences, as well as differences in pedagogical thinking when compared with the Australian and in particular, with the Victorian context of teaching and learning with new technologies.

Similarly to Scheffler and Logan's research this study employed the Delphi method with a study design which was somewhat different to the one used by Scheffler and Logan. Differences manifested themselves in the type of the Delphi method utilised, the sample engaged in the study, the use of a review panel, and the type of feedback provided to participants. Table 4.1 summarises the similarities and differences between the two Delphi processes.

Table 4.1 Similarities and differences between Delphi designs

Delphi study	Scheffler and Logan (1999)	Dakich
Type of Delphi	Modified paper-and-pen[a]	Modified electronic mail Delphi
Purpose	To refine a list of 127 competencies for the survey instrument	To update and modify the Scheffler and Logan list of competencies to be used in a survey
No of rounds	3	4
Delphi Panel	A panel of ten experts: University teacher educators, technology specialists	An international panel of ten experts: 4 primary school teachers 2 educational theorists (educational change/ ICT pedagogies) 2 teacher educators 2 technology coordinators
Panel selection criteria	Status among peers, Professional experience	Expertise in the field, professional reputation
Instrument	A list of 127 competencies based on literature review	Two instruments: First round: Scheffler and Logan (1999) list of competencies

Third round: A new framework of ICT literacy (containing 45 statements), based on previous rounds and literature review, was introduced |
| Scales utilised | 5-point Likert –type scale: | 4-point Likert –type scale: |
| Level of Consensus | 2/3s of the panel (66%) | 2/3s of the panel (66%) |

(table continues)

131

Table 4.1 Similarities and differences between Delphi designs (continued)

Methods of data analysis	Quantitative and Qualitative [b]	Quantitative and Qualitative
Feedback to the panel	Evolving list of competencies, and summary of responses	Evolving list of competencies, and summary of responses, Reports on data analysis (PDF format) Compilation of original responses (PDF)
Outliers reported	None	One
The impact of outlier on the process	N/A	Change in the course of the process (also affecting the outcomes)
Steering Committee	Not employed	An AMT of eight monitored the process and advised the facilitator
Post-Delphi evaluation	Not conducted	Conducted

Note.
[a] This is classification is based on the implicit information provided in the article, since the authors did not specify the type of Delphi utilised
[b] Only implicit information suggests that qualitative data analysis was also performed in the third round

In preparation for the first round of the Delphi the Scheffler and Logan list of computer competencies was transformed into a survey instrument. The instrument was created in Microsoft Word as a WordForm document (Appendix A). This format was thought to be user friendly, as it allowed participants to include, delete, and/or modify the existing competencies, and/or suggest new ones by simply ticking boxes or typing their responses into designated fields. The instrument was easy to distribute and to access and did not put additional demands on participants in terms of hardware, software or personal competence in operating them. At the same time it allowed data to be imported from the completed forms into a database which was then used to collate and analyze data.

4.1.2   First round: The emergence of a divergent view

The first round of the Delphi allowed the experts of the Delphi Panel to propose changes and modifications to the existing competencies by following the prompts below (Gibbs, Graves, & Bernas, 2001; Scheffler & Logan, 1999):

- Tick 'include' to leave the competency in its current form.
- Tick 'delete' to omit the existing competency.
- Tick 'modify' if you wish to modify the competency, and enter your suggestion in the textbox below.
- You also have the option to modify the title of each group, by entering your suggestion below the title itself.
- At the end of each group of competencies you will find an addendum area where you can list the new competencies proposed by you.

Delphi panellists were provided with a two-week response period. Nine of the ten panellists submitted their responses in a timely manner. As described in Chapter 3 all data received from the experts were imported into a relational database created in Visual Fox Pro. Quantitative data were analyzed and reported with the help of a business intelligence tool for statistical and financial analysis and reporting: Crystal Report. Simple statistical procedures were employed to calculate the means, and standard deviations (similarly to the statistical procedures utilised in the Scheffler and Logan (1999) study. Qualitative data were analyzed using strategies and techniques for qualitative data analysis (Hasson et al., 2000; Powell, 2003). The level of consensus, 66%, was determined by arbitrary judgment based on literature review and consultations with the AMT.

In the first round four computer competencies (11, 49, 59 and 63) were deleted, 67 modifications were made, seven group titles were modified, and 26 new competencies were suggested by nine members of the Delphi panel. A report on the expert feedback was presented at the second meeting of the AMT. The report included a summary of findings for the first round, and a collection of original responses that contained all completed questionnaires submitted by the members of the Delphi Panel in this round. This enhanced the transparency of the research process and allowed both the AMT and the Delphi Panel to monitor the facilitator's work. To protect the anonymity of information and confidentiality of participants, all members of the Delphi Panel were provided with computer generated ID numbers which were used throughout the process.

One of the ten panellists (Panellist 837), who previously indicated a possible delay in responding to the first round, submitted a response after the report of the first round had been considered at the AMT meeting. As the following excerpt from an email

demonstrates, Delphi panellist 837 expressed an irreconcilable disagreement with the Scheffler and Logan list of computer competencies:

> The Scheffler and Logan model of teacher competencies seems to be based primarily on a mechanistic, decontextualized, (and linear) understanding of the technological characteristics of standard computer operations in the mid nineties, with very little focus on the teacher's professional role and work. Cochran-Smith & Lytle, 1999, wrote about the problems inherent in the conceptualization of teachers as technicians. In their current form the "competencies" resemble a criterion-referenced list of abstract skills. In my experience working with teachers on new "skills" — whether it be computer use or new teaching models — acquiring and effectively learning the skill is almost entirely dependent upon whether they can see (visualize, imagine) the incorporation of the skill into their teaching practice in ways that make a difference — by this I do not mean that they need to be told how it can help them with their work — no I mean the skill needs to be learned in a way that is situated in or closely related to their real work. With my colleagues, I have also done some work that suggests it is very important to ensure that practice related, theoretical and ethical issues are considered together with practice related learning decisions. Perhaps these factors are also important when teachers consider competencies.
>
> … I'm afraid I am a "systemic" failure – I'm sorry if this has complicated your task in any way – I spent far too much time trying to force my thinking into the Scheffler and Logan framework before I finally gave up and developed a framework that was coherent with my beliefs about teaching, learning and technology. I realized that I was at a place of "severe dissonance" with their framework and so in the end I developed one of my own. (Panellist 837)

As indicated in the excerpt above, Panellist 837 compiled a new list of 49 competencies (Appendix B), entitled Competency Framework for Technological Literacy in Teaching and Learning. The framework submitted by Delphi Panellist 837 was comprised of three areas and nine groups of professional competence as presented in the Table 4.2.

Table 4.2 Structure of the framework submitted by Delphi Panellist 837

Area of Competence	No. of competencies	Groups
Managing technology in the learning environment	13	Group 1: Personal and professional technological literacy Group 2: Technological competency for teaching Group 3: Informed, critically reflective perspectives and values related to technology in education and in society Group 4: Technology resourced learning environments
Technologically literate teaching	11	Group 1: Technology and the curriculum Group 2: Technological literacy for students Group 3: Technology and assessment
Technological literacy and reflective practice	25	Group 1: Critical reflection and evaluation and planning for continuous improvement Group 2: Teacher research and contribution to educational knowledge

The response submitted by Panellist 837 appeared to be divergent from the responses submitted by the majority of experts participating in the Delphi process. In the Delphi literature panellists representing a divergent view are referred to as outliers (Linstone & Turoff, 1975). The input of the outlier is often ignored or is described as statistically irrelevant. Also, most Delphi processes have strict deadlines and do not accept responses after designated dates.

Due to the goal of the research and its collaborative nature in this Delphi process, examining the case of the outlier was considered and found to be important. The members of the AMT were of the view that given the small panel size the input of the outlier could not simply be considered as statistically irrelevant. Also the divergent view reflected the concern of one of the other nine panellists (Panellist 111), who completed the first Delphi questionnaire but expressed disagreement with the focus of competencies in her email:

> I've attached my response to the first form. I found it quite a difficult task because much of the language and content included in the competencies given were very different in focus to what I would devise from scratch. I'm very interested to see what comes back for the second round. (Panellist 837)

Examining the potential for the inclusion of the divergent view was conducted in several steps. It included a comparative analysis of the Scheffler and Logan list of competencies and the framework submitted by Panellist 837. To identify differences and similarities between the two lists of competencies, qualitative data analysis was performed. This included simple content analysis and grouping similar items together (Hasson et al., 2000). The analysis indicated that in many cases the competencies suggested by Panellist 837 were similar in meaning to those published by Scheffler and Logan, yet they were paraphrased and re-written using contemporary educational vocabulary (Table 4.3).

Table 4.3 Examples of similarities between competencies submitted by Panellist 837 and by Scheffler and Logan (1999)

Competencies suggested by Panellist 837	Scheffler and Logan (1999) Competencies
b2.1 Understands technology and the term computer more broadly than "PC + screen", and recognizes that technology is a tool that may support learning, but does not cause learning. Identifies and explores different ways education is (or could be) supported by technology.	7 Demonstrate knowledge of the impact of computer-based technology on our society, including present and future uses of computer technology in the home, school, and workplace.
b2.2 Knows basic computer functions in relationships to professional and educational goals: including but not limited to: word processing, data storage and analysis, spreadsheet and calculation, graphic production, artistic expression, music production, research, communication (via internet and collaborate classroom processes) etc.	5 Demonstrate familiarity with the everyday operation of computer hardware and software in order to troubleshoot minor problems.
b2.5 Uses technology, email and the internet to support professional learning, i.e., for research, writing, communication with other professionals, and participation in on-line study.	65 Use electronic mail as a personal and professional tool. and 66 Utilize network resources such as the Internet to conduct research and communicate ideas
b2.14 Values diversity, and the right of all children to learn, and recognizes different levels of access related to gender, home environment, language, culture, health/disability and socio-economic status. Develops strategies to ensure equity in computer usage in classroom and schools. Accesses information and support, as required, for students with various disabilities	31 Develop and implement strategies to address equality issues in computer education, (equal access for all students, such as minorities, males/females, and different ability levels of students).

136

As the Panellist indicated:

> I certainly used some of their information - however in most cases I situated
> them in the professional work of teaching or adapted them in some other way.
> Once again I apologize for my lateness and for not doing the task exactly as
> described. (Panellist 837)

The analysis also revealed that the wording of the competencies submitted by
Panellist 837 indicated a perspective strongly influenced by critical pedagogy as the
examples below demonstrate:

> b2. 15 Maintains a critically reflective approach to information available through
> the computer, in particular the vulnerably of children to misinformation,
> marketing, propaganda and inappropriate relationships.

> b2. 40 Researches the place of technology in information and entertainment
> media with students, and critically evaluates educational and other computer
> materials with students. Develops age-appropriate critical frameworks for such
> analysis with students.

Furthermore it appeared that some of the competencies formulated by the outlier were
too complex, and/or included more than one competency, which would not qualify them
for inclusion in the teacher survey aiming to collect data about teachers' ICT related skills
and knowledge, as the examples below demonstrate:

> b2.6 Participates in the development of local area (school/district/state)
> technology plans, maximizes use of resources available and develops programs
> in line with published policies.

> b2.27 Reviews and evaluates software for curriculum use using a range of
> pedagogical and program design criteria. Recognizes that many software
> programs are focused on specific tasks (such as drill and practice, tutorial,
> simulation, problem-solving or tests of information retention), evaluates the
> strengths and limitations of these programs, and integrates them (where useful)
> into complex learning projects (extension of S&L 33,34,35).

> b2.39 Teach students to start up computer based equipment and systems as
> required in teaching and learning, and uses software related to classroom and

personal work and in order to troubleshoot minor problems and seek assistance when required.

b2.40. Researches the place of technology in information and entertainment media with students, and critically evaluates educational and other computer materials with students. Develops age-appropriate critical frameworks for such analysis with students. (Panellist 837)

In order to gain a better understanding of the educational rationale governing the divergent view, a face-to-face interview was conducted. The aims of the interview were to identify and understand the professional values and motives as well as paradigmatic views held by Panellist 837, and to explore possible solutions and strategies for resuming the first round. The semi-structured interview started with an informal conversation where the Panellist provided information on professional background, as well as a rationale for contribution to the first round. The aims of the study and the study design were discussed in detail. It was also confirmed that in terms of intellectual property, the input of Delphi panellists belonged to the Delphi process. Regarding the flexibility of Delphi process and the structure of the first Delphi questionnaire, it was reiterated that the instrument was designed to provide an opportunity for unlimited changes and modifications. Since it was apparent that the Delphi process could not be conducted with two different lists of competencies, the possibility of compiling the two lists was also raised. This proposal did not coincide with the view expressed by the Panellist.

Panellist 837's keenness to challenge the terms of the initial study design and opposition to contribute to the modification of the Scheffler and Logan list of computer competencies prompted the consideration of the theoretical and methodological implications of this conflict on the research process. The cognitive conflict and temporary methodological stalemate raised a question of whether to serve a "dogmatic drive for conformity" (Linstone, 2002, p. 567) that can swamp the outlier, or to accommodate the divergent view that may further inspire the co-construction of new knowledge and support the "interactional nature" (Breuer et. al, 2002, p. 2) of the research process. The dilemma urged the facilitator to:

- revisit the purpose of the Delphi process,
- analyze the implications for this research project,
- re-evaluate the process, and

- see it as a real opportunity for social construction of new knowledge implying:

...that the enquiry must be carried out in a way that will expose the constructions of the variety of concerned parties, open each to critique in the terms of other constructions, and provide the opportunity for revised or entirely new constructions to emerge. (Guba & Lincoln, 1989, p. 89)

In order to better respond to the above challenge, further literature review was conducted, which included numerous modified Delphi studies, in particular those aiming to identify professional competencies and literature on qualitative data analyses. Consultations continued with the advisors. Additionally an extraordinary meeting of AMT was called to examine possibilities of resolving the conflict situation emerging from the first round of the Delphi process.

The framework submitted by the outlier (Panellist 837) was presented to the AMT along with the comparative analyses of the two frameworks, as well as the outcomes of the interview conducted with the outlier. Possible effects of including the divergent view in the research process were also discussed. The following changes and risks were anticipated:

- changes to the results of the first round of the Delphi process based on material submitted in a timely manner by nine of the ten experts,
- changes to the original research design,
- changes to timelines,
- withdrawal of experts from the Delphi panel, and
- ethical implications.

In consultation with the AMT and in accordance with the unanimous advice, the outlier's contribution was included in the final analysis of the first round. The final report on the first round was presented to the Delphi panel. Suggested modifications and changes suggested to the Scheffler and Logan list of 67 computer competencies included:

- competencies (11, 49, 59 and 63) were deleted by a majority vote of more than 66%;
- 67 modifications were made, those similar in meaning were compiled,
- group titles were modified, and

- 26 new competencies were suggested by the members of the Delphi panel.

The distribution of responses in the first round was:

- 8 panellists completed the Delphi questionnaire without challenging its structure or content,
- 1 panellist indicated disagreement with the focus of the competencies, and
- 1 panellist expressed severe disagreement with the existing structure of the Scheffler & Logan list of competencies and its approach to teachers' technological literacy.

The feedback to the experts also included a copy of the framework developed by the outlier, a letter explaining the challenges encountered in the first round of the Delphi process and a collection of original responses. The letter informed the Delphi Panel about a decision made by the facilitator and the AMT, which was to utilise the "inherent strength" of the Delphi process – its ability "to expose uncertainty and divergent views" (Linstone, 1975, p. 578), by consulting the experts on the Delphi Panel about the continuation of the process and the inclusion of the divergent view. The collection of original responses enabled the Delphi panellists to examine the raw data submitted by individual experts, as well as to look up their own responses. The code numbers of individual experts, appearing on the first page of the document, were hyperlinked with their responses, so instead of having to flip through a document of more than hundred pages, experts were able to locate individual responses by a simple click on the code number.

4.1.3   Second round: Negotiation of strategies

Hence, in lieu of making administrative decisions about the future of the Delphi process, the facilitator involved the participants of the Delphi Panel in the decision-making about the direction the Delphi process would take in second round. It was believed that this would strengthen the democratic and collaborative nature of the process. Based on consultations with the AMT, three options were offered to the Delphi Panel for the continuation of the Delphi process:

- opening up the structure of the questionnaire and merging the two lists,

- adopting the new list of competencies and refining it, and

- opening up the process to complete revision by building a new instrument.

Since there was a strong indication that the Delphi process would diverge from its initial design, changes to timelines and participant input were also anticipated. Experts on the panel were made aware of the possible changes and were requested to provide a written statement of whether they would like to continue participating in the Delphi process if alterations to study design were to occur (Appendix C). In order to illustrate the lively dynamic of negotiating the future of the Delphi process used in this research, excerpts from communication with Delphi panellists are provided below.

It is important to mention that the second round of the Delphi process was somewhat unconventional, since it was used to negotiate possible strategies with the Delphi panellists for continuing the process. Eight experts responded to the second round which resulted in 80% response rate. The possibility of new tasks and new timelines did not prove acceptable to all experts. Two primary school teachers withdrew from the process in this round. Additional telephone interviews were conducted with a number of experts giving them an opportunity to clarify their positions. Concerns were also raised about the implications of changes to the original design of this research. One of the interviewed experts (Panellist 685) supported the first option. The Panellist 685 argued that it is unnecessary to use valuable time to rewrite the Scheffler and Logan (1999) list as it appeared to be only part of this 'large study' and was used before. In the Panellist's opinion this was the right time to use this 'old model' of computers in education before a new wave of technologies emerge. The Panellist was also concerned about the impact of the outlier on the PhD project.

I feel that it would be best for you to modify your original list as you have proposed and if additional questions need to be added, then that should be done. I do not suggest redoing the whole list or substituting the List B.

My reasons are as follows: 1. Although List A is longer, it is simpler and direct and covers all the main points. 2. It was used before and this may be the last time it will be used but it still can serve a useful purpose in this study. 3. Any topics or questions that are new in Part B should be considered for inclusion in Part A. (I see only a few) 4. The list seems only a part of this large study and to re-write the whole list seems an unnecessary use of valuable time. 5. Time is

141

of the essence. The changes over the next two years in cell telephone, internet, and computers is going to be dramatic. This is the time to work with the teachers in this old model of computers in education before the wave of a whole new model is in our laps in the next few years. As an example I now do all of my grading on-line. I have not seen a paper list of students except on-line for the past two years at my university. If I want a printed paper list of students I must access my own special account and print it out myself. Maybe we are ahead of some schools or maybe we are behind. In the past all paperwork for class lists and grades went through the main department office and was handled by hands. Now it never does.

I must say that I have been on many graduate committees over the years and the ones that I wish I could go back and change were the ones where so much was added to the already complex and over burdened graduate student so that it was nearly impossible for the student to actually complete the project.
In conclusion I say it is time to act and move forward with your study. Please consider my comments in your review. (Panellist 685)

Two other panellists supported this view, by voting for option number one: opening up the structure of the questionnaire and merging the two lists which together comprised 30% of all responses. Only one person (10%) voted for option number two: adopting and refining the new list submitted by one of the panellists, while five experts (50%) voted for the third option: opening up the process to complete revision and building a new instrument. As previously mentioned two experts (20%) withdrew from the process.

As the excerpts below demonstrate, the experts voting for complete revision believed that the emphasis should be on teachers' professional role within the culture of the school and the community (Panellist 837), that competencies should be formulated by practising teachers (Panellist 034), and that they need to be continuously revised and updated in order to help teachers keep abreast of the ever-changing landscape of new technologies (Panellist 186). This is how some of the experts justified their choice:

I have voted for choice 3 though I recognize that, in practice choices 1 & 3 may be very similar - I will be happy with whichever choice best suits the purpose of the research study (as seen by the researcher who inevitably has a clearer perception of the overall process and purpose of the study). Whichever choice is made I believe it is important that strong emphasis and focus be maintained on the professional role of the teacher as the constructor of knowledge, the

facilitator of learning and the creator of a learning environment within the culture of the school and the community. (Panellist 837)

It is my professional belief that a list of teacher competencies in the area of Information and Communication Technologies would be more relevant if formulated by practising teachers. (Panellist 034)

In a quickly changing field like ICT technology, new competencies are found important, others obsolete, so list of competencies needs regular updating. In our case, suggestions seem to be so wide-ranging that the development of a new instrument seems to be necessary. (Panellist 186)

The second round concluded with the majority of participating experts voting for building a new instrument which further increased the complexity of the Delphi process. Creating an entirely new instrument would have required a different approach within the Delphi exercise and would have shifted the focus of the research. Consequently the AMT strongly recommended the development of a new instrument based on the findings of the first round and further literature review.

4.1.4   Third round: A proposal for a new framework of ICT literacy

Following the advice of the AMT, a new framework was proposed (Appendix D). The proposal drew on the:

- Scheffler and Logan list of computer competencies (1999),

- expert responses collected in the first round of the Delphi process,

- individual interviews with panellists,

- list of competencies submitted by Panellist 837,

- Learning Technologies Capabilities Guide (State of Victoria, 1998)

- National Educational Technology Standards for Teachers (ISTE, 2000),

- contemporary literature on ICT and innovative practices, teachers' professional learning and engagement, and policy documents and initiatives (discussed in Chapter 2), and

- consultations with supervisors and AMT.

143

The proposed framework included 45 items organized within five sections referring to the following areas of ICT competence:

- Operational Understanding and Application of Information and Communication Technologies (consisting of 5 competencies),

- Designing ICT-rich Learning Environments and Curriculum for Improved Student Learning (consisting of 18 competencies),

- Classroom Management, Assessment and Evaluation (consisting of 5 competencies),

- ICT for Professional Learning and Engagement (consisting of 7 competencies), and

- Socio-cultural, Ethical, Legal, and Health-related Issues in the Use of ICT in educational settings (consisting of 6 competencies).

These areas of competence are referred to as dimensions of ICT literacy in the final version of the framework, as discussed in Section 4.3.

Prior to implementation, the proposal for the new framework was reviewed by the AMT. It was then transformed into a Delphi questionnaire (Appendix D), providing Delphi panellists with the opportunity to include, delete, modify existing competencies, and add new items.

In the third round participants received feedback on the results of the second round, the new framework of ICT competencies for primary teachers transformed into a Delphi questionnaire, requirements for participation in this round, and a collection of original responses submitted by experts in the second round. Participants were provided with a four week response period.

Eight panellists responded to the third round, which translated into a 100% response rate as two panellists withdrew their participation in the second round. The third round of the Delphi process yielded the following results:

- 44 competencies out of the 45 were accepted,

- 24 modifications were suggested (Appendix M), and

- 3 new competencies were proposed.

The competency with the lowest level of consensus was (62.5%) No. 26: Maintains electronic databases of resources and classroom inventory, equipment, and budgets, was deleted. This choice suggested that the majority of the Delphi panellists did not consider the administrative tasks described by this competency, essential to teachers' work.

The three new competencies (Appendix M) suggested by the Delphi experts included:

- NC 2.1   Extending students' ability to evaluate, assess, and monitor their own work (e.g.: by creating electronic portfolios, etc.).

- NC 2.2   Enabling students to become members of local and extended communities of learning.

- NC 2.3   Exploring innovative uses of ICT such as being connected across multiple dimensions- local, global inter-communication.

Absolute consensus (100%) was reached about the inclusion of 14 competencies out of 45, with all experts on the panel voting for their inclusion. Another 14 achieved a high level of consensus (80-99%), 13 competencies attracted moderate level of consensus (66-79%), while 4 competencies achieved a low consensus level (below 66%). Based on consultations with the AMT, three of the competencies with low consensus level (No. 1, No. 8, No. 16, and No. 26) remained on the list, as they attracted a number of modifications. The distribution of individual competencies by the level of consensus is shown in Table 4.4.

Table 4.4 Distribution of responses by the level of consensus.

Level of consensus for inclusion of individual competencies	Competencies	No. of competencies	% of competencies
Absolute consensus (100%)	12, 19, 20, 23, 24, 29, 32, 33, 36, 40, 41, 42, 43, 44	14	31.1%
High (80%-99%)	2, 3, 5, 6, 10, 11, 13, 15, 18, 22, 30, 34, 38, 45	14	31.1%
Moderate (66%-79%)	4, 7, 9, 14, 17, 21, 25, 27, 28, 31, 35, 37, 39	13	28.9%
Low consensus (below 66%)	1, 8, 16, 26	4	8.9%

Delphi panellists appeared to be more comfortable with the proposal for a new framework. As the excerpts from the expert feedback suggested, the new competencies read well and positioned teachers as decision-making professional. This is what the Panellists wrote:

> The new competencies read really well. We've come a long way. Thanks for including me in the process. I have found it an interesting and sometime thought challenging process. (Panellist 111)

> The new section titles are great!!! (Panellist 837)

> I found this one much easier, agreeing with the inclusion of many of the items. It has less of 'competencies' feel to it and in most cases constructs teachers as professionals who are required to make judgments in their work. (Panellist 111)

> I've reviewed your selected competencies, and wow! They look great and comprehensive. I hope we could all pass them in higher education across the land. I agree and recommend the use of them all. They will be overwhelming to teachers but we have to keep up with this technology. And it won't slow down. (Panellist 685)

The results of the third round were presented to the AMT, and feedback was prepared for the Delphi panel. Similarly to previous rounds, the feedback included a summary of third round results together with the reflections of the researcher, a PDF document containing the details of data analysis presented in Crystal Reports (Appendix N), a hyperlinked collection of original responses, as well as instructions for the fourth round.

4.1.5   *Fourth round: Reaching consensus*

In the fourth round of the Delphi process Delphi panellists were asked to rate the ICT competencies emerging from the third round on a four point Likert-type scale (Akins et al., 2005; Wedley, 1980). The values on the scale were: not important (0), somewhat important (1), important (2), and very important (3). Based on the results of round three, the fourth round Delphi questionnaire comprised of 65 competencies, which included:

- 44 of the 45 competencies contained in the new framework introduced in the third round,

- 18 modifications (with an a or b next to the number of competency that was modified), and

- 3 new competencies were submitted by the experts in the third round.

Panellists were requested to submit their responses within two and a half weeks. With some delay, the fourth round produced a 100% response rate, with all the remaining eight experts participating in the voting process. Data received in the fourth round was analyzed by simple statistics, including the calculation of means and standard deviations. An arbitrary mean score of 2 (important), established with the AMT, was considered to be a cut off point for inclusion. All competencies with a mean rating equal to or greater than 2 were considered to be important and were included in the new framework. Items with a mean score of less than 2 were excluded. Competencies having a mean score between 3 and 4 were considered to be very important, while competencies with a mean falling between 2 and 2.99 were rated important. Competencies with a mean between 1 and 1.99 were regarded as somewhat important and competencies with a mean value between 0 and 0.99 were considered not to be important. If the modified competency had a higher mean than the original competency, then it was included in the final list of competencies instead of the original. If the original competency and the modified competency had the same mean score, the item with a lower standard deviation was included in the final framework. Table 4.5 shows the distribution of means by level of importance, while Table 4.6 and Table 4.7 reveal competencies with the highest and lowest mean scores.

Examination of mean scores revealed that the highest mean was 2.75, while the lowest was 1.00. Three competencies achieved the highest score and only one competency had a mean score as low as 1.00. Analyses of the data revealed that out of 65 none of the competencies (0%) were rated as very important, 46 (71%) were considered to be important, 19 (29%) as somewhat important, and none of the competencies were rated as not important. Each of the three new competencies (labelled NC) was rated as important. The scores are interpreted and discussed in Section 4.2.2.

Table 4.5 Distribution of competencies by importance

Level of Importance	Mean score	Competencies	Total	%	Competencies included in the final list
Very important	3-4		0	0%	
Important	2-2.99	1, 1a, 2, 2a, 3, 4, 6, 7, 7a, 8, 8b, 9a, 10, 10a, 10b, 11, 11a, 12, 13, 14, 14a, 15, 15a, 16a, 17, 18, 19, 20, 21, 22, 23, NC2/1, NC2/2, NC2/3, 24, 29, 30, 32, 33, 34, 37, 37a, 40, 41, 42, 43, 44	46	71%	1a, 2a, 3, 4, 6, 7a, 8b, 9a, 10b, 11, 12, 13, 14a, 15a, 16a, 17, 18, 19, 20, 21, 22, 23, NC2/1, NC2/2, NC2/3, 24, 29, 30, 32, 33, 34, 37a, 40, 41, 42, 43, 44
Somewhat important	1-1.99	3a, 4a, 4b, 5, 8a, 9, 9b, 16, 25, 27, 28, 31, 32, 35, 36, 38, 39, 39a, 45	19	29%	
Not important	0-0.99		0	0%	

Note: NC stands for new competency. a or b stand for a variation of a competency.

As Table 4.6 demonstrates, competencies with the highest mean scores referred to teachers' competence in: using ICT to meet particular learning outcomes (No. 10), ensuring that students develop confidence and critical awareness in using new technologies (No. 20), and extending students' self-monitoring and self-regulating capacity by engaging them in digital projects and portfolio work (No. 23).

Table 4.6 Competencies with the highest mean scores

No.	Competency	Mean	SD
10	Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.	2.75	0.43
20	Ensures that students develop competence, confidence, and critical awareness in using ICT.	2.75	0.43
23	Extends students' ability to evaluate, assess and monitor their own work (e.g.: by creating digital projects, electronic portfolios, etc.).	2.75	0.66

Competencies with the lowest mean scores (Table 4.7), referred to teachers' competence and confidence in: using electronic tools for administrative purposes (No. 27), utilising basic diagnostic strategies to recognise hardware and software malfunctions (No. 5), understanding the implications of new technologies for families, the workplace and the community (No. 39.) and demonstrating familiarity and critical understanding of current policy directions (No. 36).

Table 4.7 Competencies with the lowest mean scores

No.	Competency	Mean	SD
27	Uses electronic time management and organizational tools/software packages for time and project management, budgeting and record keeping related to professional role.	1.00	0.50
5	Demonstrates ability to utilize basic diagnostic strategies in order to ascertain causes of malfunction related to computer hardware and software.	1.50	1.00
36	Demonstrates familiarity and critical understanding of national, state and school policies related to the integration of ICT into teaching and learning.	1.63	0.86
39	Understands and communicates the negative and positive consequences of ICT at a global and local level, including its current and future uses at home, school, workplace and community.	1.63	0.99

In consultation with the AMT, one of the areas of the framework, entitled Classroom Management, Assessment end Evaluation was deleted, as only competency No. 25 (Uses Information and Communication Technologies to support a variety of monitoring, assessment and evaluation strategies), was voted for inclusion by the panellists. As a result, competency No. 25, achieving a mean score of 2.25, was amended to the section on Designing ICT-rich Learning Environments and Curriculum for Improved Student Learning.

Data analyses revealed that the fourth round of the Delphi process delivered findings about the importance of 37 ICT competencies. Therefore, the Delphi process was considered to have reached conclusion with a new framework of ICT competencies for primary school teachers (Appendix O). The new framework (interpreted and discussed in Section 4.2.1), represented a conceptual shift from the Scheffler and Logan (1999) list of computer competencies and introduced a fresh pedagogical perspective embracing a

complex and critical understanding of the potential of new technologies for facilitating student learning in the 21st century. The structure of the new framework was as follows:

- Dimension 1: Operational Understanding and Application of ICT (4 competencies),
- Dimension 2: Designing ICT-rich Learning Environments and Curriculum for Improved Student Learning (22 competencies),
- Dimension 3: ICT for Professional Learning and Engagement (six competencies), and
- Dimension 4: Socio-cultural, Ethical, Legal, and Health-related Issues in the Use of ICT (5 competencies).

Following the conclusion of the fourth round, the findings of the Delphi process were compiled and feedback reviewed by the AMT was sent to the Delphi Panel. The feedback included a summary of findings and an overview of the Delphi process, the new framework of ICT competencies for primary school teachers, a statistical representation of data analysis including the mean score and standard deviation for each competency, and a hyperlinked collection of original responses (Appendix R, only available on CD). Delphi panellists were informed about future developments of the research including the teacher survey in which the findings of the Delphi process would be validated. The panellists also received a post Delphi evaluation form that asked them to reflect on the process and the findings of the process (Appendix E). The reflections of the Delphi panellists are presented in the section below.

4.1.6 Panellists reflecting on the Delphi process

The aim of the post-Delphi evaluation was to obtain feedback from the experts on the Delphi process. As described in Chapter 3, a semi-structured questionnaire was emailed to the experts.

Four members (50%) of the Delphi Panel (including Panellists 243, 699, 699, and 186), filled in the post-Delphi evaluation form (Appendix E). While the responses could not be translated into a reliable statistical output, they provided important information about the process. Experts in general strongly agreed ($\bar{x}$ =2.75) with the analyses of the responses and the way they were presented in the feedback. Three of the four experts strongly agreed ($\bar{x}$ =2.75) that their ideas were understood and incorporated. Two experts

agreed and two strongly agreed that they were introduced to new ideas. The timelines did not suit everyone in the process ($\bar{x}$=2.00), with one panellist disagreeing, two others agreeing and one strongly agreeing with them. Most experts strongly agreed that the feedback was concise and timely ($\bar{x}$=2.75). All experts participating in the post-Delphi evaluation strongly agreed that the confidentiality agreement was respected throughout the process ($\bar{x}$=3.00). When asked about how likely they would participate in another Delphi study two experts strongly agreed and two agreed ($\bar{x}$=2.5).

Experts were also requested to highlight what they most liked about this particular Delphi process. Two experts expressed their opinions:

> Interesting to read other ideas and see these incorporated into the materials (Panellist 243).

> Efficient way to get to know the opinions of colleagues about important professional issues. Also, comparing my own remarks with those of others in terms of agreement / disagreement also helped me to reconsider some issues (Panellist 186).

When asked what they liked least about the Delphi process, Panellist 186 pointed out deadlines. Finally three of the four experts strongly agreed ($\bar{x}$=2.75) that the findings of the Delphi study may be a valuable contribution to the professional discourse.

As panellists responses demonstrate, the modified Delphi method (Dakich, 2004; Dakich, 2008a) utilised in this Delphi process fulfilled its commitment to providing participants with a transparent collaborative and democratic process, in which individual contributions were heard and incorporated, and where Delphi panellists were not only participants but co-designers of the Delphi process.

4.2   The validation of the new framework of ICT literacy

Following the conclusion of the Delphi process, the new framework was transformed into a questionnaire to be used as in the next stage of the research project, the teacher survey. The aims of the survey were to validate the findings of the Delphi process, and paint a

profile of primary teachers' ICT literacy (ICT-related knowledge and skills) by gathering data about their self-reported competence in learning and teaching with new technologies. The validation process (Dakich, 2005b) is described in this section, while teachers' ICT literacy will be discussed in Chapter 5.

Prior to implementation, the questionnaire was refined in an expert review, and pre-tested in a two-stage pilot study as described in Chapter 3. The titles of Dimensions 2 and 4 were found to be too long, and were changed to the ones shown in Figure 4.1. The debated notion of ICT competencies was dropped, and replaced with teachers' ICT literacy, to refer to teachers' overall skills and knowledge related to the integration of ICT in learning and teaching, and teacher capabilities, to refer to individual items contained by the framework. Following the pilot study two teacher capabilities were moved from Dimension 2 to Dimension 3, because of their focus on research, teacher professional learning and engagement:

- No. 15: Conducts professional enquiry using current literature and research on ICT pedagogies, when planning learning experiences and activities, and

- No. 22: Uses technology to research and extend curriculum options.

These adjustments demonstrated how the interactions between the research participants and the research process shifted the trajectory of the inquiry and shaped the outcomes of the study.

4.2.1   The Framework of ICT literacy for Primary School Teachers

The framework of ICT literacy (Appendix P) includes four dimensions as presented by Figure 4.1:

- Operational Understanding and Application of ICT,

- ICT-Rich Pedagogies and Learning Environments,

- ICT for Professional Learning and Engagement, and

- The Social Ecology of Living and Learning with ICT.

Dimension 1 consists of four capabilities that describe teachers' operational understanding and application of ICT. The capabilities refer to having up-to-date understanding of ICT used in school, workplace, home and community, demonstrating professional judgement and skill in the selection and application of common computer

152

software and hardware, as well as demonstrating familiarity and utilisation of network resources for communication and research purposes.

Dimension 2 is comprised of twenty teacher capabilities. These capabilities describe teaching practices; ICT-rich pedagogies that are embedded in the pedagogical rationale of constructivist learning environments (Jonassen, 1999a; Jonassen, 2001; Papert, 1997; Sharp, 2002; Taylor, 1999); and connected communities of learners (Siemens, 2004). The emphasis is on innovative and integrated approaches to learning and teaching with ICT, where the role of the teacher is to design, facilitate and scaffold student inquiry, by making informed choices about the relevance and responsiveness of ICT-rich learning experiences for the diverse needs of learners, and the context of living and learning in the contemporary world.
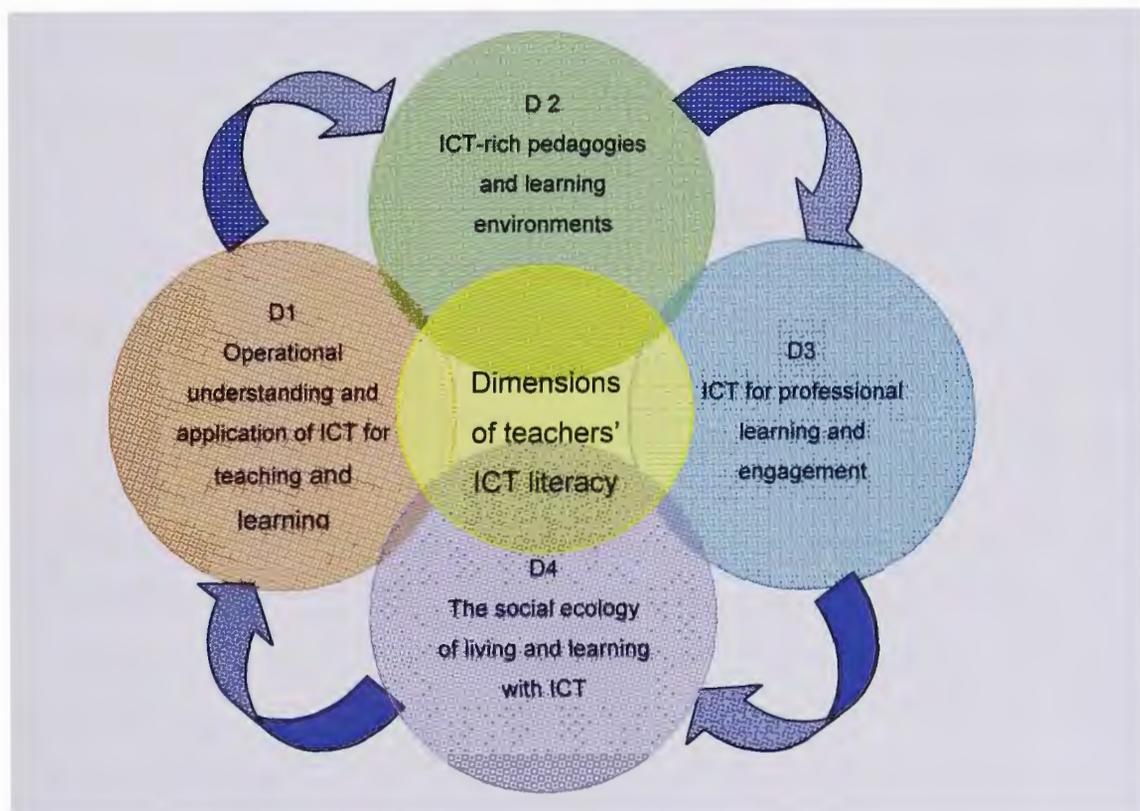

Figure 4.1 The four dimensions of teachers' ICT literacy

Dimension 3 includes eight teacher capabilities that are descriptors of ICT-rich practices and approaches related to professional learning and engagement. There is a

strong emphasis on developing critical consciousness about how ICT can be integrated into everyday professional practices, to assist and facilitate professional inquiry, continuous learning, collaboration and connectedness with the local and global community. There is also a focus on critical understanding of how the integration of ICT can influence the restructuring and reorganisation of classrooms and schools for improved student learning.

Dimension 4 of teachers' ICT literacy addresses the social ecology of integrating ICT in everyday practices of learning and teaching. It has a strong focus on developing and implementing conscious strategies that address equity, inclusion, and ethical conduct (embracing moral and legal aspects), as well as health and safety related issues when integrating ICT in learning and teaching. It also promotes the need for teachers to be familiar with recreational uses of ICT and its role in youth culture.

4.2.2 The validation process

Teachers from a randomly selected sample of 350 Victorian government schools, representing all nine school regions were invited to participate in the online teacher survey. As part of the validation process, primary school teachers participating in the online survey study were requested to rate the importance of each of the 37 teacher capabilities, using a four-point Likert-type scale, identical to the one used in the fourth round of the Delphi process. The values of the scale were: not important (0), somewhat important (1), important (2), and very important (3). As discussed in Chapter 3, in both studies an arbitrary mean value of 2 (indicating important) was considered to be the cut-off point for the inclusion of teacher capabilities into the framework of ICT literacy. Teacher capabilities with a mean score significantly less than two were not considered to be important by teachers. Significance was calculated in SPSS, utilising the single sample t-test ($p < 0.05$).

The teacher survey concluded with 124 responses. Thirty-four out of the thirty-seven capabilities were validated by the teachers. The results regarding each dimension of the framework are reported in following sections. Each section provides a comparison of the findings of the Delphi process and the teacher survey, and includes a discussion of the similarities and differences of opinion between Delphi panellists and participants of the teacher survey.

154

4.2.3 Dimension 1: Operational Understanding and Application of Information and Communication Technologies

All four capabilities comprising Dimension 1 were validated by the teachers. In Table 4.8 each capability (C) is ranked by its mean score according to the results of the Delphi process and the teacher survey. Comparison of rankings of teacher capabilities indicates that the Delphi Panel considered having an up-to-date contextual understanding of ICT to be the most important teacher capability in this dimension (C1), while being skilled in the application of common computer software and utilising networks (C3, C4) was of highest importance for the teachers. The largest discrepancy of opinions appeared to be related to utilising network resources to communicate, conduct research and exchange ideas (C4), which was considered to be of much higher importance by the teachers than the Delphi panel.

Table 4.8 Comparison of results for Dimension 1 of teachers' ICT literacy

D1.	Operational Understanding and Application of ICT	Delphi Process			Teacher Survey		
		R	M	SD	R	M	SD
C1	Demonstrates up to date understanding and knowledge of Information and Communication Technologies (ICT) used in home, school, workplace and community.	4	2.63	0.48	10	2.38	0.77
C2	Demonstrates professional judgment in the selection and application of common computer hardware, including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards etc.).	22	2.25	0.43	24	2.18	0.88
C3	Demonstrates skill in the use and application of common computer software (e.g.: word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.).	23	2.25	0.83	5	2.47	0.69
C4	Utilizes network resources such as the Internet, Intranets and Local Area Networks to communicate, conduct research and exchange ideas.	36	2.00	0.87	9	2.39	0.77

Note. R = Rank, M = Mean, SD = Standard Deviation

155

4.2.4   *Dimension 2: ICT- Rich Pedagogies and Learning Environments*

Delphi panellists and teachers agreed that the most important capability for primary school teachers is to ensure that students develop competence, confidence, and critical awareness in using ICT (C20). As presented in Table 4.9, both groups acknowledged that teachers' ability to plan for the effective management and application of ICT resources to create student-centred environments is vital to successful ICT integration (C5). Neither the Delphi Panel nor the teachers considered using ICT to support monitoring, assessment and evaluation strategies (C24) to be among the capabilities of higher importance.

With regards to differences, teachers placed more emphasis on making informed decisions about the relevance of educational software (C7), using technology to design and present units of work and prepare handouts (C12), and differentiating between applications of ICT that support routine tasks and higher order cognitive skills (C11). Delphi panellists found it to be more important to promote inclusive, student-centred learning and constructivist learning environments than did the teachers. The capabilities referred to making informed decisions about the relevance of ICT applications to particular learning outcomes (C10), choosing and designing inclusive pedagogical strategies and practices supported by ICT to respond to the diverse needs of learners (C9), applying ICT-rich curricular activities to facilitate inquiry, problem-solving, critical thinking and knowledge construction (C13), and extending students' ability to evaluate assess, and monitor their own work by creating digital projects, electronic portfolios, etc. (C23).

According to the analysis of sample means, three teacher capabilities from Dimension 2 were not considered to be important by the majority of surveyed teachers. These were:

- C17   Explores innovative uses of ICT, such as being connected across multiple dimensions: local and global communication.
- C18   Facilitates on-line communication and collaboration of students at a local and global level.
- C19   Encourages students to become members of local and extended communities of learning.

Further statistical analysis, utilising a single sample t-test, was conducted to determine the statistical significance of the deviation of sample means of these three capabilities from the test value (2= important). The results of the t-test found that two of

156

the three teacher capabilities (C18 and C19) had significantly different means from the test value. Consequently, teacher capabilities C18 and C19 were not validated by the random sample of primary school teachers (Table 4.9).

Table 4.9 Comparison of results for Dimension 2 of teachers' ICT literacy

D2.	ICT-Rich Pedagogies and Learning Environments	Delphi Process			Teacher Survey		
		R	M	SD	R	M	SD
C5	Plans for the effective management / application of ICT resources to create learner-centred environments.	5	2.63	0.70	6	2.46	0.73
C6	Makes informed choices in the selection and application of appropriate hardware to suit the needs of the learners and the context of learning.	10	2.50	0.50	18	2.30	0.89
C7	Makes informed decisions about the relevance and educational value of software, based on professional principles related to student learning, teaching goals, authentic curriculum design and technological infrastructure, by relying on existing professional competence, collaboration with colleagues, educational websites and relevant literature.	16	2.38	0.48	3	2.49	0.71
C8	Designs and integrates ICT-enhanced learning experiences across the curriculum.	11	2.50	0.71	8	2.40	0.76
C9	Understands and supports the diverse needs of learners by choosing and designing inclusive pedagogical strategies and practices supported by ICT.	6	2.63	0.48	14	2.34	0.77
C10	Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.	1	2.75	0.43	11	2.38	0.69

(table continues)

157

C11	Differentiates between applications of ICT that support routine tasks, and those that require higher order cognitive skills, problem solving and collaboration, and applies them to appropriate learning activities and situations.	24	2.25	0.83	15	2.33	0.76
C12	Uses technology to design and present units of work and prepare handouts.	37	2.00	0.71	20	2.28	0.81
C13	Applies ICT-enriched curricular activities to facilitate enquiry, problem solving, critical thinking and knowledge construction.	7	2.63	0.48	21	2.27	0.75
C14	Integrates ICT into a range of learning activities to facilitate both individual and collaborative work.	17	2.38	0.70	13	2.34	0.76
C15	Supports inter-/multidisciplinary curricular activities with ICT.	18	2.38	0.48	26	2.13	0.75
C16	Promotes innovative uses of technology amongst students, encouraging creativity and originality.	8	2.63	0.48	12	2.36	0.80
C17	Explores innovative uses of ICT, such as being connected across multiple dimensions: local and global communication.	25	2.25	0.66	33	1.93	0.89
C18	Facilitates on-line communication and collaboration of students at a local and global level.	9	2.63	0.48	36	1.76	0.87
C19	Encourages students to become members of local and extended communities of learning.	31	2.13	0.78	37	1.68	0.89
C20	Ensures that students develop competence, confidence, and critical awareness in using ICT.	2	2.75	0.43	1	2.56	0.63

(table continues)

158

Table 4.9 Comparison of results for Dimension 2 of teachers' ICT literacy (continued)

C21	Communicates with parents about ICT and curriculum, as well as about appropriate and balanced use of computers at home.	32	2.13	0.93	29	2.06	0.80
C22	Critically reflects on these experiences, and designs plans based on professional inquiry for improved student learning and innovative learning environments.	26	2.25	0.83	31	2.03	0.83
C23	Extends students' ability to evaluate, assess and monitor their own work (e.g.: by creating digital projects, electronic portfolios, etc.).	3	2.75	0.66	23	2.20	0.84
C24	Uses information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.	27	2.25	0.66	27	2.12	0.80

Note. R = Rank, M = Mean, SD = Standard Deviation

4.2.5 Dimension 3: ICT for Professional Learning and Engagement

Table 4.10 demonstrates that both teachers and Delphi panellists considered sharing and discussing effective practices with other teachers and participating in collaborative projects (C31) as moderately important for successful integration of ICT in learning and teaching. Both groups held similar views about the importance of using technology to research and extend curriculum options (C26), and using ICT to communicate with parents, colleagues and the larger community (C29).

Teachers found it more important than Delphi panellists to engage in ongoing professional development related to the integration of ICT in order to support student learning (C30). This capability was ranked by the teachers as the fourth most important capability in the entire framework of ICT literacy. Panellists, on the other hand emphasised the importance of demonstrating continual growth in understanding and applying ICT to educational settings, and keeping abreast of current and emerging technologies and pedagogical approaches (C28).

Table 4.10 Comparison of results for Dimension 3 of teachers' ICT literacy

D3.	ICT for Professional Learning and Engagement	Delphi Process			Teacher Survey		
		R	M	SD	R	M	SD
C25	Conducts professional enquiry using current literature and research on ICT pedagogies, when planning learning experiences and activities.	33	2.13	0.60	35	1.82	0.85
C26	Uses technology to research and extend curriculum options.	34	2.13	0.60	22	2.21	0.77
C27	Develops a personal plan for continuous professional learning related to ICT pedagogies.	19	2.38	0.48	32	1.95	0.79
C28	Demonstrates continual growth in understanding and applying ICT to educational settings, by keeping abreast of current and emerging technologies and pedagogical approaches.	12	2.50	0.50	25	2.14	0.79
C29	Uses technology to communicate ideas and collaborate with parents, colleagues, and larger community.	35	2.13	0.33	30	2.05	0.87
C30	Engages in ongoing professional development related to integration of ICT to support student learning.	28	2.25	0.43	4	2.48	0.68
C31	Shares, discusses and evaluates effective practices and strategies with other teachers, and participates in collaborative projects for designing ICT- rich learning environments.	20	2.38	0.70	19	2.29	0.78
C32	Demonstrates understanding of how the integration of ICT can influence the restructuring/reorganization of classrooms and schools for improved student learning.	29	2.25	0.83	28	2.09	0.81

Note. R = Rank, M = Mean, SD = Standard Deviation

Capabilities referring to planning for continuous professional development related to ICT-rich pedagogies (C27), as well as conducting professional enquiry using current

literature and research on ICT-rich pedagogies (C25) were considered of lesser importance by the majority of teachers participating in the survey.

The single sample t-test confirmed that teacher capability C25 had a mean value significantly less than two, hence it was not validated by the random sample of primary school teachers (Table 4.10).

4.2.6 Dimension 4: The Social Ecology of Living and Learning with ICT

Table 4.11 Comparison of results for teacher capabilities in Dimension 4.

D4.	The Social Ecology of Living and Learning with ICT	Delphi Process			Teacher survey		
		R	M	SD	R	M	SD
C33	Develops and consciously implements strategies to address equity issues related to equal access for all students, including different levels of ability, race, gender, socioeconomic status, language and culture.	13	2.50	0.50	7	2.40	0.73
C34	Demonstrates familiarity with the role of technology in youth culture and recreational uses of ICT.	14	2.38	0.70	34	1.93	0.86
C35	Applies appropriate ethical positions and responsible behaviours associated with the use of ICT, such as network/Internet policies, copyright laws and intellectual property.	21	2.50	0.50	2	2.50	0.76
C36	Maintains a critically reflective approach in the use of electronic information in relation to vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc.	15	2.50	0.71	17	2.32	0.85
C37	Identifies health hazards related to the use of ICT and creates a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.).	30	2.25	0.66	16	2.33	0.79

Note. R = Rank, M = Mean, SD = Standard Deviation

161

The application of ethical positions and responsible behaviours associated with the use of ICT, such as network/Internet policies, copyright laws and intellectual property, was ranked as the second most important aspect of teachers' ICT literacy by the teachers (C35). Also, the need for developing and consciously implementing strategies to address issues related to equity and inclusion (C33) was considered to be of high importance by the participants of the teacher survey (Table 4.11).

4.3 Discussion and conclusions

Chapter 4 has reported the development and validation of a new Framework of ICT Literacy for Primary School Teachers. The framework was developed in a four-round Delphi process and was validated by 124 primary school teachers from a random sample of 350 Victorian government primary schools.

The dynamic of the Delphi process resulted in transitions in research design, which affected the role of the researcher and the outcomes of the Delphi process, thus adding to the existing body of knowledge both in the area of the digital pedagogies and research methods. As a result of collaborative decision making, the Delphi exercise departed from its original aim to modify a peer-reviewed list of computer competencies, and arrived at a new Framework of ICT Literacy for Primary School Teachers.

The new framework includes 37 teacher capabilities belonging to four dimensions of ICT literacy: Operational Understanding and Application of ICT, ICT-Rich Pedagogies and Learning Environments, ICT for Professional Learning and Engagement, and The Social Ecology of Living and Learning with ICT. It promotes constructivist learning environments and integrated approaches to teaching and learning with ICT, and positions the teacher as a conscious professional, who makes informed decisions about the integration of ICT for improved student learning.

The validation process revealed similarities and differences of opinion between the experts on the Delphi Panel and teachers participating in the teacher survey about the importance of individual teacher capabilities for facilitating student learning with ICT. Teachers confirmed the importance of 34 out of the 37 teacher capabilities belonging to the framework of ICT literacy. The following three teacher capabilities were not validated by the participants of the teacher survey:

- C18   Facilitates on-line communication and collaboration of students at a local and global level.
- C19   Encourages students to become members of local and extended communities of learning.
- C25   Conducts professional enquiry using current literature and research on ICT pedagogies, when planning learning experiences and activities.

Comparative analysis of findings revealed that participants of the teacher survey and the Delphi Panel agreed about the utmost importance of ensuring that students develop competence, confidence, and critical awareness in using ICT. Similarly, both groups acknowledged the high importance of teachers' ability to plan for the effective management and application of ICT resources to create learner-centred environments.

Delphi panellists in general rated higher teacher capabilities that emphasise the importance of contextual awareness and critical consciousness related to ICT integration. Additionally, they placed more importance on creating inclusive, engaging learning environments that provide the learner with more autonomy. In contrast, surveyed teachers considered more important teacher capabilities that addressed the foundational dimension of ICT integration (O'Rourke, 2005), characterised by practical consciousness (Giddens, 1984).

Teacher capabilities referring to continuous professional development, as well as sharing effective practices with colleagues, were rated highly by the participants of the teacher survey. However, capabilities promoting self-directed approaches to professional development, such as developing personal plans, or conducting inquiry using current literature and research on ICT pedagogies, were not considered important by the teachers. This finding corresponded with the findings of Demetriadis et al. (2003) about teachers' willingness to engage in professional learning related to ICT if offered within the context of the school culture.

Contrary to the findings of Scheffler and Logan study (1999), most capabilities related to socio-cultural, ethical, legal, health and safety-related issues to the use of ICT received equally high ratings from both the Delphi Panel and the participants of the teacher survey. Yet, being familiar with the role of technology in youth culture, and recreational uses of ICT was considered of lesser importance by the teachers.

163

Comparison of findings emerging from the Delphi process and the survey study revealed differences between contemporary pedagogical thinking and current social practices related to the integration of ICT in learning and teaching. These discrepancies highlight the need for engaging teachers in professional development that will embrace a more holistic approach to ICT integration, placing teaching and learning in the complex local and global structures of socio-cultural reality, and provide the "actors of the schools of future" (McCluskey, 2003) with more agency to seamlessly integrate ICT with their everyday practices.

It is also important to reflect on some of the methodological implications of this particular Delphi process, on the Delphi method, as well as on the benefits of using the Delphi method in mixed methods designs. The Delphi process employed in this research project resulted in significant methodological transitions. It departed from its original design, adopting a more flexible approach. By embracing collaborative decision making and practitioner judgment (Cherednichenko et al., 2001) it supported the inclusion of the outlier's contribution. The underlying dynamics between the key agents of the Delphi process revealed a conflict of paradigms and indicated a possible intellectual rivalry (Pels, 1998). However, it also highlighted the interdependence of participants in a research process designed to reach consensus. The tensions emerging from the Delphi process also indicated an important shift from the old narratives of ICT integration towards fresh pedagogical and epistemological interpretations of teaching and learning with ICT.

The validation of the Delphi findings revealed, that by using the Delphi method in mixed methods designs it is possible to counterbalance some of the shortcomings of this method. These include issues related to validity and reliability of findings (Hasson et al., 2000; Kennedy, 2004) and conducting Delphi exercises outside of the context of real life (Kennedy, 2004). This study has demonstrated that the incorporation of the Delphi method in mixed methods designs links the Delphi findings to authentic real world situations and provides possibilities for further examination of the Delphi findings, thus addressing issues related to reliability and validity or in qualitative terms the trustworthiness of findings (Dakich, 2008a).

Chapter 5.

Teachers' ICT literacy in Victorian primary schools

This chapter is about the findings of the teacher survey that investigated teachers' ICT literacy in a random sample of 350 Victorian government primary schools. The aims of the teacher survey were to validate the newly developed framework of teachers' ICT literacy generated in the Delphi process, to gather data about teachers' ICT literacy capabilities across the four dimensions of the new framework, and to identify factors that influence teachers' ICT literacy. The validation of the new framework was discussed in Chapter 4. The present chapter provides an insight into the demographic and professional characteristics of survey participants, describes teachers' self-reported ICT literacy and identifies factors influencing its development. The chapter also on reports on teachers' open-ended responses to the survey and concludes with a discussion of findings.

5.1 Demographic and professional characteristics of survey participants

This section describes demographic and professional characteristics of survey participants. It provides information about the geographical location and size of the schools and reports on the age, gender, teaching qualifications, teaching experience and computer use of participating teachers.

5.1.1 School region and student population

Survey responses were received from 124 teachers teaching in schools representing all nine regions of the Victorian Department of Education and Training. The following analysis shows that the 124 returns were a reasonable reflection of the primary teaching profession as the characteristics of the respondents strongly match with those of the general population. For this reason, the findings of the teacher survey provide important insights into teachers' ICT literacy in Victorian primary schools.

As shown in Table 5.1, almost two-thirds (63.8%) of all responses were returned by teachers teaching in schools located in the four metropolitan regions. The distribution of responses by region is similar to the geographical distribution of government schools (primary and secondary) published in the 2007 Summary Statistics for Victorian Schools (DE&T, 2007).

Table 5.1 Distribution of responses by school regions

School Region	Frequency	Percent
Barwon South Western	2	1.9
Central Highlands Wimmera	5	4.76
Eastern Metropolitan	15	14.29
Gippsland	9	8.57
Goulburn North Eastern	12	11.43
Loddon Mallee	10	9.52
Northern Metropolitan	21	20.00
Southern Metropolitan	11	10.48
Western Metropolitan	20	19.05
Total	105	100

Analysis of survey data indicates that more than two-thirds of responses (69%) came from teachers in schools with a moderate to large student population. Table 5.2 presents the distribution of participants according to the size of their school's student population.

Table 5.2 Distribution of responses by student population

Student population	Frequency	Percent
up to 100	16	14.16
101 to 250	19	16.81
251 to 500	51	45.13
500+	27	23.89
Total	113	100.00

166

5.1.2   Gender and age

Responses to the teacher survey indicate a greater participation of female teachers (71.7%) compared with their male counterparts (28.3%). However, similar to other studies looking into teachers' computer use (Van Braak, Tondeur, & Valcke, 2004), the teacher survey reveals a slightly higher representation of male teachers in the survey sample. This is apparent when data is compared to the MCEETYA statistics (MCEETYA, 2004), according to which only 20.1% of teachers teaching in Victorian primary schools in 2003 were male. This discrepancy may be explained by the worldwide gender inequity in ICT-related professions (Valenduc & Vendramin, 2005) which includes teaching.

Responses also reveal that the majority of surveyed teachers (68.6%) belonged to the 40+ year old age group. About a quarter (26.4%) of survey participants were aged 25 to 39, while 5% of primary school teachers participating in the teacher survey were under 25 years of age. This mirrors the findings of the 2004 MCEETYA report (p. 11), which reported that 66.7% of Victorian primary school teachers were over 40 years of age, 27.3% were aged 25-39, while only 6.1% were in the 20-24 age range. These findings resemble the 2006 Victorian statistics (Victorian State Government, 2006b), according to which the single biggest age group of government sector teaching staff were teachers aged between 50-54, who comprised 22.8% of the total teaching workforce.

5.1.3   Teaching qualifications and teaching experience

The distribution of teaching qualifications presented in Table 5.3 demonstrates a high proportion of respondents with post-graduate qualifications. Figures show that almost all survey participants (95%) have completed four years of teacher training, or hold higher degrees in education.

Table 5.3 Distribution of responses by teaching qualifications

Teaching qualifications	Frequency	Percent
Less than 4 years (e.g. Diploma in Teaching)	6	5.0
4 Years course (e.g. BEd/BA+Dip Ed, etc.)	64	52.9
Postgraduate studies (e.g. MEd/MA+Dip Ed/BEd, etc.)	51	42.1
Total	121	100.0

Teaching experience was another demographic characteristic that showed similarities between the survey sample and the target population (MCEETYA, 2004). Most teachers participating in the survey (84.1%) have been practising in the profession for more than five years. As shown in Table 5.4, just over half (50.8%) of them have been teaching for more than twenty years.

Table 5.4 Distribution of responses by teaching experience

Teaching experience	Frequency	Percent
Less than 5 Years	19	15.8
5-10 Years	21	17.5
11-20 Years	19	15.8
More than 20 Years	61	50.8
Total	120	100.0

5.1.4 Curriculum area

The analysis of responses with regard to curriculum area suggests that more than three quarters (87%) of surveyed teachers were generalists (teaching most subjects). Only 7.2% identified themselves as ICT specialists, while 19% of participating teachers also indicated teaching in other specialist curriculum areas, such as reading recovery, disability and impairment, Languages Other Than English (LOTE), Studies of Society and Environment (SOSE) and Psychology. School principals and assistant school principals also participated in the survey (10%). These figures reflect the general arrangements in Victorian primary schools (Victorian State Government, 2006b).

5.1.5 Teachers' use of computers

Survey participants were requested to provide information about their computer use in the classroom, in the staffroom and at home. Even though computers have been part of the classroom furniture in Victorian government primary schools for more than two decades and two-thirds of the respondents had been teaching for more than ten years, less than one third (31.9%) of the surveyed teachers reported using them regularly in the classroom for more than 10 years. As shown in Table 5.5, almost two-thirds of the teachers (61.4%) have been using computers in the staffroom regularly for more than five years, with less than one third (28.9%) of them doing so for more than ten years. Data in

168

the table illustrates that all the surveyed teachers have access to computers at home and use them on a regular basis. Almost half of the survey participants (47.8%) have been regularly using their computer at home for more than ten years.

These data indicate that teachers' professional use of computers is not consistent with the length of their teaching experience, suggesting a delay in the adoption of computers for professional practices.

Table 5.5 Teachers' use of computers

Teachers' computer use	Classroom		Staff room		At home	
	f	*%*	*f*	*%*	*f*	*%*
Less than 1 year	5	4.2	8	9.6	0	0.0
From 1 to 4 years	34	28.6	24	28.9	14	12.4
From 5 to 10 years	42	35.3	27	32.5	45	39.8
More than 10 years	38	31.9	24	28.9	54	47.8
Total	119	100.0	83	100.0	113	100.0

Note. f = frequency

5.2 Teachers' self-reported ICT literacy

This section includes the findings emerging from the data analysis for each of the four dimensions of teachers' ICT literacy, as well as for individual teacher capabilities within each dimension. As described in Chapter 3, a four-point Likert-type scale was used to measure teachers' ICT literacy. The values of the scale Likert were beginner (1), intermediate (2), advanced (3), and expert (4). Teachers were asked to select one of these to indicate the level of their own competence related to individual teacher capabilities contained in the framework of ICT literacy.

5.2.1 Analysis of teachers' ICT literacy across the four dimensions

Overall, teachers were found to have intermediate to advanced skill levels for each of the four dimensions of the framework of teachers' ICT literacy, as shown in Table 5.6. They appeared to be the most competent about Dimension 1: Operational Understanding and Application of ICT, and the least competent about Dimension 4: The Social Ecology of Living and Learning with ICT.

Table 5.6 Teachers' ICT literacy across the four dimensions

Dimension	N	M	SD
D 1: Operational Understanding and Application of ICT	116	2.47	0.65
D 2: ICT-rich Pedagogies and Learning Environments	117	2.14	0.63
D 3: ICT for Professional Learning and Engagement	117	2.05	0.65
D 4: The Social Ecology of Living and Learning with ICT	116	2.02	0.66

Note. N = Number of participants, M = Mean, SD = Standard Deviation

5.2.1.1 Dimension 1: Operational Understanding and Application of ICT

Findings for individual teacher capabilities comprising Dimension 1 are presented in Table 5.7. Mean values show that teachers perceived themselves to have intermediate to advanced levels of competence for each of themselves. According to their self-reports, teachers were the most competent at demonstrating skill in the use and application of common computer software as described by C3.

Table 5.7 Operational Understanding and Application of ICT

		Level of competence		
D1	Operational Understanding and Application of ICT	N	M	SD
C1	Demonstrates up-to-date understanding and knowledge of Information and Communication Technologies (ICT) used in home, school, workplace and community.	116	2.55	0.69
C2	Demonstrates professional judgment in the selection and application of common computer hardware, including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards etc.).	116	2.30	0.83
C3	Demonstrates skill in the use and application of common computer software (e.g.: word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.).	116	2.58	0.75
C4	Utilizes network resources such as the Internet, Intranets and Local Area Networks to communicate, conduct research and exchange ideas.	115	2.45	0.74

Note. N = Number of participants, M = Mean, SD = Standard Deviation

5.2.1.2   Dimension 2: ICT-rich Pedagogies and Learning Environments

Teachers reported to be at an intermediate level of competence concerning Dimension 2 ($\bar{x}$ =2.14). Mean scores for individual teacher capabilities included in this dimension are presented in Table 5.8. Mean values suggest that teachers felt the most competent about using technology to present units of work and prepare handouts (C12), making informed decisions about the relevance and educational value of software (C7), and making sure that students develop competence, confidence and critical awareness in using ICT (C20).

Table 5.8 ICT-rich Pedagogies and Learning Environments

| D2 | ICT-rich Pedagogies and Learning Environments | Level of competence | | |
		N	M	SD
C5	Plans for the effective management / application of ICT resources to create learner-centred environments.	115	2.28	0.70
C6	Makes informed choices in the selection and application of appropriate hardware to suit the needs of the learners and the context of learning.	116	2.22	0.80
C7	Makes informed decisions about the relevance and educational value of software, based on professional principles related to student learning, teaching goals, authentic curriculum design and technological infrastructure, by relying on existing professional competence, collaboration with colleagues, educational websites and relevant literature.	114	2.32	0.74
C8	Designs and integrates ICT-enhanced learning experiences across the curriculum.	113	2.29	0.82
C9	Understands and supports the diverse needs of learners by choosing and designing inclusive pedagogical strategies and practices supported by ICT.	113	2.13	0.75
C10	Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.	115	2.23	0.78
C11	Differentiates between applications of ICT that support routine tasks, and those that require higher order cognitive skills, problem solving and collaboration, and applies them to appropriate learning activities and situations.	113	2.17	0.76
C12	Uses technology to design and present units of work and prepare handouts.	114	2.68	0.80

Table 5.8 ICT-rich Pedagogies and Learning Environments (continued)

C13	Applies ICT-enriched curricular activities to facilitate inquiry, problem solving, critical thinking and knowledge construction.	115	2.15	0.74
C14	Integrates ICT into a range of learning activities to facilitate both individual and collaborative work.	114	2.25	0.72
C15	Supports inter-/multidisciplinary curricular activities with ICT.	113	2.03	0.73
C16	Promotes innovative uses of technology amongst students, encouraging creativity and originality.	111	2.18	0.80
C17	Explores innovative uses of ICT, such as being connected across multiple dimensions: local and global communication.	113	1.87	0.82
C18	Facilitates on-line communication and collaboration of students at a local and global level.	115	1.83	0.76
C19	Encourages students to become members of local and extended communities of learning.	114	1.76	0.73
C20	Ensures that students develop competence, confidence, and critical awareness in using ICT.	114	2.32	0.78
C21	Communicates with parents about ICT and curriculum, as well as about appropriate and balanced use of computers at home.	112	2.18	0.81
C22	Critically reflects on these experiences, and designs plans based on professional inquiry for improved student learning and innovative learning environments.	113	1.99	0.77
C23	Extends students' ability to evaluate, assess and monitor their own work (e.g.: by creating digital projects, electronic portfolios, etc.).	115	1.97	0.84
C24	Uses information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.	115	2.17	0.84

Note. N = Number of participants, M = Mean, SD = Standard Deviation

Participating teachers found themselves the least competent at encouraging students to become members of local and extended communities of learning (C19), facilitating on-line communication and collaboration (C18), exploring innovative uses of ICT, such as

172

local and global communication facilitated by ICT (C17), and at extending students' ability to evaluate, assess and monitor their own work by creating digital projects, electronic portfolios etc (C23). As described earlier in the validation of the Delphi findings in Chapter 4, two of these teacher capabilities (C18, C19) were also found to be the least important aspects of teachers' ICT literacy by survey participants.

5.2.1.3 Dimension 3: ICT for Professional Learning and Engagement

Findings concerning Dimension 3 of the ICT literacy framework suggested that teachers overall perceived themselves to be at an intermediate level of competence when using ICT for professional learning and engagement ($\bar{x}$ =2.05, shown in Table 5.9).

Table 5.9 ICT for Professional Learning and Engagement

D3	ICT for Professional Learning and Engagement	Level of competence		
		N	M	SD
C25	Conducts professional enquiry using current literature and research on ICT pedagogies, when planning for learning experiences and activities.	115	1.92	0.74
C26	Uses technology to research and extend curriculum options.	115	2.18	0.79
C27	Develops a personal plan for continuous professional learning related to ICT pedagogies.	116	1.99	0.75
C28	Demonstrates continual growth in understanding and applying ICT to educational settings, by keeping abreast of current and emerging technologies and pedagogical approaches.	114	2.03	0.73
C29	Uses technology to communicate ideas and collaborate with parents, colleagues, and larger community.	113	2.09	0.81
C30	Engages in ongoing professional development related to the integration of ICT to support student learning.	115	2.16	0.74
C31	Shares, discusses and evaluates effective practices and strategies with other teachers, and participates in collaborative projects for designing ICT- rich learning environments.	113	2.13	0.79
C32	Demonstrates understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and schools for improved student learning.	113	1.98	0.73

Note. N = Number of participants, M = Mean, SD = Standard Deviation

173

The responses for individual capabilities shown in Table 5.9 indicated that teachers were the most competent at using ICT to research and extend curriculum options (C26), engaging in ongoing professional development related to the integration of ICT to support student learning (C30), and sharing and evaluating effective practices and participating in collaborative projects for designing ICT-rich learning environments (C31).

According to their self-reports, teachers were the least competent at conducting professional inquiry using current literature and research on ICT pedagogies, when planning for learning experiences and activities (C25), understanding the influence of ICT integration on the restructuring of classrooms and schools (C32), and developing a personal plan for continuous professional learning related to ICT pedagogies (C27).

5.2.1.4 Dimension 4: The Social Ecology of Living and Learning with ICT

Survey responses also revealed that overall teachers perceived themselves as least competent at Dimension 4 of teachers' ICT literacy, The Social Ecology of Living and Learning with ICT ($\bar{x}$ =2.02, see Table 5.6).

Table 5.10 the Social Ecology of Living and Learning with ICT

		Level of competence		
D4	The Social Ecology of Living and Learning with ICT	N	M	SD
C33	Develops and consciously implements strategies to address equity issues related to equal access for all students, including different levels of ability, race, gender, socioeconomic status, language and culture.	114	2.11	0.74
C34	Demonstrates familiarity with the role of technology in youth culture and recreational uses of ICT.	115	1.95	0.76
C35	Applies appropriate ethical positions and responsible behaviors associated with the use of ICT, such as network/Internet policies, copyright laws and intellectual property.	114	2.17	0.85
C36	Maintains a critically reflective approach in the use of electronic information in relation to vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc.	115	2.03	0.81
C37	Identifies health hazards related to the use of ICT and creates a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.).	115	1.86	0.74

Note. N = Number of participants, M = Mean, SD = Standard Deviation

174

The findings for the individual capabilities shown in Table 5.10 indicated teachers' lack of confidence and competence in identifying health hazards related to the use of ICT (C37). They also pointed towards teachers' lack of familiarity with the role of technology in youth culture and recreational uses of ICT (C34), a capability found to be one of the four teacher capabilities with the lowest mean scores in the validation process. Within this dimension of ICT literacy teachers reported to be the most competent in applying appropriate ethical positions and responsible behaviours associated with the use of ICT (C35), and catering for student diversity (C33). This reflects teachers' awareness of the potential legal implications related to any breach of duty of care in Australian schools.

5.3 Factors influencing teachers' ICT literacy

This section examines some of the external influences that have an impact on the development of teachers' ICT literacy. It reports on teachers' own perceptions about factors contributing to the development of their ICT literacy, and interprets the influence of the following independent variables on teachers' ICT literacy:

- age,
- gender,
- curriculum area,
- teaching qualifications,
- teaching experience, and
- teachers' use of computers.

5.3.1 *Teachers' perceptions about factors influencing the development of their ICT literacy*

Survey item number 9 (Appendix F) asked teachers about factors contributing to the development of their ICT literacy, such as:

- pre-service education,
- in-service professional development,
- workplace experience,
- having a computer at home,
- support from colleagues,

175

- support from school leadership, and
- other.

Table 5.11 Factors contributing to the development of teachers' ICT literacy

...	N	Not Important		Somewhat important		Very important	
		f	%	f	%	f	%
Pre-service education	106	40	37.70	33	31.10	33	31.10
In-service professional development	121	4	3.30	43	35.50	74	61.10
Workplace experience	122	1	0.80	20	16.30	101	82.80
Having a computer at home	122	1	0.80	15	12.29	106	86.88
Support from colleagues	121	6	4.90	43	35.50	72	59.50
Support from school leadership	119	13	10.90	43	36.10	63	52.90
Other	16	1	6.30	2	12.50	13	81.30

Note. f = Frequency, N= Total number of responses

The distribution of responses presented in Table 5.11 suggested that the most important external influence in the development of teachers' ICT literacy was having a computer at home.

Workplace experiences were the second most important factor. More than half the survey participants believed that in-service professional development, support from colleagues and support from school leadership also played an important role in the growth of their ICT related knowledge and skills. It is notable that according to 37.7% of survey participants, pre-service education was not considered to play an important role in the development of their ICT literacy. This finding reflects the demographic profile of participants, which indicates an aging teacher population in Victoria, with two-thirds of surveyed teachers over 40 years of age. These teachers would have had little or no ICT training during their pre-service education that would be relevant to their new roles and current classroom practices. Other influences that teachers perceived to be important contributors to the development of their ICT literacy included family and friends, having access to professional development and postgraduate studies.

5.3.2 The influence of age on teachers' ICT literacy

Teachers' age seems to have a considerable influence on the level of their ICT literacy. Analysis of mean values shown in Table 5.12 illustrates a trend for teachers aged between 25 and 39 to be the most competent at Dimensions 2, 3 and 4, while the youngest teachers, aged under twenty–five, seem to be the most competent at Dimension 1 of teachers' ICT literacy. A one–way ANOVA was utilised to evaluate the significance of these results. The test showed that the influence of age on individual dimensions of teachers' ICT literacy was significant only for Dimension 1: Operational Understanding and Application of ICT ($F=5.618$; $p=0.005$).

Table 5.12 The influence of age on teachers' ICT literacy

			Dimension 1 N=112	Dimension 2 N=84	Dimension 3 N= 104	Dimension 4 N=110
Age	Under 25	N	6	5	5	6
		Mean	2.63	2.20	1.83	2.00
		SD	0.61	0.52	0.85	0.64
	25-39	N	30	20	27	27
		Mean	2.78	2.32	2.28	2.13
		SD	0.56	0.51	0.59	0.70
	40+	N	76	59	72	77
		Mean	2.34	2.06	1.99	2.02
		SD	0.65	0.65	0.63	0.66
F			5.618	1.413	2.330	0.284
Sig (p)			0.005	0.249	0.102	0.754

Note. SD = Standard Deviation

5.3.3 The influence of gender on teachers' ICT literacy

Comparison of means shown in Table 5.13 indicates gender differences related to individual dimensions of teachers' ICT literacy. Mean values for female teachers' ICT literacy ranged from $\bar{x} =1.95$ to $\bar{x} = 2.26$ (beginner to intermediate), while mean values for male teachers ranged from $\bar{x} = 2.13$ to $\bar{x} = 2.95$ (intermediate to advanced). Male teachers participating in the survey rated themselves higher across all dimensions. Further analysis demonstrated that these gender differences are statistically significant for each dimension of teachers' ICT literacy. This finding is not unusual, as there are other studies that show that males rate themselves higher than females in self-efficacy with ICT (Meredyth, Russell, Blackwood, Thomas, Wise et al., 1999; Vale & Leder, 2004).

However, it is also known, that men are generally more self-confident in self-assessment tasks than females (Baruch, 1996; Haynes et al., 2004).

According to results presented in Table 5.13, both female and male teachers appeared to be the most competent at Dimension 1: Operational Understanding and Application of ICT. Male teachers perceived themselves more competent at facilitating student learning with ICT (Dimension 2) and using ICT for professional learning and engagement (Dimension 3) than did female teachers. While male teachers felt the least competent at the social ecology of living and learning with ICT (Dimension 4), female teachers reported to be the least competent at using ICT for professional learning and engagement (Dimension 3).

Table 5.13 The influence of gender on teachers' ICT literacy

			Dimension 1 N=112	Dimension 2 N=84	Dimension 3 N= 103	Dimension 4 N=109
Gender	Female	N	79	60	72	76
		Mean	2.26	1.97	1.95	2.01
		SD	0.60	0.57	0.62	0.68
	Male	N	33	24	31	33
		Mean	2.95	2.51	2.32	2.13
		SD	0.50	0.56	0.62	0.63
T			40.750	32.643	33.779	32.262
Sig (p)			.000	.000	.000	.000

Note. SD = Standard Deviation

5.3.4 The influence of teaching experience on teachers' ICT literacy

Table 5.14 shows the influence of teaching experience on teachers' ICT literacy. Mean scores indicate that teachers with five to ten years of teaching experience appeared to be the most competent at Dimensions 1, 2 and 3, while teachers with less than five years of experience seemed to be the most competent at Dimension 4 of teachers' ICT literacy. Further statistical analysis however confirmed that teaching experience had a significant influence only on Dimension 1 of teachers' ICT literacy (F=4.002; p=0.010).

Table 5.14 The influence of teaching experience teachers' ICT literacy

			Dimension 1 N=111	Dimension 2 N=83	Dimension 3 N= 103	Dimension 4 N=109
Teaching experience	Less than 5 years	N	18	14	16	17
		Mean	2.51	2.22	2.07	2.13
		SD	0.48	0.48	0.66	0.58
	5-10 years	N	18	12	16	17
		Mean	2.89	2.40	2.35	2.07
		SD	0.64	0.33	0.63	0.73
	11-20 years	N	19	13	19	18
		Mean	2.20	1.94	1.89	1.94
		SD	0.62	0.43	0.63	0.59
	More than 20 years	N	56	44	52	57
		Mean	2.41	2.07	2.03	2.04
		SD	0.67	0.42	0.63	0.71
F			4.002	1.476	1.652	0.231
Sig (p)			0.010	0.227	0.182	0.875

Note. SD = Standard Deviation

5.3.5   The influence of computer use on teachers' ICT literacy

The influence of teachers' use of computers was the last independent variable evaluated. The length of time of using computers in the classroom, in the staffroom, and at home was evaluated. Table 5.15 shows the mean values for the length of the time of teachers' classroom use of computers. Comparison of means suggests that teachers who have been using computers in the classroom for more than ten years are the most competent across all dimensions of teachers' ICT literacy. Surprisingly, tests of statistical significance show that teachers' use of computers in the classroom had a significant influence on each dimension of teachers' ICT literacy except for Dimension 2: ICT-rich pedagogies and learning environments.

A different trend emerged regarding the influence of staffroom use of computers on teachers' ICT literacy. As presented in Table 5.16, teachers with five to ten years of experience using computers in the staffroom perceived themselves the most competent across all four dimensions of ICT literacy. Contrary to the effects of teachers' use of computers in the classroom, the use of computers in the staffroom had a significant influence only on Dimension 1 of teachers' ICT literacy (F=4.290; p=0.008).

179

Table 5.15 The influence of classroom computer use on teachers' ICT literacy

			Dimension 1 N=111	Dimension 2 N=83	Dimension 3 N= 103	Dimension 4 N=109
Teachers' use of computers in the classroom	Less than 1 year	N	5	5	5	5
		Mean	2.35	2.07	1.98	2.12
		SD	0.93	0.81	0.86	0.73
	From 1-4 years	N	29	22	28	28
		Mean	2.12	1.93	1.86	1.84
		SD	0.59	0.55	0.63	0.67
	From 5-10 years	N	40	27	36	39
		Mean	2.57	2.13	2.02	1.91
		SD	0.67	0.61	0.58	0.60
	More than 10 years	N	37	29	34	37
		Mean	2.71	2.34	2.34	2.31
		SD	0.53	0.58	0.58	0.57
F			5.395	1.970	3.497	4.020
Sig (p)			0.002	0.125	0.018	0.009

Note. SD = Standard Deviation

Table 5.16 The influence of staffroom computer use on teachers' ICT literacy

			Dimension 1 N=77	Dimension 2 N=57	Dimension 3 N= 73	Dimension 4 N=76
Teachers' use of computers in the staffroom	Less than 1 year	N	6	5	6	6
		Mean	1.96	1.89	1.69	1.70
		SD	0.86	0.70	0.75	0.75
	From 1-4 years	N	21	17	20	20
		Mean	2.33	2.02	1.95	1.85
		SD	0.61	0.59	0.58	0.59
	From 5-10 years	N	27	18	24	26
		Mean	2.79	2.43	2.22	2.07
		SD	0.59	0.47	0.58	0.60
	More than 10 years	N	23	17	23	24
		Mean	2.57	2.26	2.20	2.02
		SD	0.52	0.62	0.63	0.62
F			4.290	2.053	1.836	1.724
Sig (p)			0.008	0.118	0.149	0.170

Note. SD = Standard Deviation

According to the results shown in Table 5.17, the length of time of using computers at home had the most significant influence on teachers' ICT literacy. As illustrated by the mean scores in Table 5.17, teachers who had been using computers at home for more than ten years seemed to be the most competent across all dimensions of teachers' ICT literacy. Further statistical analysis revealed that the length of time of using computers at home is the only factor that has a significant influence on competency levels related to all four dimensions of teachers' ICT literacy ($p<0.05$ for all dimensions).

Table 5.17 The influence of home computer use on teachers' ICT literacy

			Dimension 1 N=104	Dimension 2 N=79	Dimension 3 N= 99	Dimension 4 N=102
Teachers' use of computers at home	Less than 1 year	N	0	0	0	0
		Mean	0	0	0	0
		SD	0	0	0	0
	From 1-4 years	N	11	10	10	10
		Mean	2.02	1.55	1.56	1.50
		SD	0.75	0.56	0.59	0.67
	From 5-10 years	N	42	33	40	42
		Mean	2.46	2.14	1.97	1.88
		SD	0.59	0.58	0.63	0.62
	More than 10 years	N	51	36	49	50
		Mean	2.60	2.29	2.23	2.23
		SD	0.62	0.59	0.60	0.63
F			3.906	6.388	5.779	7.291
Sig (p)			0.023	0.003	0.004	0.001

Note. SD = Standard Deviation

5.4 Teachers' responses to the open-ended survey questions

Teachers participating in the survey study were offered two open-ended questions (Appendix F) that provided them with an opportunity to comment on the framework of ICT literacy, and to provide suggestions. The qualitative data obtained by these two items yielded additional information about barriers to and catalysts for teaching and learning with ICT in Victorian government primary schools. The content analysis (Miles & Huberman, 1994) indicated that some of the most common barriers to successful ICT integration were: teachers' skill levels, technical difficulties related to operating hardware and software, lack of full-time technical support and limited access to relevant and ongoing professional development. Many of these observations were validated by the findings of the qualitative fieldwork to be discussed in Chapter 6.

The following response submitted by a survey participant provides a powerful summary of some of the most pertinent issues affecting many teachers when trying to make ICT an integral part of student learning:

> Everything in relation to ICT in schools is related to resources. Money for PD is practically non-existent. Much of the hardware is old and faulty. We do however have some new technology, which continues to excite us. Computers per child in Victoria are not as the figures would suggest. I have six computers in my room with only three that are capable of the programs I run.

Professional development associated with ICT integration appeared to be the most frequently recurring theme in teachers' comments. For example one of the teachers wrote: "Administration is reluctant to allow teachers to attend professional development if it is not 'connected' to the curriculum. However new technologies have to be learnt somehow."

Lack of opportunities for professional development provided by schools is not the only issue affecting the take up of ICT. According to a number of participants, time constraints and other pressures of professional and private lives prevent them exploring the potential of new technologies for student learning.

Even though teachers were held back by these difficulties, they were still forward-looking and optimistic about learning to teach with ICT. Survey responses revealed that teacher collaboration and mentoring programmes provided pathways for teachers to improve their ICT literacy. As one participant noted: "My computer skills have improved greatly last year due to the support in the form of a mentor – SSOP (office), a mentor who has taken the time to show me something new each week".

Survey responses also suggested that collaboration and collegiality were of great value when learning about teaching with new technologies. Collaborative practices were particularly effective when they were supported by a whole-school approach and/or collaboration with the local community. As a surveyed teacher said: "I do not have the skills and competencies to provide complex instruction, in the application of specific programs [I am] relying on the skills and expertise of our ICT manager, colleagues and students". Difficulties related to access were also better managed in collaboration with teh local community, as one of the teachers revealed: "We do share [ICT] with the local

secondary college. This is vital to maximise the use of resources on cash-strapped schools."

Unfortunately providing students with opportunities to learn with and through ICT was still unachievable for many teachers as they struggled with access to networked computers and software applications. This, however, did not prevent them from aspiring to have access to a variety of ICT, not just computers. As one survey participant noted, this would help teachers to better cater to the needs of their students:

> ...I would like to have an interactive whiteboard connected to my PC in the classroom, and be able to navigate the web for any theme, e.g. Natural Disasters. Visual images for the whole class would be a motivating force! Applications for Maths would be beneficial, especially for fractions. ...For children with language disorders visual images would be beneficial to their learning, or [to] other students who may be visual learners.

However, while some teachers may be inspired by and excited about the potential of ICT for student learning, there are others, who warn that too much emphasis on new technologies can get counter-productive at times. As one of the surveyed teachers said:

> From an educational perspective it is important to remember that ICT is a tool for learning, and should share an equitable amount of time in the curriculum, but it should not dominate to the exclusion of other tools.

Finally a comment on the new framework of ICT literacy: A participant in the teacher survey saw it as an opportunity for improving her/his ICT literacy:

> Something new – is what I want/need at the moment –so I am able to practise these skills immediately and with purpose. This [the questionnaire] has worked better for me than in-service PD [professional development].

5.5 Discussion and conclusions

The findings of the teacher survey provided a snapshot of teachers' ICT literacy in Victorian primary schools, and identified factors that influence the development of primary school teachers' knowledge and skills of integrating new technologies with their pedagogical practices. Demographic and professional characteristics of survey

183

participants, such as geographic location, age, gender, curriculum area, and teaching experience showed that the sample was generally representative of the target population.

A number of key findings have emerged regarding teachers' ICT literacy. Participating teachers reported having intermediate to advanced skill levels across all four dimensions. They found themselves the most competent at Dimension 1: Operational Understanding and Application of ICT, and the least competent about Dimension 4: The Social Ecology of Living and Learning with ICT. When looking at individual teacher capabilities across the four dimensions of the framework of teachers' ICT literacy, participating teachers perceived themselves the most competent about using technology to design and present units of work and prepare handouts, and demonstrate skill in the application of common computer software such as word processing, text and image editing, data and file management, graphics and design, multi and hypermedia. They also expressed the need for having up-to-date understanding and knowledge of ICT used in home, school, workplace and community. However, survey results also revealed that teachers' perceived levels of technical competence have not been accompanied by a sound pedagogical understanding of how new technologies could assist them in creating new learning environments and student-centred approaches to learning. This was illustrated by teachers' self-reported lack of confidence in innovative uses of new technologies, such as extending students' ability to evaluate, assess, and monitor their own work by creating digital projects, electronic portfolios, or using ICT for supporting inter-/multidisciplinary curricular activities.

Findings of the teacher survey further suggested teachers' lack of competence in applying leading edge applications of ICT to teaching and learning, such as Web2 technologies used for social networking. Amongst the 37 teacher capabilities of the framework of ICT literacy teachers perceived themselves the least competent at encouraging their students to become members of extended communities of learning, and facilitating on-line communication and collaboration of students at a local and global level. This may be explained by teachers being relatively unfamiliar with new frontiers of the virtual world, recreational applications of ICT and their potential for student learning. It is worth mentioning that the current legal environment where teachers could face serious consequences for any breach of terrestrial rules on the largely unregulated information superhighway also slows down the adoption of Internet technologies in primary schools. Some of the main concerns include, lack of teacher control, possible

184

breaches of duty of care, and the vulnerability of young children in online environments. The pedagogical and cultural implications of taking learning beyond the classroom are also posing new challenges for teachers. In these blended environments where student learning extends beyond traditional boundaries of classroom walls and state and national borders, learning becomes more of a negotiated inquiry process where teacher control is decreased and learner autonomy is emphasised. As the findings of the teacher interviews and classroom observations to be described in Chapter 6 confirm, these challenges can be effectively met when teachers are provided with a supportive school culture and a whole school approach to the integration of ICT in learning and teaching.

Teachers also report having limited competence in identifying health hazards related to the use of ICT and in creating safe learning environments. This finding mirrors the lack of awareness in the general public about the health risks imposed by new and emerging technologies on the living environment. These concerns include compliance of these technologies with ergonomic principles, levels of radiation, time spent working/playing with them, etc.

In order to develop a contextual understanding of teachers' ICT literacy several factors that influence its development were identified. Inferences made between demographic information provided by survey participants and their self-reported ICT literacy suggested that male teachers generally perceived themselves more capable across all dimensions than female teachers and these differences proved to be statistically significant. Teachers' age and teaching experience appeared to have a significant influence only on operational understanding and application of ICT literacy. Surprisingly using computers in the classroom for more than 10 years had a significant influence on each dimension of ICT literacy apart from Dimension 2, which refers to pedagogically informed integration of ICT in learning experiences and learning environments. However, using computers at home for more than ten years has significantly increased teachers' ICT literacy across all dimensions. This finding has been reinforced by teachers' own perceptions revealed in the teacher interviews, according to which having a computer at home was identified as the most important contributor in the development of their ICT literacy.

Teachers' responses to the open-ended survey questions indicated that many of them were genuinely interested in exploring innovative practices with new technologies. However, lack of access to hardware and software, just-in-time technical support and

185

opportunities for relevant professional development, acted as barriers to engaging students in new learning experiences. Teachers believed that many of these barriers could be overcome by collaboration, mentoring and by sharing effective practices with ICT. These themes will be explored further in Chapter 6 that reports on the qualitative fieldwork conducted with four teachers from two Victorian government primary schools.

.

Chapter 6.

Learning to teach with ICT:

Snapshots from the field

Chapter 6 presents the findings of the qualitative fieldwork, the aims of which were to explore current practices of facilitating student learning with ICT in the contemporary primary school, and to bring forth teachers' opinions about the challenges of ICT integration. Four primary school teachers from two Victorian state primary schools participated in this stage of the research project. They provided the researcher with opportunities to gain insight into everyday practices of learning and teaching with ICT with a focus on primary literacy and numeracy. The fieldwork that included multiple naturalistic observations and semi-structured teacher interviews was designed to triangulate the findings of previous stages of the research, and to yield responses to the following research questions:

- How do teachers integrate ICT in the everyday social practices of teaching and learning?

- To what extent are they transforming student learning with ICT?

- How does teachers' ICT literacy influence their teaching practices and pedagogical approaches?

The chapter includes three selected cases of practice, involving the four teachers, each followed by a commentary that explores the connections between teachers' ICT literacy and pedagogical approaches. The cases depict authentic practices of teaching and learning with ICT while the commentaries explore the nature of ICT integration including patterns of student learning and engagement, teaching practices and pedagogies, the role of ICT in the process of learning, the learning environment and teachers' ICT literacy. The commentaries are followed by teachers' reflections on their practices which provide an insight into teachers' underlying philosophies that influence ICT integration, describe

cultural and pedagogical shifts, and identify catalysts for and barriers to teaching and learning with new technologies. The chapter closes with a discussion of findings and conclusions.

6.1 Integrating ICT in literacy learning

6.1.1 School context

Kate and Maria teach grades 3 and 4 students at Kookaburra Primary School. The school is located in the western suburbs close to the state capital and caters for the diverse needs of 460 students. With its 25 teachers it provides a pleasant and progressive learning environment, and aims to stay in tune with current educational trends. Improving student learning with ICT is one of these aims. According to Kate, the school has always had a "big vision" related to ICT and it is one of the school's curriculum priorities.

At Kookaburra Primary School there are a number of teachers who take a leadership role in integrating ICT in learning and teaching. They bring new ideas and provide support to colleagues. Kate and Maria belong to this group of teachers who eagerly experiment with the integration of ICT in order to improve student learning. Their innovative efforts are both supported and constrained by the school's ICT infrastructure: a laboratory, equipped with 16 computers, TV, video/DVD player, digital video camera and digital photo camera, as well as four PCs per classroom. A timetable regulates class access to the laboratory so that students from each class have the opportunity to engage in ICT-rich learning experiences for one hour per week. All computers are connected to the local network (Intranet) and the Internet. The Intranet provides students and teachers with educational resources, mainly educational software packages. All teachers are provided with laptops that are updated every three years.

Kate and Maria work in a team-teaching environment. There are 26 students in each of their classes. One of Maria's students has a speech difficulty accompanied by Attention Deficit Disorder (ADD). An integration aide comes in on a regular basis to assist with his successful engagement in learning tasks and experiences. Parent volunteers are also part of the learning community. According to Maria, parents take turns in helping students during the week. They enjoy being involved in helping teachers organise the learning activities and facilitate student learning.

The two teachers opened up the retractable wall dividing their classrooms so they can teach and learn together. Maria says that these are the only two classrooms in the school that have shared retractable walls, providing an open door, which seems to be a metaphor for collaboration and collegiality: "we never actually close them, we don't want to close them" (Kate). To achieve this Kate and Maria had to go through a formal procedure, by putting in an application and presenting their rationale to the staff. Since then Kate and Maria do everything together, design the learning experiences, evaluate and assess student learning, share ideas, troubleshoot and plan for professional development: "We get along, we have similar teaching philosophies, approaches, everything. We are very similar, very compatible in that sense and I think that's important" (Maria). They both agree that the success of their collaboration lies in good communication: "I would say the most important thing between the two of us is our communication. … We communicate every day after school, we make time for it - fifteen minutes allocated time at least" (Kate).

6.1.2 Case of practice

The purpose of the classroom observation was to observe how ICT were integrated in teaching and learning in a primary literacy lesson, where teachers combined working with contemporary text with art and crafts and digital media. The lesson was held in the joint classroom, where there were eight networked computers available for use by students. Students were learning about blurbs. According to Kate, the intended learning objective was to help students understand what a blurb was. Building on students' prior knowledge Kate asked the following questions: "Where do we find a blurb in everyday life? What is the purpose of it? What makes it interesting?" Kate introduced the activity, by reading students a blurb from the back of a giant storybook. Two students assisted her by looking up the meaning of the word blurb in the dictionary. Kate involved the 56 students in a group conversation about blurbs on books, videos, DVDs, etc. She gave students a small homework task, asking them to find and read a blurb on a book or DVD.

Following the exploration of the topic, students were assigned to one of the four workstations where different tasks were awaiting them. Both grades had an identical setup of learning activities, each grade occupying the space in 'their part' of the big classroom. There were four workstations set up for each class:

189

- Workstation 1: Students were required to read a blurb and make up a story. They had to type up and print their stories using the so-called Technology Boxes where the networked computers were located.
- Workstation 2: Students had to practise handwriting by copying words and sentences, using worksheets. The task was not related to the theme and ICT played no role in this activity. Its purpose was to aid the development of hand-writing skills.
- Workstation 3: Students were expected to read a story and write a blurb based on it. Similarly to those working on Workstation 1, they had to type up their blurbs in the Technology Boxes.
- Workstation 4: Students had to create a three dimensional character from the story they read using art and craft supplies such as paper, fabric, strings, pegs, etc. ICT were not integrated into this task.

During the lesson teachers were busy assisting students with questions related to these four tasks. Both teachers were moving around making sure that each student completed all four tasks. They were providing students with clear instructions. Their voice was firm, their body language affirmative. There seemed to be a strong emphasis on getting the work done. Teachers collaborated regularly during the lesson with each other as well as with the parent helpers and the integration aide. Students were so busy learning, working, giving each other advice and showing each other how to do something that they did not have a chance to engage in unproductive behaviours.

In the Technology Boxes students were typing up their stories or blurbs using Microsoft Word. Their focus was on the visual presentation of their work. They eagerly experimented with features provided by WordArt. Most students seemed to be confident users of MSWord, including troubleshooting skills such as selecting the application that was not responding from the task list and closing it without having to reboot the PC. At this stage students worked independently on the task, not seeking help from teachers. Instead they were continuously communicating with each other while working on the computers. Boys and girls seemed to be equally efficient in completing their tasks. A number of students called Computer Technicians were helping their peers with occasional technological glitches. The Computer Technicians were identified by the teachers as experts in using ICT, and were encouraged to assist and teach their peers.

Towards the end of the lesson more and more students were heading towards the Technology Boxes, which became somewhat overcrowded. Clearly there was lack of time and lack of computers. The teachers had to intervene. They chose to help students complete their work by assisting them in typing up their blurbs or stories. The parent helpers followed the example set by the teachers.

As the 'final proof' and tangible outcome of the learning process, blurbs and stories were published on the printer located just outside the classroom door. Printed stories were placed into 'Computer Folders' owned by each individual student. Following the two hour session each class sat in a circle in front of the white board at opposite ends of the joint classroom, and presented their work to their peers and teachers. The students read out their blurbs and stories, and talked about the characters they created based on their stories and blurbs. Both teachers gave positive feedback to their students, even in cases where blurbs turned out to be too long: "It is still a good try; this is your first blurb" (Maria).

The lesson was over; the computers were not turned off, which indicated that they might be used again that day.

6.1.3   Commentary

6.1.3.1   Teaching practices and learning experiences

As described by Kate, the lesson was an introduction to a series of interdisciplinary learning activities with a focus on primary literacy, which was "making an advertisement poster about a book, writing a blurb and trying to sell it to somebody". The workstations provided students with choices, and having different activities was an opportunity to cater for learner diversity, which is "the best thing about teaching" (Maria). The workstations offered activities that accommodated different learning styles, multiple intelligences, and different ability levels, however, there was no clear manifestation of catering for different socio-cultural backgrounds. Students were actively engaged in the learning experiences and had a number of different roles and performed associated tasks. The roles included reader, writer, computer operator, peer-tutor, publisher, artist and presenter.

Although students were sitting in groups around the desks, they were working individually on their tasks. Nevertheless they found a number of spontaneous opportunities to communicate with each other, to help each other. Students working in the

Technology Boxes also engaged in spontaneous social interaction, information-exchange and peer-teaching even though collaboration was not inherent in the task.

Kate and Maria used a number of good teaching practices and pedagogical approaches. They collaboratively designed the learning experiences, gave instructions to students, monitored task progression, provided feedback and managed student movement between workstations. The teachers seemed to be operating in the background as facilitators of learning for most of the time. They walked around the workstations and responded to students' questions and requests. There was much more interaction than intervention. Kate and Maria appeared to be very comfortable with the presence of the parents in the classroom, who successfully collaborated with the teachers to facilitate the learning process. Kate and Maria appeared to be very capable of organising and guiding student learning and preferred teaching situations that allowed interaction and discussion among students.

With regards to learning experiences, students were provided with opportunities to join a teacher-led whole-class discussion at the beginning of the lesson prior to moving to the four workstations that offered students a variety of learning activities in order to extend their literacy skills. From a discipline–based learning perspective of the English Domain (VCAA, 2005), students operated at level 2 and 3 of the Victorian Essential Learning Standards (VELS). At Workstations 1, 2 and 3 students worked with text in spoken, written and electronic forms. This included reading, writing, speaking, listening, understanding as well as creating text in print and electronically. Reading strategies included: reading stories and blurbs, looking for key words and content, consulting a dictionary, interpreting ideas, understanding the plot and identifying key characters. Strategies for writing included: practising handwriting, planning, composing text, checking and self-correcting, editing, using word processing and graphics, and publishing. At Workstation 4 students engaged in creative, hands-on experiences within the Arts domain that involved creating and making the characters of stories. This activity engaged students in working and experimenting with different materials such as paper, fabric, strings, pegs, etc. The arts activity helped extend students' imagination as well as their aesthetic and kinaesthetic abilities and skills.

The lesson concluded with students reporting on their learning. This provided them with an opportunity to develop their speaking and listening skills further by communicating their ideas and thoughts with an audience, and by practising presentation

192

and storytelling. Unfortunately the emphasis of student presentations was more on the product rather than the process, which provided limited opportunities for meta-cognition and evaluation of learning.

6.1.3.2   The learning environment

The analysis of the learning environment was facilitated by Jonassen's model of constructivist learning environments (Jonassen, 2001) presented in Appendix J (p. 323). Apart from the eight attributes of constructivist learning environments the observations also looked at the inclusive nature of the learning environment designed by the teachers.

The learning environment in Kate and Maria's classroom was active and manipulative as students were provided with tasks that required active engagement and a lot of hands on activities. As described by the teachers, the tasks were part of a larger project the aim of which was "making an advertisement poster about a book, by writing a blurb and trying to sell it to somebody" (Kate), which to an extent demonstrated the intentional, constructive, and contextual nature of learning environment. Despite having workstations set up for group work, collaboration and conversation were not inherent in the activities designed by the teachers. Students worked on individual tasks and only spontaneously interacted with each other. Student reflection on learning focused on the product rather than the process.

The teachers' intention to create an inclusive environment catering for different learning styles (Kolb, 1984; Kolb, Boyatzis, & Mainemelis, 2001), multiple intelligences (Gardner, 1993), and a range of ability levels was successfully realised. However, there appeared to be a lack of cultural responsiveness, as teachers did not use this excellent opportunity to mobilise the power of literature and/or other artefacts for making connections with cultures represented by their students.

6.1.3.3   The role of ICT in facilitating student learning

The role of ICT during the described lesson was limited. Computers were used only for word processing and for manipulating simple graphics in WordArt. Word processing included typing up handwritten text, checking for spelling, self-correcting proof-reading and editing. Students took turns in using the eight networked PCs and the two teacher laptops to type up their stories and blurbs using MS Word. The stories were printed out using a HP LaserJet, located in the hallway in front of the classroom. Typing up

193

handwritten stories and blurbs did not seem to be an engaging activity, hence students were more excited about the visual presentation of their work eagerly experimenting with WordArt, an inbuilt feature of Microsoft Word.

While working on the computers opened up opportunities for spontaneous communication amongst peers, it did not seem to facilitate interactions between students and teachers. The teachers occasionally walked by the Technology Boxes and did not spend longer periods of time with individuals or groups of students to engage in conversations about the use of computers for accomplishing the task. As described in the case, teachers intervened only when it became obvious that limited time and access to hardware might have prevented students from completing their work, which in this case meant typing up their stories and blurbs for them. Later in the interviews the teachers insisted that this was not their usual practice with ICT.

In Maria's opinion the purpose of integrating ICT in this lesson was "basically using their [students] knowledge to print out the paper". It provided students with an opportunity to use their computer skills to "learn how to enlarge writing, how to use different fonts, how to centre the words, how to change, highlight, italic..." Maria also believed that ICT made student work more presentable: "you write an essay by hand, you type it up after, I mean, it's a different feel ... it looks fantastic!" She also argued that students "pick up on their punctuation a lot better" when using a computer:

> Because they see it... they've also got the spell check which underlines it. ...That makes them more aware of Ok, this is what's wrong there, so it's up to them to change it afterwards...and try and fix the spelling or any error before we get to it. (Maria)

Even though computers were integrated in the learning experiences, their use was almost tokenistic. The eight computers in the joint classroom were used to support traditional literacy practices. According to the VELS Level 3 guidelines on Information and Communication Technology, word processing was used to increase the "attractiveness and accuracy of their information products" (VCAA, 2005), to identify typographical errors and improve their proof-reading, self-correcting and editing skills. There was an emphasis on presentation skills, and it appeared that the potential of the learning activities to be a vehicle for innovative and creative use of digital media to support literacy practices such as locating and retrieving online information, visualising

thinking strategies or communicating ideas online were not explored. Although trouble-shooting for technical glitches provided excellent opportunities for problem-solving and social interaction, these opportunities were unforeseen and unnoticed by the teachers, making higher-order thinking and collaboration amongst peers a by-product rather than an important part of learning.

6.1.3.4   Teachers' ICT literacy

The classroom observations indicate that the strongest aspect of teachers' ICT literacy was: Operational Understanding and Application of ICT (Dimension 1), with a special emphasis on demonstrating skill in the use of common computer software (C3), in this particular case, word processing. With regards to Dimension 2: ICT-rich Pedagogies and Learning Environments, the emphasis appeared to be on ensuring that students develop competence and confidence in using ICT (C20), however, there was little evidence of nurturing critical awareness related to the use of ICT. The observations did not provide evidence about Dimension 3 (Professional Learning and Engagement with ICT), or Dimension 4 (The Social Ecology of Living and Learning with ICT) of teachers' ICT literacy. Some of these aspects were revealed during the interview and are discussed in the next section.

6.1.4   Teacher reflections

6.1.4.1   The importance of ICT for student learning

Kate and Maria believe that using ICT in the classroom is very important for student learning in the 21st century. In Kate's opinion the world around us is digital and "technology has become a part of our life", and students "should always be exposed to it". Kate believes that empowering students with ICT skills will improve their chances for employment and would better position them in the society. In her opinion the best thing teachers could do is "showing children how to use technology".

Kate and Maria take their students to the computer laboratory once a week, where "Kate teaches them to gain skills in using programs such as Microsoft Word, PowerPoint. They also do a lot of Internet research for their projects." (Maria). In the classroom, computer use "is mostly related to learning experiences, catching up with their work" (Kate), but students also have the time to experiment and explore technology that offers them more opportunities for learning. In Maria's opinion, it is important to provide

students with hands on experiences, and use the school resources, because as she puts it: "…that's what we are here for."

Even though both teachers use ICT across the curriculum, one of their main focuses is literacy: "A special timetable is set up for students that allows them to have half an hour each for themselves e.g. for publishing stories" (Kate). They also use computers for developing students' numeracy skills. Students have access to software packages via the Intranet, however in the teachers' opinion these applications are not catering for all ability levels. Mathematics is considered by both teachers to be an area for improvement. Kate argues that there is a need for a whole-school approach targeting middle years: grades 3 and 4, when thinking about the integration of ICT in learning and teaching numeracy.

Maria asserts that although students have time for themselves to explore ICT, "they are not allowed just to play games" (Maria). The work they do on computers is mainly classroom related and often involves catching up on activities especially story publishing. Kate also explains that each student has a 'special computer folder' where printed stories are collated and which shows the pattern of how students have developed their writing skills.

According to Maria, presentation (using Microsoft PowerPoint) is a "big thing" that motivates students: "The kids are much more proud of their work that is neater. They change the font, they can do so many creative things with their writing, and make a book presentable" (Maria). Kate agrees and thinks that presentation software provides students with "more enthusiasm, because they don't have to actually use paper and pen, it's actually pushing buttons, and deleting anytime they like" (Kate).

Both teachers argue that the Internet has opened up new perspectives on communication. The Internet provides access to email that allows teachers and students to communicate and share a lot quicker at no personal cost. Apart from facilitating communication, the Internet is a gateway to vast resources of information: "Instead of going to a library and try[ing] to read or look up a book, and somebody has borrowed it, it's not there…It's having access to the whole world basically" (Maria).

6.1.4.2 *Pedagogical and cultural shifts*

In Kate and Maria's opinion there have been considerable changes to the role of the teacher since they started using computers in the classroom. Students have more control over their learning and more ownership over the outcomes of the learning process. In

general, students have more responsibility. The role of the teacher is changing: "We role-model, we're still the teacher, although we don't like having that authoritarian role of... you know, I'm the teacher" (Kate).

Maria thinks her teaching used to be more teacher-directed. With ICT things have changed:

> I think it was more pen and paper and more blackboard and 'get out your book'. Now, it's 'Ok let's investigate', so there is a lot of investigating that happens. And it happens through the computer because, because we do have it as a tool now. (Maria)

Maria frequently uses PowerPoint presentations in her teaching. In her opinion it caters for different learning styles: "The kids love it, yeah, it allows the kids, who are more visual to be able to have a go, to be able to challenge themselves."

Learning with ICT has also influenced classroom relationships. As some students bring expertise from outside the school peer teaching becomes a very common practice: "...kids do learn sometimes really well from each other, sometimes better than the teacher" (Maria). Expertise of individual students in specific areas including ICT is recognised both by teachers and peers. The teachers have formally recognised students with advanced skills and knowledge in ICT. These students are called ICT technicians and their role is to assist their peers in ICT–related tasks.

With ICT, learning leaves traditional concepts of time and space. Student learning and collaboration goes beyond the classroom walls. Kate and Maria are open to such changes: "in the class, they won't have enough room, they may be friends outside the school, so they can show [things related to the use of ICT] to each other outside the school on a weekend" (Kate).

Kate believes ICT, especially the Internet with its resources and discussion forums, provides great support for teachers:

> It has made my teaching easier to a sense that I have a lot more resources... It's the World Wide Web, [the] Internet. You have your own teachers' forum, where you can get lots of information. Basically I use it for information gathering and planning. (Kate)

According to the teachers, access to information is also quicker, more convenient and more exciting:

> We don't stand there and say: "Right, go to your local library and do this." Now it's a general thing of 'Jump on the net and search, because you have everything, nearly everything on the world is on it. (Kate)

With ICT students not only have more resources but also have the opportunity to explore the boundaries of their own abilities: "they can go as far as they want… they can go further, so it's up to them how far they push themselves" (Maria).

Despite all the advantages of teaching and learning with ICT, Kate warns that teachers and parents should not forget the importance of real-life experiences for student learning: "Yeah, on the other hand you might say, but what about the real life experiences, you still got that, you still teach that as well, you still take them out to practicality.".

6.1.4.3   Barriers to successful integration of ICT

At Kookaburra Primary School limited access to ICT and technical difficulties prove to be major barriers to successful technology integration: "We have got four computers per classroom. This is in our room, so we've got basically four computers to accommodate 26 students" (Kate). To ensure equitable access Kate and Maria created a timetable to provide all students with equal opportunities of having hands-on experiences with technology. Although this seems to be working well, Maria believes that having more computers would make a real difference:

> …to be successful, you need every child to have a computer, just like teachers do now. They all have their own laptop, and teachers are using it and learning about it. The only way is hands on, and unless you've got your own computer... (Maria)

Maria drew on her own learning experience, remembering the difficulties faced when she started using computers:

> I mean when I first learnt computers, I would go to people and they would be saying: "Ok, got to be this and this." They won't let me actually do it. I could never remember. I used to write it down. If I missed a step it would not work for

me. And then I started telling people: "Show me ... show me, I'll press the key."
(Maria)

However, access was not the only obstacle encountered by the teachers. Technical difficulties and teachers' lack of functional and operational understanding often triggers feelings of helplessness and anxiety when something goes wrong. Some of the most common technical difficulties seem to be those linked to networks: "...the problem there which we mainly and always come across is, if the network's down ... and I'm thinking: Oh, my God what do we do now?" (Maria). At Kookaburra Primary there is no just-in-time technical support available to assist teachers and students with such glitches. The technician comes in two days per week. Teachers have to register their ICT-related problems in a logbook:

> There is a logbook that we place it [technical glitch] in, and it may take two weeks [for the problem to be solved] - and two weeks is a lot of time wasting for the children. They miss out on opportunities and not knowing so much about computers the both of us, it makes it more difficult ... getting them [computers] working ... You can't pull out another teacher from another grade, 'cause it's wasting their teaching time, so it makes it more difficult. That's a big problem that we have. (Maria)

6.1.4.4   Catalysts for successful integration of ICT

One of the things that made a real difference to teachers' use of ICT was the initiative of the Victorian Department of Education and Training to provide school teachers with laptop computers. Laptops also helped them become more familiar with ICT:

> Before I knew nothing with these computers. Since having it at home, and having the time (because you never have time at school), I've just learnt so much, and I'm very proud of myself, of what I have learnt, because I was very, very computer illiterate. I was a one-finger, where's-the-A, where's-the-B. (Maria)

Maria says having a laptop is very different from having access to a desktop computer at school. Laptops provide flexibility in time and space and convenience, since teachers have no time at school to experiment with technology:

It's very convenient. You carry it with you, instead of having (I mean if we were) to be allocated a desktop besides one of the kids'...then it would be less convenient, because we would have to come back to classroom every time. (Maria)

She believes that access to hardware and software, time, practice and collaboration help teachers learn about technology a lot faster and help them build the skills they need to improve their professional practices with ICT:

It's practice, basically knowing that you've got an undo button, you can undo anything you've done. Getting a program, like I've recently got a touch-typing course, 'cause I'm still a two finger-typist. But ... getting it, seeing it, putting the program on, and actually having a go. So you know - better than sitting at home. I've got the time there; I haven't got the time here at school to learn. I see a lot of things with Kate, Kate has taught me a lot as well. It has been great working with her. (Maria)

Since having laptops Kate and Maria have used computers for administrative purposes, planning, assessment and evaluation. They both think technology just makes it easier, clearer and neater. It is easy to change, delete, modify. "All my evaluation is on there, my work programme everything, everything I do is on there...Everything I've got is on my laptop. If I was to lose my laptop, I think I'd be devastated" (Maria).

Teacher learning and professional development related to ICT is supported by the school leadership at Kookaburra primary school. According to Kate, there is an ICT committee working at school that regularly informs teachers about in-school and out-of-school professional development that teachers can attend according to their interests. Kate was a member of the ICT committee last year. Apart from these more formal approaches to professional development, teachers often take the opportunity to share good practices with ICT and mentor each other. According to Kate, sometimes a colleague "will come up with what they've done, they'll get a projector ready and we will all go" (Kate). "Teachers are very good like that here. They are happy to give you time, as long as you can find the time to get together, they are happy to share and teach you", Maria adds.

When it comes to out-of school professional development, teachers are offered opportunities at staff meetings to attend seminars, workshops, presentations, etc, which they can choose from:

I just went to one last week, last Thursday night. It's a software program called Kahootz, which is a brand new program, and it was just phenomenal! I can't wait until I get it onto my laptop... I cannot wait to have these kids onto that program. It is just fantastic. We constantly get ICTs [professional development seminars] I've been to many, many, that was just the latest on I've just been to. (Kate)

Maria laughs as she reveals her latest self-directed professional development activity with ICT: "And my latest one was just teaching myself touch-typing" (Maria).

Amid the ever-changing landscape of technological advances, Kate and Maria are aware that learning with ICT is a never-ending journey. Both teachers have their focus on up-skilling themselves in the use of software applications so that they can teach those skills to their students. Maria would like to learn about making movies with her students:

I've still got a lot to learn, and obviously there are a lot of new programs that come out. A lot of them, a lot of the movie making ones, which would be great to incorporate into your classroom. And I was getting one this year I might look into that. I am still improving my touch-typing (laugh). (Maria)

While feeling competent about using new technologies in the classroom, Kate admits she also has further plans to improve her teaching with ICT: "Although Maria is saying I am very good at everything (laugh), I've got a lot to learn. To attend software programs and [to learn] how to actually implement it, teach it with kids" (Kate).

6.2 Integrating ICT in learning about Australian history

6.2.1 School context

Gina and Joanne are primary school teachers in Platypus Primary School. The school's well-established culture of learning and teaching with ICT is summarised by the school motto, hanging on the staffroom wall: Looking forward, staying ahead. Students and teachers are provided not only with state of the art ICT infrastructure, but also with high quality technical support as well as numerous opportunities for professional and personal growth. The school has two computer laboratories. One is a well-resourced multimedia lab, the other is a standard computer lab located in the school library. The library offers

201

students and staff access to laptops that can be borrowed at all times. There are four to five computers in each classroom and each teacher is provided with a laptop.

Platypus Primary School has developed sophisticated structures for supporting learning and teaching with ICT. It has an ICT manager who takes leadership in establishing a culture of technology-rich practices within the school. These new practices are based on collaboration, collegiality, and connectedness with the community. The ICT manager coordinates the work of technicians and works closely with teachers and students to ensure that there are no interruptions to the learning process.

Effective ICT integration is supported by a whole school approach to developing the knowledge and skills of both staff and students. In order to support effective mobilisation of student expertise, the school runs a professional development programme for students, the Mentors in Computer Education (MICE) Programme. MICE is a project that empowers students with ICT skills so that they can participate in the facilitation of learning by mentoring other students, peer-teaching and co-teaching with their teachers. It is the ICT manager who prepares the MICE students for working with their peers and teachers.

In the year of data collection for this project the school had taken an integrated approach to teaching and learning with ICT. Instead of being a School Charter priority on its own, as it had been in the past, ICT were integrated with two current School Charter priorities: Mathematics and English, essential elements of student learning. This indicated a shift from a technological perspective to integrated and more authentic approaches of teaching and learning with ICT.

Teacher professional development is a high priority at Platypus Primary. Professional Learning Teams of teachers facilitate teacher collaboration in order to promote successful integration of ICT in learning and teaching. They provide teachers with opportunities to share ideas and learn from each other in the more intimate and comfortable environment of smaller groups referred to as Professional Learning Teams. Working in smaller teams within the school environment reduces some of the pressures and counter-balances anxiety and information overload. It encourages teachers to learn at their own pace and go beyond their comfort zone without experiencing significant levels of frustration.

As well as the readily available professional learning opportunities within the school, the leadership provides teachers with a wide range of opportunities to participate in out-

of-school professional development. Teachers eagerly take advantage of these opportunities. In fact this is how the researcher met Gina and Joanne, two primary school teachers committed to transforming their practices in order to improve student learning. Both teachers participated in an out-of–school professional learning programme organised by the Victorian Department of Education and a local university. The aim of the professional learning programme was to provide support to schools and teachers committed to student-centred learning.

6.2.2   Case of practice

Gina, the classroom teacher invited the researcher to observe how ICT were used to support learning in an integrated history project in a grade 5/6 class at Platypus Primary School. The aim of the project was to take students through the process of creating an illustrated storybook about an Australian historical personality or an historical event. Students were working in pairs to achieve this aim. The lesson was held in the computer laboratory adjacent to the school library. There were eighteen Pentium III PCs, each equipped with microphones, headphones, and LCD screens. The laboratory also had a flatbed scanner and a printer. All computers were networked and had a filtered access to the Internet. Through the Local Area Network (LAN) students could browse the electronic database of the school library called Spectrum that enabled them to locate books and other resources for this eight-week long integrated unit in History. The task during this lesson was to perform research and collect data using multiple resources, such as books, search engines and the electronic database of the school library. Students also had to take on-screen notes and save them using simple word processing tools. Gina emphasised the importance of placing events and characters into historic contexts taking into account time, culture and setting. She also encouraged students to search for visual data that could help them illustrate the context and make the storybook more interesting. There was a strong emphasis on understanding issues related to intellectual property and plagiarism. Gina told her students that they needed to make sure to present the information in their own words rather than engage in cutting and pasting online text, which is considered to be plagiarism. She also reminded students to keep their audience in mind, who were also students of their own age.

During the lesson, students were taking turns in looking for information. They were searching the Internet, and at the same time they were exploring books related to their topic by looking up resources from the online library catalogue. Some students were

working on creative solutions such as designing the cover page of the book using paper and coloured pencils and then digitising the image by scanning. Others would simply scan the title pages of books for future reference as suggested by the teacher. All students appeared to be very efficient in searching for and retrieving information, saving and managing data. A lot of peer tutoring was happening in the classroom. Students were helping each other with finding information, scanning documents as well as with saving data and creating files. The teacher was walking around assisting students with their questions and tasks. Although she appeared to be very confident in using ICT, she never solved the problems students encountered. Instead she scaffolded problem-solving by asking a lot of questions and encouraging students to look for alternative solutions and learn new skills.

Towards the end of the lesson problems arose with the network connection. The ICT manager arrived to inform the teacher and the students that the Internet was intermittently on and off. She wanted to see if they required any help. Although this technical problem created a bit of an inconvenience for students they all managed to complete their tasks. Gina reiterated the importance of avoiding plagiarism by reminding her students once again that they needed to make sure that what they had written was all their writing, using their own vocabulary. At the end of the lesson Gina instructed her students to save their work. She also encouraged students to reflect on their own learning by asking the following questions:

- What did you use?
- Where did you go?
- What did you found out?
- What application did you use to save your data?

6.2.3 *Commentary*

6.2.3.1 *Teaching practices and learning experiences*

The aim of the integrated history project spanning over eight weeks was to provide students with an interdisciplinary learning experience by creating an illustrated book about an Australian historical event or personality. The project was comprised of several stages which included project design, information gathering, problem-solving, reading and interpreting multi-media texts, historical or factual writing and talking to people from

the community. Students appeared to be very excited about the project and were engaged in the learning process throughout the lesson. They worked in pairs, or as the teacher said, in partnerships to accomplish the task. Collaboration was inherent in the task prompting negotiation, collaborative decision making and consensus seeking. Similarly to their peers from Kookaburra primary school, students took several different roles. They became designers, researchers, note-takers, writers, readers and artists. Their roles and the associated tasks demanded a competent use of ICT which played a significant role in facilitating student learning.

Gina, the teacher implemented a variety of teaching practices and pedagogical approaches to integrate ICT during this lesson. She was scaffolding, coaching and modelling the enquiry process by supporting interaction and collaboration among students. The teaching practices utilised and encouraged experimentation, exploration, collaboration and creativity by students. The learning experiences included project design, multimodal research, reading, interpreting, classifying and evaluating information, critical thinking, transforming texts and images from print to electronic form (e.g. digitising handwritten or printed text and hand-made images), sharing information, expressing views and opinions and demonstrating literacy skills through the task of transforming information and raw data into a narrative.

This integrated task included several domains identified by VELS (VCAA, 2005) for grades 5 and 6. These domains included History, Civics and Citizenship, English, the Arts, and ICT. From a discipline-specific point of view, according to VELS standards and progression points for History for grades 5 and 6, the teacher engaged students in learning experiences aimed to develop knowledge and understanding of significant events in Australia, and fostered the acknowledgment of individuals that had shaped Australian history and culture. Students were expected to develop the ability of historical reasoning and interpretation by designing their own inquiry, questioning primary and secondary sources of historical information, understanding historical language and concepts, customs of daily life, and cultural and religious contexts. They were also required to showcase their literacy skills and artistic abilities by using text and images to document their research, evaluate information and evidence, and provide a compelling narrative to an audience. From a civics and citizenship perspective students also developed their understanding about various cultural groups and their contribution to the Australian society.

With ICT being an integral part of the described learning experiences, Gina found it important to raise student awareness about the socio-cultural and ethical aspects and conventions of ICT-aided research, including issues related to copyright, authorship, and intellectual property. She clearly articulated the need for ethical conduct when using information available on the World Wide Web and scaffolded students' learning about the transformation of online information into a narrative. She also discussed with her students criteria related to writing for different audiences, in this case for an audience of their own age.

Gina's communication strategy involved asking open-ended questions and using verbs corresponding to different levels of cognitive engagement according to Bloom's Cognitive Domain (Bloom, 1956). The focus appeared to be on application (do, use, need, apply, solve), comprehension (describe, explain), analysis (organise, compare), synthesis (construct, design, create) and evaluation (judge, evaluate, select). Her teaching practices demonstrated a shift from outcome-oriented instruction towards the facilitation of student-shaped exploration and enquiry. Gina encouraged students to consciously focus on their needs and adjust the process of learning accordingly, which again illustrates an innovative dimension of pedagogy: self-regulatory learning (Boekaerts, 1995). With regards to the non-verbal dimension of interaction, she used a lot of positive body language such as smile, posture, authoritative but warm tone of voice that communicated support, provided positive reinforcement and acknowledgement. She established a warm and friendly atmosphere in the classroom, where students were encouraged to take ownership of the learning process, by making choices and decisions related to the task, evaluating their progress and reflecting on their own learning.

Overall, the practices utilised by Gina seemed to be embedded in constructivist principles (Duffy & Jonassen, 1992; Jonassen, 2004) where the teacher's role was to scaffold the learning (Bruner, 1986), problematise knowledge, recognise the relativity of a personal view, acknowledge and use student expertise, and support self-managed learning by making students aware of their own needs and aspirations. The pedagogical approaches implemented were responsive to student diversity, addressing different learning styles (Kolb, 1984), multiple intelligences (Gardner, 1993), diverse ability levels and cultural backgrounds.

6.2.3.2 The learning environment

The learning environment created by the teacher mirrored constructivist values and principles (Jonassen, 2001). There was strong emphasis on contextualisation of the learning, based on existing personal experiences, knowledge, needs and interests of the learners. The authentic inquiry provided students with tasks of real-world relevance that required sustained investigation, collaboration, interdisciplinary perspective and metacognition (Lombardi, 2007).

The teacher and the learners operated in a social and conversational setting. Collaboration was inherent in the task and the learning. The culture of communicating and working together nurtured the development of personal perspectives, multiple solutions and creativity, which indicates that the teacher consciously planned for providing the learners with an inclusive environment. She promoted metacognition and self-regulated learning by encouraging students to assess their own needs, think about thinking and monitor their learning.

6.2.3.3 The role of ICT in facilitating student learning

The role of ICT was to provide students with a platform for multimodal research and exploration, for accessing, retrieving and recording information, and for the construction and publication of a storybook. Students used a variety of resources to assist their inquiry, which included the Internet, the electronic database of the school library, books, magazines and other artefacts. ICT were used to digitise handwritten text and handmade artefacts such as students' drawings that would be later used as illustrations or cover pages for the storybook.

ICT were seamlessly integrated into student learning throughout the lesson. Apart from encouraging students to apply and expand their ICT skills and knowledge of effective use of Internet browsers, search engines, data management techniques such as downloading, saving information, and managing files. Gina assigned a complex role to ICT to support new learning. During the lesson ICT were used to provide information and assist in the development of collaborative and organisational skills, creativity, problem-solving, critical thinking skills as well as values and attitudes; all embedded in complex, real-world contexts. Students were using ICT to search the Internet, evaluate and download relevant information, merge human creativity with the advantages of contemporary technological solutions, and transpose literacies by transforming drawings,

207

written or printed text and printed images into digital format. During this lesson ICT were not the purpose of learning. It was used to serve a purpose: deep learning about an Australian historical event or personality.

6.2.3.4   Teacher's ICT literacy

Gina demonstrated confidence and competence in Dimensions 1, 2, and 4 of teachers' ICT literacy. With regards to Dimension 1 she displayed a sound operational understanding and application of ICT, by modelling and scaffolding effective uses of the ICT equipment available in the lab. She presented professional judgment in the selection of common computer software and hardware appropriate to the learning task, and demonstrated use of network resources for research purposes. She also demonstrated a high level of competence related to Dimension 2, by using ICT to facilitate integrated approaches to teaching and learning, scaffolding student inquiry and problem-solving, responding to the diverse interests of the learners, and ensuring, that students developed competence, confidence and critical awareness in using ICT. As for Dimension 4, the teacher presented a commitment to developing a culture of ICT-aided research that is based on ethical conduct and critical evaluation, thus demonstrating an informed perspective related to the social ecology of living and learning with ICT. She was also using ICT for her own professional learning (Dimension 3) which is further explored in the following section.

6.2.4   Teacher reflections

6.2.4.1   The importance of integrating ICT into student learning

In Gina's opinion being ICT literate and being able to integrate ICT successfully into teaching and learning are essential features of contemporary teacher professionalism. However, she considers ICT as a "component of multiliteracies, a vehicle, a tool for communicating and learning." Gina has been participating in a professional development network during the year that had reinforced her thinking and extended her understanding of multiliteracies: "I see ICT as more than computer, as digital photography, as a whole live medium... I really think it is a powerful instrument in canvassing their learning." Gina uses ICT with her students for conducting research, recording what they have learnt, for finding out new ways of doing things, for communicating with others and for doing "global exploration" (Gina). She believes that although ICT is quite an important tool for

learning, "we should not ignore what's been in the past, and should not discount books, discount magazines and things like that."

Gina has strong values related to the socio-cultural and ethical issues around the use of ICT:

> I think it's such an integral part of using the resources of ICT these days, because they are so much out there....it's not all free, even though it's out there and you can access it, there is still that element of copyright and plagiarism, so we certainly put that into our kids and tell them that they just can't copy. (Gina)

According to Gina, access to hardware and software is not an issue at Platypus Primary School. ICT is used most of the time to suit the process of learning and to respond to the needs of the learners. "I don't have an issue with equality of use or equity of use because we have so many opportunities in this school during the week...some might need it this week, some might not use it this week." There is no set schedule for students when it comes to the use of ICT. According to Gina:

> It is not a timetable thing. I don't timetable kids and say: "You have to have 40 minutes of ICT." It is far more valuable in my eyes. In my opinion ICT is used as it is needed by students. (Gina)

Being surrounded by an ICT–rich environment, Gina's students seem to be very comfortable with ICT. They are also confident in using the corresponding vocabulary. "I don't think there is any point in babying them down. I think they need to be exposed to it...No beating around the bush." Having students learning about and with ICT seems to be something parents are looking for when enrolling students into Platypus Primary School. According to Gina, "It is the expectation from us, that they can do this." She argues that students, just like teachers, come to the school with different levels of ICT literacy:

> They come with different levels of ability... and the teachers are the same. We have different levels of competence and comfort and ability to use ICT. Myself personally I'm not afraid of it, I like the challenge of using it, I like playing with it so I can develop my own confidence and then help the kids to develop their own levels of confidence. (Gina)

Her attitude has been well demonstrated in the classroom as Gina successfully builds on student expertise and available technical support in order to seamlessly integrate ICT into the learning experiences.

6.2.4.2 Pedagogical and cultural shifts

According to Gina, roles and relationships are changing in the classroom as students are sometimes more confident users of ICT than teachers. She sees a potential for professional growth in this. Gina argues that "students bring a lot more of the expertise in the area of ICT, they are so much more immersed in it, and I think, as a teacher you have potential to grow." Although she is a confident user of ICT, at times she is ready to take up the role of the learner and learn from the students.

> I often say to the kids: "Well, yeah, you showed me - that's great." And I think if you stay open to the learning, basically they stay open to the learning as well and they feel a sense of achievement and comfort, and leadership too, that they have this knowledge that they can share with you, it's a two way street, I think the relationship has changed... (Gina)

And Gina is open to such changes: "I have no issues whatsoever, quite comfortable in being vulnerable, and saying to the kids, I don't understand this, you show me or let's work together." Gina is not alone in her efforts, as the school recognises and facilitates the two-way learning by running the MICE programme that prepares students experienced or interested in ICT, to take up leadership roles in teaching and learning with ICT.

On the other hand, she believes that changes to learning and teaching have not all occurred as a result of ICT. In her opinion the explosion of knowledge and the transitions in teaching philosophies contributed to transitions in roles that resulted in students taking more responsibility for their learning. However, she believes that ICT makes learning more exciting and meaningful:

> So it's going out, and looking out and looking at different ways of communicating and learning. But I think it [ICT] has opened up a fair bit of freedom and creativity in a way that people are involved, and ... things are not so much in boxes any more, ... I think the learning is far more meaningful. (Gina)

With regards to her future plans for facilitating student learning with ICT, Gina would like to see it as "a component of multiliteracies":

> Again, I don't want ICT to become the only tool. I think sometimes there is more emphasis on ICT than everything else. I think it is part of the natural integrated process... In an ideal classroom it would be good to have access to all of that things, all time, ...uhm..., that is Utopia, if we had all the money possible to buy all the latest hardware, all the latest software, and that is an Utopia, I mean that will not necessarily be. (Gina)

6.2.4.3   Barriers to successful integration of ICT

Although having access to state-of-the-art technology at school is important, in Gina's opinion successful ICT integration is not all about access to software and hardware. There are a few things that hinder this process. She brings attention to two major factors: technical difficulties mostly related to unstable networks (a problem that also affected student learning described in this case), as well as time. According to Gina, traditional timetables interfere with new learning:

> ...what happens with research - you'd like a bit more time. Once you start getting into it, you'd like to not stop and start. But because of the timetable session of an hour, the children are restrained by time. Say, it was back in the classroom, and the computers could be used quite independently, the students could come and go as needed... We've tried to allow that in our planning that they have two or three weeks to ... do their collective research. (Gina)

6.2.4.4   Catalysts for successful integration of ICT

In Gina's opinion successful integration of ICT in teaching and learning requires a holistic approach that is supported by the school community as a whole:

> You need to embrace it, you need to include it as a part of the package of learning and I just think if we keep ourselves open as a school and as a community. The kids will have more opportunities, and we certainly have best intents in driving vision and principalship. And I think our management is very, very well on the ball in terms of the new technology, new software, new ideas... (Gina)

In fact it is that holistic approach that successfully facilitates effective practices with ICT at Platypus Primary School. Teachers at the school can pursue a number of avenues for building their competence and confidence in integrating ICT with their pedagogical practices. However, Gina argues that teachers' competence and confidence in teaching and learning with ICT vary: "Here with the staff we have the extremes, those who work very comfortably, and those who are very nervous about it." Although there is a big focus on ICT as it is "underpinning all learning in this school", it is very important that integrating ICT is within the teachers' comfort zone:

> We PD among ourselves...and [the school] put on a PD for us... trying to keep us all moving forward, but it is in within your comfort zone. It's what you feel capable and comfortable with sticking up and running with it.So we have the extremes, and the lot of people in the middle who are very Ok with more common programs like Word and your PowerPoint and possibly Publisher. But there are those who are committed to looking into some of the other wider possibilities as well. (Gina)

In Gina's opinion teacher collaboration is vital for making safe transitions towards new pedagogies:

> ...you do not want children to see that the teacher does not feel comfortable, but you bring teachers together so you have that sort of scale on one end, and you have the other end of the scale. We have a support group, we have a fortnightly tutoring. (Gina)

The fortnightly meetings of Professional Learning Teams provide teachers with opportunities for collaboration and professional growth. The process of sharing ideas and practices becomes more fluent, since teachers "have a more intimate opportunity to share children's vision, choose a moderation of paths in use of ICT in a small forum so that people have [more of] a voice than maybe in more macro situation." The teams are usually facilitated by someone, who considers ICT being a vital part of student learning:

> There is always someone in this team that always goes back to carrying the ICT banner and remind you what you haven't thought about....Yeah, and they protect their pet love and ... and promote it so. (Gina)

Gina also emphasised that the culture of collaboration has always flourished at Platypus Primary School. ICT has only added a new dimension to it: "It becomes an addition, it becomes another way of collaborating, another communication, I think we always had a really good culture here of staff collegiality and co-operation."

Communication is a key factor in successful collaboration within the school and within the larger community. As a result of such thinking, the school has introduced communication with parents via email. Teachers send newsletters and emails to parents. Some parents have welcomed the novel means of communication, others are more reserved. Gina says there are strict regulations related to privacy which includes the publishing of student names and photos. In her opinion ICT has created a whole set of new issues related to the ethics and conventions of human interaction and communication: "As wonderful as it is as a vehicle it has created a whole new set of problems and of course the parents are very cautious." According to Gina, communication amongst staff is easier with ICT. In the morning when teachers arrive at school "everybody comes in throws their laptop... first thing you do when you hit your office is you look into Outlook and make sure that you read emails, what have been emailed, we all communicate very effectively using that."

Apart from communicating with each other and the broader community, teachers use ICT for planning as well. Most of them completed the Intel PD on using planners, but as Gina points out, they do not only look at custom options provided, but try to bring to it an innovative edge: "we look at not only using a tool to do our planning, and using it electronically... so we actually look in depth at what we can add to it". Sharing ideas and information is also easier with ICT:

> ...if someone had a really great article and a really great activity they want to
> do, we just pop it onto the email, or into the Intranet and people just go and pick
> it up, so it's a very collegial sharing process. (Gina)

Gina enjoys working in the supportive environment of Platypus Primary School that provides teachers with numerous opportunities for collaboration and professional growth:

> It's a fabulous place to work, it really is fabulous, I'm not only saying that, it's
> really fabulous. Our school level reports are very favourable in terms of our own
> colleagualism and professionalism <inaudible> in this school. Perhaps one thing
> that did reflect on them is stress level ... and when anyone can actually ask them

"Who has imposed this upon you?" Quite often it's ourselves, because we strive for excellence and we strive to do the best we possibly can. We are such an innovative staff ... that when you do look back, look at the mirror, you go: "Hang on! I imposed [this] on myself" (laugh).....If you are not learning you are not growing, I know it may sound a little corny but it's really, really true... As far as I am concerned you don't need to get up tomorrow morning if you are not prepared to learn something else, to find that something by the end of the day. (Gina)

6.3 Integrating ICT in learning mathematics

6.3.1 Case of practice

The mathematics lesson took place in a joint classroom of another group of grade 5and 6 students at Platypus Primary School. Students were learning about fractions. Joanne, the teacher utilised differentiated learning in order to cater for a variety of skill, ability and achievement levels (Tomlinson, 2003) . The ICT infrastructure in the classroom included three PCs in each half of the joint classroom. Joanne had her laptop operating on her desk. Only two of the computers available to students were used during the observed numeracy lesson. They were utilised to support student learning of a select group of students within a sophisticated integrated project called the Market Garden Challenge. The rest of the class including 20 other students participated in activities related to developing understanding and knowledge of fractions. ICT were not integrated into these activities. There was one student in the classroom who did not participate in the Maths activities, as he was having a focused session with the integration aide.

Joanne started this numeracy lesson with an activity using fraction cards. She selected eight volunteers to participate. Each student was given a card with a fraction written on it. Their task was to compare their fraction with other students' fractions, and, as a group create a line beginning with smallest fraction and finishing with the largest. Following the exercise Joanne reviewed with her students the concept of the denominator, after which she divided students into pairs to work collaboratively on a task with fraction cards. The task required students to present visually the fractions on a paper sheet by creating a diagram, and rank, fractions with different denominators from the smallest to the largest.

214

Some students seemed to have difficulties with understanding the task, but their peers spontaneously came to their desks and helped out.

Simultaneously a group of "gifted students" (Joanne's words) was working on an interesting collaborative project: the Market Garden Challenge. The Market Garden Challenge was an integrated history project, an important aspect of which was the understanding of the historical background of growing vegetables for the local community. The collaborative project, which included a focus on numeracy skills and basic Maths concepts:

- planning documents,
- creating an operational timeline for the vegetable growing season,
- creating a detailed list of expenses and income,
- estimating and recording profit and loss after selling the vegetables, and
- developing a plan or a model of the market garden.

The group was also responsible for sharing the task and managing the workload as presented in the project outline. This collaborative inquiry was designed to provide students with an authentic and meaningful experience of combining ICT and primary mathematics in order to model and solve real-world problems. The eight–week project involved managing a one hectare property. It included working with parents, experts and representatives of the School Leadership Team and the School Council. It was intriguing to note the complexity of the Market Garden Challenge. When asked about it Joanne thought students could explain best what they were doing so their input was sought for understanding.

The group of four students, Brad, Ram, Will and Marko, were working on different tasks. Brad and Ram were designing the visual presentation of the garden, the plan of which was previously developed in an Excel spreadsheet. Will was typing up the factual data that the group obtained by using multiple sources of information, such as listening and speaking to a parent presenter, finding corresponding articles in the local papers, and searching for relevant information on the Internet. Marko was calculating the anticipated expenses and income. He worked with a budget of $AU 5000. According to the task outline, he should have used Excel spreadsheets for this purpose, but he chose to write up his budget in MS Word. As Marko explained, students spent most of their time working

on individual tasks, but regularly came together for meetings in order to manage the project and track its development.

While these four students were working independently on the Market Garden Challenge project, the teacher spent time with each pair of students working with fractions, to see how they were proceeding with their task. By engaging in conversations and by scaffolding thinking and problem-solving Joanne helped students create graphic representations of fractions using area and linear models.

When asked about the criteria for differentiating the learning experiences the teacher indicated that activities were designed to cater for different ability levels. Ability levels were identified by students' test results. She said that the four identified "gifted students" were working on the Market Garden Challenge project. One of the students from the group put it this way: "We got this task because we are the smartest in the class" (Mark). One of the other boys quickly made a correction: "We are not the smartest but we are good at Maths and we need this challenge, we need something challenging otherwise we would be bored" (Will).

6.3.2 *Commentary*

6.3.2.1 *Teaching practices and learning experiences*

During this lesson the teacher engaged the students in differentiated tasks aimed at acquiring skills and knowledge in the domain of primary numeracy. Students were grouped according to their achievement levels and were assigned different tasks. The majority of the class was working on deepening their understanding and knowledge of fractions, while a small group identified as gifted by the teacher, worked on complex inquiry called the Market Garden Challenge.

Collaboration was part of each task designed by the teacher regardless of achievement levels. Apart from patterns of collaboration facilitated by the teacher, students were spontaneously interacting and assisting each other throughout the learning process.

The four gifted students eagerly engaged in the learning activities involved in the Market Garden Challenge, which promoted active learning strategies and higher-thinking, such as exploration, information gathering, construction, analyzing and drawing conclusions from data, electronic presentation of learning, and collaborative reflection. As market gardens were a significant part of the local heritage, the aim of the learning

experience was to extend students understanding of the local history and situate it within the Victorian and Australian context. Students were looking at how people and events shaped the local history of agriculture and trade.

This authentic learning task took learning and collaboration beyond the classroom walls, involving parents with expertise in agriculture, and experts from the school representing areas of leadership, management, and finance. The eight-week long project involved managing a one hectare property, with many challenges including calculating the area of irregular shapes, estimating the number of plants to be planted, working with timelines, keeping profit and loss statements, as well as employing workers and calculating their pay. Students and invited experts came together on a weekly basis to discuss issues. These weekly meetings would serve as reference points where students could discuss problems and ask questions from the invited experts. At the end of the eight weeks the project was to be presented to a panel from the school and their work would be assessed. The student work was guided by an assessment rubric so they knew what was expected from them. Their assessment against the learning outcomes based rubric would decide who would earn the right to participate in the Mathematics Talent Quest (MAV, 2005).

From the perspective of the current curriculum standards (VCAA, 2005), Mathematics domain for Level 4 (applicable to grades 5 and 6), the focus of student learning for the groups working with fractions was on numbers and structure: understanding the concept of denominator, comparison of fractions, graphic representations of simple ratios denoted by fractions, and recognition of equivalent rates expressed by fractions. As for students working on the Market Garden Challenge the VELS standards and progression points focused on numbers, space, measurement and use of mathematics in real situations, such as creating two-dimensional representations of the market garden, by using metric units for measuring length, width and surface area, and recognising the potential of mathematics for solving real-life problems by calculating anticipated expenses and income as well as profit and loss. According to VELS Level 4, students were required to work mathematically. The four students working on the Market Garden Challenge were expected to use technology for generating drawings of shapes and geometric designs, and use computers to investigate and implement algorithms. While technology was used to assist the design of the garden, there was no evidence to support the use of technology for implementing algorithms during this lesson.

217

Joanne, the teacher, used a variety of pedagogical approaches that represented a powerful shift in underlying teaching philosophies. There was no direct instruction during the observed numeracy class. Joanne provided her students with differentiated learning experiences that according to her professional judgment were appropriate to the students' ability levels and learning needs. She worked in the background organising the learning activities, juggling with the complexity of having to facilitate several groups of students working on different tasks. She scaffolded, and modelled the inquiry for students, monitored task progression, supported team-building and collaboration, and provided feedback on the learning. While these seemed to be effective strategies for student-centred learning, it appeared that the estimation of different ability levels were based on student achievement measured by outcome-oriented standards and criterion referenced measurement techniques such as tests and rubrics. Unfortunately given that these tools did not take into account student aspiration and motivation they may have resulted in unintentional exclusion of individual students from learning experiences that require higher-order thinking and complex problem-solving, which in turn has the potential to compromise student access to high status skills and knowledge (Apple, 2004b).

6.3.2.2   The learning environment

The learning environment created by Joanne had the characteristics of all the dimensions of constructivist learning (Jonassen, 2001). It involved active learning strategies described above. It was constructive as it built upon prior knowledge and experiences, and collaborative, as it required interaction for the completion of tasks, it was intentional and reflective, as learners had to provide a rationale for their solutions, and it was contextualised and authentic for the group of high achievers or gifted students working on a real-world problem called the Market Garden Challenge.

Given that the purpose of differentiated learning is to cater for different learning styles and ability levels and foster inclusion in communities of learners (Tomlinson, 1999) the learning environment did not appear to be inclusive of all learners. Although the teacher undoubtedly had the necessary pedagogical expertise and experience to make decisions about criteria for differentiated learning, her professional judgment in grouping students by achievement levels appeared to have unwittingly triggered exclusion. A solid body of research (Goos, Stillman, & Vale, 2007; Johnson & Johnson, 1999, 2005; Slavin, 1996; Webb, 1982; Zevenbergen, 2003) indicates that heterogeneous groups have numerous advantages over homogenous groups when it comes to student collaboration.

218

They not only promote inclusion but are more beneficial for inquiry-oriented tasks. However, Anthony and Walshaw's (2007) recent report on effective pedagogy in mathematics education supports the teacher's decision by arguing that homogenous groups in mathematics education work effectively in some educational circumstances such as interventions aiming to address particular learning needs and to provide targeted challenge within the classroom.

6.3.2.3   The role of ICT in facilitating student learning

ICT were available as learning resources for the highest achieving group of students during this lesson. It was used to facilitate data collection and information gathering as students were using the Internet to find answers to some of their project-related questions. According to Joanne, ICT were also used in several sessions preceding the lesson to prepare students for the tasks. Joanne with the help of the MICE experts taught her students how to use MS Excel and spreadsheets for calculation, construction, planning and design.

Although ICT appeared to be integrated seamlessly in the project as a whole, during the observed lesson it was used to facilitate the learning of only a limited number of students, raising questions about equitable access to ICT and ICT-rich learning experiences in the numeracy domain. An Internet browser and two generic software packages, MS Word and Excel, were used by students during the classroom observations, while the use of Excel for designing the market garden provided students with a new and challenging task, this possibility was not sufficiently harnessed. ICT appeared to be more add-on feature to traditional activities such as typing up notes and completing calculations. Tasks such as calculations of expenses and income that were previously planned to utilise MS Excel, were mostly typed up in MS Word without using Excel features to automate calculations and increase the efficacy of student work. As a consequence students did not develop or extend their skills in generating formulae in Excel syntax.

The potential of ICT to facilitate communication and collaboration was not harnessed either during this class, as students did not use email and did not create a virtual meeting space for themselves to communicate about their research. They chose to meet face-to-face in order to share their ideas and discuss their work. Consequently from the perspective of the Victorian Essential Learning Standards, Information and

Communications Technology, Level 4, ICT were utilised for collecting information, creating reports, saving and managing files, and to some extent for visualising thinking, but it has not been utilised to scaffold problem-solving or facilitate communication and collaboration amongst students.

While the contribution of ICT to this particular learning process seemed to be limited, data from teacher interview indicate that ICT had a respectable role in the project as a whole and was to some extent integrated into every stage of the inquiry. Findings also reflected Joanne's exceptional understanding of the potential of ICT for student learning, which for some reason did not translate into effective use of ICT during the observed lesson.

6.3.2.4   Teacher's ICT literacy

The classroom observations indicate that one of the dominant aspects of this teachers' ICT literacy was Dimension 2 with special emphasis on the following teacher capabilities:

- designing and integrating ICT-enhanced learning experiences (C8),
- applying ICT-enriched curricular activities to facilitate inquiry, problem-solving, critical thinking and knowledge construction (C13), and
- supporting inter-/multidisciplinary curricular activities with ICT (C15).

Other dimensions of teachers' ICT literacy could not be explicitly observed as the teacher was neither using technology, nor did she engage in "sustained shared thinking" (Siraj-Blatchford and Siraj-Blatchford, 2006) with students using technology. The post-observational interview confirmed that Dimension 2 of teachers' ICT literacy: ICT-rich pedagogies and learning environments appears to be Joanne's strength. Analysis of field data in this case also suggested a strong link between her teaching philosophy and teacher capabilities belonging to Dimension 2 of the framework for teachers' ICT literacy.

6.3.3   Teacher reflections

6.3.3.1   The importance of ICT for student learning

Joanne views ICT as a tool that students use with ease and confidence, since it is part of their natural learning process: "I see ... ICT as a tool that we use for the children to give them a range of experiences. ...We try where possible to integrate it as part of their

220

natural learning." Joanne believes that ICT is a powerful medium that can help cater for student diversity. In her opinion it provides opportunities for students with special needs to work "on an equal power with the others". At the same time it challenges those who have higher levels of aspiration:

> I have four identified gifted students in this class, and ICT offers a medium for them to really develop their creativity. To extend their knowledge, it's an area they are all particularly interested in, and something they are looking for. (Joanne)

Joanne also considers ICT an important medium to develop a broad spectrum of skills, such as social skills, academic and creative abilities. She works on finding a balance between developing technical skills and integrating ICT in authentic learning tasks:

> ...we may have a very focused session that is just looking at developing their knowledge and on their awareness of how to use a particular program of the ICT programs, so that then it can be integrated into the work that we do...(Joanne)

She acknowledges that students participating in the MICE programme contribute greatly to successful integration of ICT across the curriculum:

> ...and the MICE leadership programme, it's a valuable tool for that, because then they come back as support mechanism, they are teaching their classmates, so it's developing those relationships with them. It's teaching to be able to articulate what it is, what they need to do to assist the other students in the classroom. (Joanne)

Joanne argues that it is important to incorporate ICT in facilitating student learning, as ICT provides students with life skills, so that they don't feel overwhelmed later in life when interacting with new technologies.

In her opinion technology has opened up new ways for human communication that makes us part of a broader community. Joanne believes that we need "...to communicate with people in other countries, to communicate with students and schools, in other countries, and ICT provides that opportunity for them and the computers and the Internet provide that opportunity to do that." She is also aware of the potential of mobile devices for communication that include the exchange of text, sound, and video.

221

6.3.3.2 Pedagogical and cultural shifts

In Joanne's classroom ICT has also contributed to changes in roles and relationships: "Since technology has arrived ... I think our understanding of students has developed from when I started teaching. It was very much the role when the teacher was the person to instruct and to teach." She argues that:

> Nowadays, with the expertise of students and the knowledge of students, a lot of times the teacher's role is more to facilitate and to draw on the expertise of others, we can't be experts in all areas. And we need to be able to draw on the expertise that is around us. (Joanne)

The importance of drawing on the expertise of students that has been widely recognised by this School through organising a special programme for students interested or having advanced skills in areas of ICT:

> This is the MICE programme, which is a Mentors in Computer Education programme, that provides an opportunity for students who have a talent in a particular area. To have that talent explored further, and the expert's programme enables all children to have an opportunity to develop those leadership roles. And I think if you are encouraging students to take on those leadership roles it is really important to provide the opportunities for them to refine their skills in that area and give them opportunity to use them. (Joanne)

Joanne believes education is about learning from each other. The teacher's role in such a learning environment is to scaffold the learning experiences and student collaboration, as well as to question things and look for alternatives:

> Education, particularly in my classroom, and I think education in general, is a co-learning experience that we learn from each other, where the children feel confident to develop their leadership skills, where they feel confident to explore new understandings, and question things that are happening and to offer alternatives to them which is addressing their needs. More so that whereas we develop the scaffold... and the plan that we want to work with ... then to use their skills and expertise to work together, to actually developing those understandings. (Joanne)

Joanne willingly takes up the role of the learner when it comes to new and emerging technologies:

> From a pedagogical practice idea of co-learners I see myself as learning to use ICT and very fortunate here that we have some extremely... uhm ...exceptionally talented people in that area to work with us, to provide that guidance for us. So quite often I say to my students that I am learning this with you. And so that we can use and build on the skills and students are aware that some of the other students have greater knowledge in particular areas that I will learn from them. (Joanne)

As a teacher teaching with ICT, Joanne thinks ICT should not be thought as a separate subject, instead she believes that teachers need to understand how it can be used as a tool to support and facilitate learning. She integrates ICT into a variety of learning activities. She uses ICT as a tool not only for presentations and publishing, but for research and communication. Similarly to Gina, Joanne maintains a critically reflective approach in the use of electronic resources: "using it as a research tool, also having the children aware, that people can put information on the Internet but you need to be very aware of the authenticity of the information."

When it comes to ICT–aided communication, Joanne's future plans are focused on facilitating the communication of her students with other students and classes on a local and global scale. According to Joanne, this could provide students with authentic and real-world learning experiences and developing their understanding of their immediate and broader contexts, which is: "...making that link between what we are learning in the classroom and the world outside, so that they can see how the two fit together."

6.3.3.3 Barriers to successful integration of ICT

Some of the things that hinder Joanne's successful integration of technology are technical problems. Since such difficulties can be frustrating at times, learning to cope with them is an imperative:

> ... when you have glitches with [technology] (laugh), it can present problems quite often and it is one of the things that you learn to cope with, that you will have something planned and for some reason or the other the network is down, or so. Therefore we can't access the program, or students have forgotten their

223

logon codes... that can become frustration at times but we learn to get around that. (Joanne)

Lack of access to ICT can be a problem too. Even though having to work together on one computer provides students with valuable social skills, Joanne thinks "sometimes it's easier if they've got individual access to them."

6.3.3.4   Catalysts for successful integration of ICT

At Platypus Primary School teaching and learning with ICT has always been considered important. It is one of the hallmarks of the school. Joanne acknowledges that the school provides students and staff both with resources and opportunities for ongoing learning:

> It is really important that it just became very much an integrated tool into all areas of the curriculum here, and that we are providing students with the skills that they need because it is a vital part of their ongoing learning ... (Joanne)

She believes that the success of ICT integration rests upon using these resources and opportunities effectively. Effective use of resources is facilitated by a whole school approach that means both providing staff and students with access to professional development and permanent technical support. Platypus Primary School has an ICT manager who plans and works with staff and students towards successful integration of ICT. But having such an invaluable 'asset' can result in additional difficulties at times:

> Probably our biggest problem with our ICT manager is that her expertise is recognised very greatly, and which means that she has demands from outside the school on her, that sometimes that we can't access things exactly when we want it. But that's part of life and it's dealing with that. (Joanne)

The ICT manager does not leave anything to chance. She prepares MICE students to take an active role in preventing technical problems:

> Our computers are on before the school day starts so we know if there are any major glitches or problems with the computers. The students have been trained up with those troubleshooting strategies if they can't fix it that we can actually have somebody come and have it fixed, so that it is ready to go before the day, so that makes it much easier (laugh). (Joanne)

Just-in-time technical support fortifies these collaborative efforts, and helps teachers work towards their educational goals and objectives even when they seem to be threatened by technological glitches that exceed student expertise:

> We are very lucky this year that we have technicians here the whole time, so if we do have incidents.... (laugh). They walk through, you are able to access that support...and that makes working with ICT much easier if you can get that immediate access on the spot. (Joanne)

This whole-school approach where both students and staff are provided with the necessary skills and support to embrace technology accelerates the integration of ICT in teaching and learning at Platypus Primary School. The emphasis is on collaboration and mentoring that encourages both students and teachers to contribute to the cultural and pedagogical shifts and to search for new ways of teaching and learning with ICT.

6.4 Discussion and conclusions

This chapter reported on the findings of the qualitative fieldwork. It provided an in-depth analysis of ICT-rich pedagogical practices, examined the role of ICT in student learning, provided insights into the barriers to and catalysts for successful ICT integration and explored pedagogical and cultural shifts taking place in schools and classrooms. The cases of practice described in this chapter echo findings of previous studies (Bauer & Kenton, 2005; Conlon & Simpson, 2003; Cuban et al., 2001; Kozma, 2003a; OFSTED, 2005), by illustrating that despite huge investments in educational technologies and teacher professional development, teaching and learning with ICT has not become a daily social practice in the contemporary primary classroom.

Findings of the fieldwork indicate that new technologies in schools have created a number of new challenges for teachers which include operating hardware and software, designing pedagogically sound technology-rich learning experiences and keeping up with the ever-changing landscape of ICT. They revealed some important issues, such as teachers' awareness of the importance of integrating ICT in learning and teaching, barriers and catalysts to successful ICT integration, and the pedagogical and cultural shifts taking place in classrooms and schools where teachers take up the challenge of engaging students in new learning experiences with ICT.

Teachers participating in the field inquiry demonstrated an acute awareness of the importance of facilitating student learning with ICT. They felt that socialising students into the digital world was one of their responsibilities. In their opinion empowering students with ICT skills provides them with "skills for work and life" (Gina) which translates into more opportunities for future employment and a better position in the knowledge society. Apart from being aware of the social responsibility that comes with the integration of ICT, teachers realise the pedagogical potential of ICT and see it as a "new tool for changing education" (Gina) which provide students with more resources and new opportunities for learning. ICT is also viewed as a component of multiliteracies. It is "a medium for providing students with a range of experiences" (Joanne), and a "powerful instrument for canvassing their learning" (Gina).

All teachers participating in the field inquiry argued that there had been considerable changes since they started using ICT in their classrooms. These included changes in classroom roles and relationships, shifts in teaching philosophies and pedagogies and school culture. Before teachers and students relied more on pen and paper, now with all the resources ICT provides the cases illustrate that learning is more about problem-solving and investigating. This gives students more ownership over the process and outcomes of learning. Classroom roles and relationships are also changing as many of the students are more confident users of ICT than teachers. They take up the responsibilities of peer-teaching and co-teaching, which in the case in Platypus Primary School is supported by a whole-school approach. In such environments teachers are more likely to move from private practice to team-teaching and collaborative planning (Becker & Riel, 2001), creating communities of practice (Wenger, 1999; Wenger et al., 2002) in order to support themselves and others adjust to the changing conditions.

Despite teachers' enthusiasm and genuine intention to provide their students with the best opportunities for learning, the effective integration of ICT in learning and teaching hits many brick walls. Findings from these cases of practice suggest that some of the major barriers to effective ICT integration are access to hardware, issues related to time, technical support, and most of all teachers' limited ICT literacy, which embraces not only the technical but the pedagogical and the socio-cultural aspects of teaching and learning of ICT. As a result ICT often become an add-on to traditional learning activities. In such instances instead of serving the purpose of new learning experiences relevant for students lives ICT becomes the purpose itself (Yelland, 2007; 2008).

226

Findings of classroom observations suggest that the use of ICT most often limited to word processing, typing up information or handwritten text, and to conducting online information search. This finding echoes Larry Cuban's observations (2001), according to which "...e-learning in public schools has turned out to be word processing and Internet searches" (p. 178). During the classroom observations ICT were not utilised for facilitating on-line communication and collaboration, or for extending the physical learning environment into the virtual.

Apart from computers, a scanner and a printer (as in Cases 1 & 2), no other digital equipment was utilised to support the process of learning, which illustrates a narrow view of ICT, limited to computers. Iram and John Siraj-Blatchford (2006) argue that ICT should be viewed and understood more broadly by educators and involve other digital devices, such as mobile technologies, digital audio and video devices, electronic white boards, electronic microscopes, and include digital devices from our environment, such as traffic lights, computers in cars, supermarket checkouts, and bank cash points, to provide students with authentic and meaningful learning experiences.

Although in all three of these cases the use of ICT was mostly about word processing, especially in Cases 1 and 3, typing up information and conducting research, differences were observed in the pedagogical rationale guiding the integration of ICT in learning and teaching in Cases 2 and 3. In Case 1 the pedagogical intent of integrating ICT in literacy activities was to provide students with more technical skills. In particular this included mastering the skills of using the word processor with the focus on presentation and on developing greater awareness of punctuation and spelling. In Cases 2 and 3 the pedagogical rationale was to use ICT for a series of tasks involved in interdisciplinary projects. Accordingly, in Case 2, ICT were used for a history project with a literacy focus, the aim of which was develop an in-depth understanding of an Australian historical event or personality developed through publishing an illustrated storybook. ICT aided research, writing and publishing. In Case 3, ICT were used in an integrated history project with a mathematics focus, where it was used for conducting research, calculations, planning and design.

The classroom observations suggest differences in teachers' ICT literacy. In Case 1 the emphasis was on the operational dimension of teachers' ICT literacy (Dimension 1 of ICT literacy) with a focus on operating software and hardware, whereas in Cases 2 and 3 the teachers' focus was on pedagogical and socially responsible use of ICT (Dimensions

227

2 and 4). These differences could be attributed to teachers' opportunity for professional development as well as to the culture of teaching and learning with ICT in their schools. It appears that professional development opportunities focusing on new pedagogies and integrated approaches provide teachers with a broader understanding of the 'Whys and Hows' of technology integration when compared to professional development focusing on the acquisition of technical skills related to the use of particular software packages.

The findings also indicate that the culture of ICT within the school context has a considerable influence on teachers' ICT literacy and the way teachers use technology. As reported in the literature (Lloyd, Cochrane, & Beames, 2005), technology integration is more successful when teachers are provided with just-in-time professional learning in a familiar environment that allows them to be "moving forward with ICT within their comfort zone" (Gina). This finding supports Coppola's (2004) observation that "teachers learn better in the real setting of their own workplace that are not isolated culturally and structurally" (p. 37) and can work at their own pace. Coppola argues that schools need to become learning communities where teachers and students can learn together, which explains the success of the MICE project at Platypus Primary School.

In summary, the fieldwork provided valuable data about teachers' pedagogical practices, their knowledge and skills as well as their underlying philosophies, and indicated important links between teachers' ICT literacy and pedagogical practices that will be discussed in the next chapter.

Chapter 7.

Towards the social practice of digital pedagogies:

Discussion of findings

If the way we think of change is limited by imagining things very much like the ones we know (even if 'better'), or by confining ourselves to doing what we know how to implement, then we deprive ourselves of participation in the evolution of the future. It will creep up on us and take us unawares. (Papert, 1998)

This chapter brings together findings of the three sub-studies or research phases described in Chapters 4, 5 and 6 in order to respond to the main research question. It includes a summary of the research project as a whole revisits the research problem and the questions that guided the inquiry. Chapter 7 provides an overview of the most significant findings emerging from the Delphi process, the teacher survey and the qualitative fieldwork. The new framework of teachers' ICT literacy is used to triangulate, consolidate and interpret these findings, explore ideas and make connections to contemporary professional discourses in the field. The discussion of findings is followed by the conclusions and implications for theory, policy and practice as well as recommendations for future research.

7.1   Overview of the research

The research described in this dissertation was designed to explore connections between teachers' ICT literacy and pedagogical practices, and interpret the implications of these connections for student learning and educational change. The aims of the study were to investigate the situated nature of ICT integration in learning and teaching and to portray the skills and knowledge teachers need to facilitate new ICT-rich social practices of

teaching and learning in Victorian government primary schools. As described in Chapter 3, three sub-studies: a Delphi process, a teacher survey and a qualitative field study were linked together by an exploratory mixed–methods design (Dakich, 2006) to generate responses to the research questions guiding the inquiry:

Main question:

- How does teachers' ICT literacy influence the nature of ICT integration into teaching and learning in primary schools?

Sub-questions:

- What are the dimensions of teachers' ICT literacy?
- What factors influence teachers' ICT literacy?
- How do teachers integrate ICT in the everyday social practices of teaching and learning?
- To what extent are they transforming student learning with ICT?

A new Framework of ICT Literacy for Primary School Teachers developed in the Delphi process and validated in the teacher survey was employed to collect data about teachers' ICT literacy and scaffold the interpretation of findings. In this chapter the framework will be used to bring together results emerging from both qualitative and quantitative data sets, support the triangulation and theorisation of findings and generate responses to the main research question by identifying connections between teachers' ICT literacy and pedagogical practices.

As discussed in Chapter 4, the framework identifies four dimensions of teachers' ICT literacy: Operational Understanding and Application of ICT, ICT-Rich Pedagogies and Learning Environments, ICT for Professional Learning and Engagement, and the Social Ecology of Living and Learning with ICT.

7.2 Connections between teachers' ICT literacy and pedagogical practices

7.2.1 *Operational understanding and application of ICT*

The first dimension of teachers' ICT literacy refers to knowledge and skills, such as having up-to-date understanding of new technologies, demonstrating professional judgment and skill in the selection and application of common computer software and hardware and demonstrating ability to use network resources for communication, collaboration and research purposes. The emphasis is not only on the acquisition of technical competence of operating software and hardware, but also on teachers' professional capability to make informed choices about the usefulness of particular hardware and software for student learning, communication, collaboration and teacher professional learning.

Findings of the Delphi process and the teacher survey suggest differences of opinion between experts and teachers about the importance of individual teacher capabilities comprising Dimension 1. According to the Delphi experts, the most important teacher capability in this dimension of the framework of ICT literacy is having up-to-date understanding and knowledge of ICT used at home, school, workplace and community. Congruently with current literature (Cope & Kalantzis, 2000; Lankshear et al., 2000) the Delphi panellists emphasise the importance of keeping abreast with technological innovations, developing a holistic perspective and critical understanding of the role of new technologies in our personal, professional and social lives.

In contrast findings of the teacher survey indicate that according to the teachers, the most important capability is demonstrating skill in the use and application of common computer software that include word processing, text and image editing, data and file management, graphics and design, multimedia and hypermedia, etc. Teachers' narrow focus on basic technology skills reveals their limited familiarity with new technologies and their fear of being seen as incompetent in their professional role (Cuban, 2000a; Cuban et al., 2001; OECD, 2006; OFSTED, 2005). This often results in tokenistic uses of ICT or the dressing up of old practices in new technologies (Yelland, 2007). Additionally, the integration of new technologies often involves the challenge of double innovation (Chaptal, 2002) and juggling multiple learnings (Hall, 2006) in the process of which ICT tools get in the way of effective practices and innovative pedagogies.

Teacher interviews reveal that frequent technological glitches, unreliable infrastructure and limited technical support yield increased anxiety and amplify the focus on risk management (Becta, 2003b; Webb & Schirato, 2006), hence decreasing teachers' creative capacity to transform student learning with ICT. This finding also confirms observations from other professions such as business, where operational risks, unreliable support and obsolescence are jeopardising effective professional practices with new technologies (Carr, 2004). Carr argues that in the world of business operational risks can paralyze productivity, and ruin the reputation of enterprises. In education such risks can jeopardise the effectiveness of the learning process and question the professional authority of the teacher.

Remarkably, findings of the teacher survey also revealed that teachers perceive themselves to be the most competent at Dimension 1 of teachers' ICT literacy, in particular at demonstrating skill in the use and application of common computer software. This finding suggests that perceptions of importance of certain skills and capabilities may serve as catalysts for their acquisition.

Teachers' operational understanding and application of ICT are influenced by many different factors. This study explored teachers' perceptions about the following factors contributing to the development of their ICT literacy: pre-service teacher education, in-service professional development, workplace experience, access to computers, and support from colleagues and school leadership. It also examined the influence of independent variables such as age, gender, teaching experience and teachers' use of computers. According to the analysis of teachers' own perceptions and the analysis of variance of independent variables discussed in Chapter 5, the most significant factor influencing their ICT literacy was having and using a computer at home. This finding supports Krumsvik's (2005) observation, according to which access to a computer at home is an important condition of teacher engagement with ICT.

The importance of home computer for the development of teachers' ICT literacy was reiterated and further explained by the results of the teacher interviews. Teachers participating in the fieldwork argue that the Notebook for Teachers and School Principals Programme established in 1998 by the Victorian Department of Education and Training has allowed teachers not only to use the notebooks in the classroom, but to take them home and use them in their own time for professional and personal purposes. Interview participants report that owning a laptop and being able to engage in hands-on experiences

232

with new technologies in their own time and within their comfort zone has made the most significant contribution to the development of their ICT literacy.

Survey findings also reveal the significant influence of gender, age, teaching experience and the use of computers in the classroom on Dimension 1 of teachers' ICT literacy. Teachers' self-reports indicate that male teachers are more competent in operating new technologies then female teachers. They also show that teachers aged 25-39 are the most competent in this dimension of teachers ICT literacy. Teachers who have used computers in the classroom for more than ten years scored higher in all four dimensions of ICT literacy.

7.2.2 ICT-rich pedagogies and learning environments

Dimension 2 of teachers' ICT literacy refers to teaching practices and ICT-rich pedagogies that are embedded in the pedagogical rationale of constructivist learning environments (Jonassen, 1999a; Jonassen, 2001; Papert, 1997; Sharp, 2002; Taylor, 1999, and connected to communities of learners (Siemens, 2004). The emphasis is on innovative and integrated approaches to learning and teaching with ICT, where the role of the teacher is to design, facilitate and scaffold student inquiry (Kalantzis et al., 2005). Teachers are expected to make informed choices about the relevance and responsiveness of ICT-rich learning experiences to the diverse needs of learners, and the context of living and learning in the digital world.

The findings of the Delphi study and the teacher survey suggest agreement between Delphi panellists and survey participants that the most important capability for primary school teachers is to ensure that students develop competence, confidence, and critical awareness in using ICT. This echoes current policy directions (DEECD, 2008; MCEETYA, 2005b, 2005c; VCAA, 2005) and is consistent with teachers' views expressed in the teacher interviews. Teachers believe that empowering students with ICT skills provides them with "skills for work and life" (Gina) which translates into more opportunities for future employment and a better position in the knowledge society.

Similarly both the Delphi panellists and surveyed teachers acknowledge the importance of teachers' ability to effectively manage ICT resources in order to create learner-centred environments. However, teachers' self reports gathered by the survey, as well as classroom observations, reveal that there is no significant transition in teaching styles and practices when integrating new technologies into student learning. Repeatedly

233

teachers report to be the most competent at aspects of using new technologies that they find the most important. This includes teacher-centred educational scenarios such as presenting units of work and preparing handouts, or using common computer software. Such skills revert to the times of Skinners' teaching machine, the idea of programmed instruction, and behaviourist conceptualisations of learning (Skinner, 1968; Skinner, 1974) of the industrial age. Teachers also appear to use new technologies to replicate traditional literacy practices. These include typing up handwritten texts and using the Internet as a virtual repository of easy-access information. These findings confirm Larry Cuban's (2001) observations about the integration of ICT in American public schools on the threshold of the New Millennium:

> Teachers have been infrequent and limited users of the new technologies for classroom instruction. If anything, in the midst of the swift spread of computers and the Internet to all facets of American life, e-learning in public schools has turned out to be word processing and Internet searches. As important supplements as these have become to many teachers' repertoires, they are far from the project-based teaching and learning that some techno-promoters have sought. (Cuban, 2001, p. 178)

Almost a decade later the situation in Victorian government schools is not far from Cuban's portrayal. While information and communication technologies have re-engineered most social practices, many teachers are still not ready to engage the digital natives in 21st century learning experiences. Teachers participating in the survey study report to be less competent in facilitating new ways of teaching and learning with ICT such as:

- supporting interdisciplinary curricular activities with new technologies,
- using ICT to facilitate inquiry, problem-solving, critical thinking and knowledge construction,
- extending students' ability to evaluate, assess and monitor their own work by creating digital projects, electronic portfolios, and
- responding to the diverse needs of learners by designing inclusive pedagogical strategies and practices with ICT.

Findings of the fieldwork suggest that limited numbers of computers in classrooms and busy schedules affecting access to computer labs affect teachers' ability to engage

234

students regularly in ICT –rich learning experiences. This finding confirms the results of large international studies discussed in the literature review (Chaptal, 2002; Conlon & Simpson, 2003; OECD, 2006; OFSTED, 2002, 2005) reporting on teachers' sporadic use of new technologies. According to contemporary research on engaging students in ICT–rich learning experiences, student engagement with ICT in schools is rarely varied and sustained (Selwyn, 2000) and students more often use computers for study purposes at home than in schools (OECD, 2006). Apart from successful projects piloted by governments or large corporations ICT are still not ubiquitous in daily practices of teaching and learning in public schools. Seamless integration of new and emerging technologies to facilitate student-centred learning and support the development of 21st century life skills is yet to be realised.

Both the teacher survey and qualitative fieldwork further suggest teachers' lack of confidence in applying emerging applications of ICT to teaching and learning, such as social networking. The results of the validation of the new framework described in Chapter 4 revealed that the following teacher capabilities were not validated by the random sample of teachers teaching in Victorian government primary schools:

- Facilitates on-line communication and collaboration of students at a local and global level (C18).

- Encourages students to become members of local and extended communities of learning (C19).

Notably, out of the 25 teacher capabilities included in Dimension 2, these were the two capabilities teachers perceived themselves the least competent in. This finding may be explained by teachers not being familiar with the educational benefits of virtual worlds and, recreational applications of ICT. It is important to acknowledge that in the current legal environment teachers could face legal consequences for any breach of terrestrial rules on the seemingly unregulated Information Superhighway, which creates fear and contributes to slow adoption of online applications in primary schools. Some of the main concerns include, lack of control, breach of privacy, and the vulnerability of young children and youth in online environments.

The pedagogical implications of taking learning beyond the classroom are also posing new challenges for teachers. In these blended environments, where student learning extends beyond traditional boundaries of classroom walls, state and national borders,

learning becomes more of a negotiated inquiry process. Consequently, teacher control is decreased and learner autonomy is emphasised, which introduces a new layer of uncertainty for most teachers who learnt the craft of the teaching in the 20th century. These findings prove to be a significant contribution to current understandings about the use of emerging technologies to support new ways of teaching and learning, as to date there are few publications reporting on teachers' attitudes towards and practices with social networking technologies in primary and middle school settings. These findings therefore provide leads for policy directions, teacher education and teacher professional development about the adoption of social networking technologies in P-12 (K-12) education.

While being critical of teachers' resistance to embracing new and emerging technologies as tools of profession, it is important to take into account their epistemological and ontological history. Most teachers teaching in Victorian government primary schools have completed their pre-service education towards the end of the 20th century, within the paradigm of the didactics of the modern past, where the role of the teacher was to pass on cultural capital and official knowledge (Apple, 1993) to new generations and test the outcomes of the learning. Their teaching routines and practices have been strongly influenced by their own teaching philosophies, cultural traditions (Pépin, 1998) and pedagogical discourses (Ruthven et al., 2004). In the information age and the so-called knowledge society, the role of the teacher has been subject to an unprecedented professional metamorphosis in the history of education. Post-modern thought and constructivist epistemology has shifted the focus from 'objective knowledge' to the subjectivity of the learner and to a critical analysis of the socio-cultural context of education. Teachers were expected to transform themselves from a 'sage on the stage' to a guide on the side (King, 1993) and respond to the needs of their increasingly diverse groups of learners. The emergence of new technologies and their deployment in schools further challenged existing roles and relationships in educational settings. Teachers "who were not born into the digital world" (Prensky, 2001a) have been expected to adapt to these new circumstances, without much support. Prensky calls these teachers digital immigrants, who have been socialized into the digital world in a different way, and the language of new technologies went "into a different part of their brain" (Prensky, 2001a). In his opinion these teachers will always retain their immigrant accent. However, he does not mention that teachers' pedagogical blueprints can make this accent even heavier.

This argument demonstrates that the challenges of facilitating student learning with new technologies emerge from a complex interplay of socio-cultural, technological and pedagogical issues surrounding the infusion of new technologies into public schools. Teachers' perceptions collected by the survey reveal that skills and capabilities related to operational understanding and application of new technologies are essential for managing ICT as a new medium for learning. However, complementary findings from the survey and qualitative fieldwork further suggest that new learning (Kalantzis & Cope, 2008b; Yelland, 2007, 2008) can only be achieved by assisting teachers to develop deep pedagogical connections between new technologies and student learning. Research reviewed in Chapter 2 shows that teachers' pedagogical understanding of integrating new technologies into teaching and learning is as important as access to new technologies (Cox et al., 2003a, 2003b). Cox et al. argue that the "crucial component in the appropriate selection and use of ICT within education is the teacher and his or her pedagogical approaches" (Cox et al., 2003a, p. 3). Findings of other research studies also indicate (Patahuddin, 2008; Ruthven, 2006; Ruthven & Hennessy, 2002) that teachers' beliefs, teaching philosophies and pedagogical ideas have significant influence on the way they integrate ICT in teaching and learning. Ruthven et al.(2004) argue that "teachers' pedagogical discourses and practices shape teacher representations of ICT use" (p. 285). These earlier findings explain why in this study the use of computers in the classroom was not a significant influence on Dimension 2 of ICT literacy.

When investigating other factors influencing teachers' competence in integrating ICT in teaching and learning, findings of this study suggest that significant influences on teachers' Dimension 2 of teachers' ICT literacy appear to be gender and computer use at home. Male teachers report to be more competent in facilitating new learning with ICT, while having access to a computer at home improves both male and female teachers' ICT literacy in this dimension. Findings of the qualitative fieldwork suggest that heavy workloads, limited access to ICT infrastructure, lack of time and lack of technical support may be some of the reasons why teachers choose not engage (more often) in innovative teaching practices with ICT.

7.2.3 ICT for professional learning and engagement

Continuous learning related to harnessing the potential of new and emerging technologies is the key to their successful integration into teaching and learning. Dimension 3, as the second largest dimension of teachers' ICT literacy, portrays the nature of this learning. It

contains eight teacher capabilities that describe ICT-rich practices and approaches related to professional learning and engagement. There is a strong emphasis on developing critical consciousness about how ICT can be integrated into everyday professional practices, to assist and facilitate professional inquiry, continuous learning, collaboration and connectedness with the local and global community. There is also a focus on developing a critical understanding of how the integration of ICT can influence the restructuring and reorganisation of classrooms and schools for improved student learning.

The validation of the framework revealed that teacher capabilities referring to continuous professional development related to ICT, as well as sharing effective practices with colleagues were highly rated by the participants of the teacher survey, a finding also confirmed by the qualitative fieldwork. However, promoting more self-directed approaches to professional development, such as developing personal plans, or conducting inquiry using current literature and research on ICT pedagogies, were not considered to be important by the teachers.

As described in Chapter 5, teachers' self-reports related to Dimension 3 of the ICT literacy framework, suggest that, overall teachers perceive themselves to be at an intermediate level of competence when using ICT for professional learning and engagement. Survey responses indicate that teachers are the most competent at using ICT to research and extend curriculum options, engaging in ongoing professional development related to the integration of ICT to support student learning, and sharing and evaluating effective practices and participating in collaborative projects for designing ICT-rich learning environments. Teachers report to be the least competent at conducting professional inquiry using current literature and research on ICT pedagogies, when planning for learning experiences and activities, understanding the influence of ICT integration on the restructuring of classrooms and schools, and developing a personal plan for continuous professional learning related to ICT pedagogies. This seems to be an important finding as governments and professional associations around the world have invested in the creation of online content to provide teachers with opportunities for engaging in self-directed, just-in-time learning about effective integration of new technologies into their pedagogical practices. It also has implications for teacher education calling for practices that prepare pre-service teachers for managing their professional growth.

While online content can be a powerful medium to assist self-directed approaches to teacher professional learning and engagement, teachers' open-ended survey responses and findings of the qualitative fieldwork suggest that relevant professional development involving hands-on experiences within a supportive school culture best facilitate transitions in teaching philosophies and pedagogies. Findings of the qualitative fieldwork also suggest that professional learning with a focus on new pedagogies technology integration is more effective compared to professional development focusing on the acquisition of technical skills and knowledge. Similarly, findings of classroom observations and teacher interviews indicate that the culture of ICT within the school context has a considerable influence on teachers' ICT literacy and pedagogical practices with ICT. Technology integration is more successful when teachers are provided relevant just-in-time professional learning (Lloyd et al., 2005) in a familiar environment that allows them "moving forward with ICT within their comfort zone" (Gina). These findings support Demetriadis et al.'s (2003) and Coppola's (2004) observations that 'teachers learn better in the real setting of their own workplace when they are not isolated culturally and structurally" (p. 37) and can work at their own pace. In such communities of practice (Krumsvik, 2005; Wenger et al., 2002), teachers are more likely to engage in continuous learning related to the integration of ICT. These views are also reinforced by the quantitative findings of this study that suggest that using computers in familiar environments such as the classroom and at home for prolonged periods have a significant influence on Dimension 3 of teachers' ICT literacy. Gender also proves to significantly influence this dimension, with male teachers reporting to be more competent in professional learning and engagement with ICT.

7.2.4 The social ecology of living and learning with ICT

The fourth dimension of teachers' ICT literacy addresses the social ecology of integrating ICT in everyday practices of teaching and learning. It has a strong focus on developing and implementing conscious strategies that address equity, inclusion, and ethical conduct (embracing moral and legal aspects), as well as health and safety related issues when integrating ICT in learning and teaching. It also prompts teachers to be familiar with recreational uses of ICT and its role in youth culture. The inclusion of this dimension in the framework of teachers' ICT literacy accentuates the importance of a culturally aware, critically reflective approach to ICT integration that goes beyond the immediate learning environment, and helps teachers realise that norms and rules related to human interaction

239

with new technologies are socially constructed, and are contextualised in culture, history and power (Lankshear et al., 2000).

Survey results reveal that teachers perceive themselves the least competent in this dimension of ICT literacy. The findings indicate teachers' lack of confidence and competence in identifying health hazards related to the use of ICT, and show teachers' limited familiarity with the role of technology in youth culture, recreational uses of ICT and their potential for student learning. Within this dimension of ICT literacy teachers feel most competent in applying appropriate ethical positions and responsible behaviours associated with the use of ICT which they ranked as the second most important teacher capability in the framework of teachers' ICT literacy. This indicates teachers' heightened awareness of their social responsibility and duty of care, as well as their vulnerability in an emerging legal environment that regulates the use of new technologies in schools with children and under-aged youth. In juxtaposition, teachers do not find it important to demonstrate familiarity with the role of technology in youth culture and recreational uses of ICT. This reflects the uncomfortable status quo present in many schools ignoring, restricting or preventing the use of 'potentially dangerous' applications of social networking technologies such as wikis and blogs, online games and virtual worlds, and other forms of social networking. Consistent with the findings of the teacher survey and other research studies (Cuban, 2001; Patahuddin, 2008; Watson, 2006) teachers participating in the qualitative fieldwork made limited use of the World Wide Web. Apart from the carefully filtered search engines, no emerging Internet applications were utilised to engage students in exploration or collaboration extending the traditional learning environment.

Identifying health hazards related to the use of ICT and in creating safe learning environments that comply with basic ergonomic and health principles was perceived as an important teacher capability by the participants of the teacher survey, however teachers' self reports suggest limited competence in this area. Teachers' lack of awareness mirrors that of the general public about the health risks imposed by new and emerging technologies on humans and the living environment. Issues of interest include compliance of these technologies with ergonomic principles, levels of radiation and time spent working/playing with them. The effects of these risks either have not been identified yet or are carefully concealed by manufacturers of ICT devices.

Quantitative findings of the study reveal that similarly to the other three dimensions significant influence on teachers ICT literacy appear to be gender and computer use at home and in the classroom. As noted in Chapter 5, the influence of gender is treated cautiously because of the tendency of male participants to rate themselves higher in self-assessment task then females (Meredyth, Russell, Blackwood, Thomas, Wise et al., 1999; Vale & Leder, 2004).

7.3 Conclusions

Findings emerging from this research confirm and complement the findings of research studies reviewed in Chapter 2, indicating that the infusion of new technologies has not resulted in considerable changes to the day-to-day practices of learning and teaching (Anderson & Becker, 2001; Chaptal, 2002; Cuban, 2000b; Watson, 2001; Yelland, 2007). Survey and field data gathered from teachers teaching in Victorian government primary schools suggest that teachers are still learning to facilitate student learning with new technologies. Consistent with findings of other studies (Becker & Ravitz, 2001; Becker & Riel, 2001; Dale et al., 2004) it appears that one of the significant barriers to successful technology integration appears to be teachers' lack of confidence and pedagogical understanding in using new technologies as tools of the profession. Most teachers report to have developed the necessary technical skills that enable them to incorporate ICT in conventional educational settings and support traditional teaching practices and strategies. However, findings imply that without adequate structural support teachers often find it difficult to harness the potential of new technologies for creating new learning environments and initiating "profound cultural" (Lankshear et al., 2000, p. 26) and pedagogical shifts.

Literature reviewed in this dissertation indicates that one of the reasons for the delayed pedagogical response is that teachers have not been central to narratives emerging around the infusion of ICT into schools. The visionary narrative (Drenoyianni, 2006) of liquid modern times (Bauman, 2003; Bauman, 2007), and current directions of educational reform rooted in the "highly regulatory techno-rationalist business worldview" (Lankshear, 1998, p. 313), aligned the deployment of ICT in schools with better learning outcomes, more effective teaching practices and above all educational and social change (Apple, 2004a; Bromley, 1998; Drenoyianni, 2006). Enculturating new

241

generations into the information economy, and helping learners acquire new literacy skills have become national educational priorities (DEECD, 2008; MCEETYA, 2005b), yet more often than not teachers have been left alone to work their ways through to fulfilling these goals.

Teachers' professional odyssey with new technologies can be explained through the lens of Giddens' structuration theory. According to Giddens (1984), changes to social practices often result in a strong reaction of anxiety in human actors. In order to reduce this anxiety they apply existing rules, or as Sewell (1992) calls them schemas, to new situations in order to make meaning of them. Consequently human actors (teachers in the context of this study) incorporate new resources (e.g. technological artefacts) into existing routines and structures. Giddens maintains that the routinisation of human actions are the foundations of social life. Routines are habitual actions that grant social actors a sense of "trust and ontological security" (1984, p. xxiii) and result in the reproduction of existing social structures. However, through reflexive monitoring of their habitual actions human actors develop personal theories of action and become knowledgeable agents, capable of initiating change. In contrast to the neoliberal rationale of technology deployment, Giddens argues that "technology does nothing, except as implicated in the actions of human beings" (Giddens & Pierson, 1998, p. 82).

Giddens' theory links into views expressed by other authors referred to in Chapter 2, who believe that in order to achieve successful integration of ICT in learning and teaching in schools, the relationship between people and technologies needs to be reconceptualised (Kincheloe, 2005; Lankshear et al., 2000; Moyle, 2005). By putting teachers first (Lankshear et al., 2000) and providing them with supportive cultures for the development of new literacy skills and pedagogical knowledge, teachers will be more prepared to draw on the potential of new technologies and to take learning from the industrial age into the 21st century.

As the findings of this study indicate, teachers' pedagogical repertoire with new technologies thus becomes the new denominator of cultures of schooling and social access. Access that goes beyond the "simple binary notion of technology haves and have-nots" (Warschauer, 2003a), and brings to the forefront the issue of equitable access to quality learning experiences that transcend the boundaries of the classroom walls and connect learners with the real world through inquiry, communication and collaboration.

Promoting equity and excellence in Australian schools has become a national goal for schooling in the 21st century. According to the Melbourne Declaration on Educational Goals for Young Australians, achieving this goal is the collective responsibility of governments, school sectors, individuals and the broader community (MCEETYA, 2008).

7.4 Significance and contribution to knowledge

This research has made two significant contributions to knowledge: one to the field of digital pedagogies and one to mixed methods research.

First by drawing on the expertise of an international online Delphi panel, this research project has generated a new, pedagogical framework of ICT literacy that was validated by teachers from a random sample of 350 Victorian government primary schools (Dakich, 2005b, 2008b). The Framework of ICT Literacy for Primary School Teachers presented in this dissertation redefines the relationship between new technologies and pedagogies by introducing novel ways of thinking about learning and teaching with ICT. It positions teachers as knowledgeable professionals, capable of making informed educational decisions based on the needs of their students, as well as their local and global communities. The emphasis on operating new technologies is shifted to developing a new pedagogical repertoire that is embedded in a critical understanding of the socio-cultural and historical contexts in which technological artefacts are born and are being redefined through new social practices of learning and teaching with ICT. It is expected that the knowledge and skills portrayed by the framework will help teachers strengthen their professional agency in facilitating new, ICT-rich social practices of learning and teaching in the contemporary primary school. It is also anticipated that the new framework, together with other findings of this study discussed in Chapters 5, 6, and 7 will inform educational policy development and support change in in-service and pre-service teacher education.

Second, by integrating the Delphi method in a mixed method research design, the study has increased the reliability and validity of the Delphi findings (Dakich, 2008a), which were considered to be the most significant limitations of the Delphi method (Hasson et al., 2000; Kennedy, 2004; Sackman, 1974). The methodology of this study, was reported on at the second and the fourth Mixed Methods Conferences in Cambridge,

UK (Dakich, 2006, 2008a), where it was the only research project to integrate the Delphi method with other research methods in a mixed method design.

The findings of this study may have further implications for theory. By filling in the gap in contemporary research on ICT in education the study has provided quantitative data about primary school teachers' ICT literacy, and described factors that influence teachers' knowledge and skills related to the integration of ICT.

As indicated in Chapter 1 by combining qualitative and quantitative techniques the study also addressed the methodological gap emerging from research on ICT and pedagogical change signalling the need for the validation and triangulations of findings. The study has also responded to calls from literature (Cuban, 1993; Cuban et al., 2001; Ravitz et al., 2000; Wood et al., 2005) for in-depth observation of teacher's practices with ICT. However it is important to recognise the limitations of the generalisability of qualitative findings due to the small number of classroom observations.

In the context of the emerging mixed methods paradigm the dissertation offers a detailed account of the mixed methods research design implemented in this study offering graduate students and researchers an insight into the intricacies and possible pitfalls of combining quantitative and qualitative methods in educational research.

7.5 Implications for policy and practice

7.5.1 Implications for policy

The overall findings of this study call for reinventing the teacher of the 21st century, and redefining their role in educational change and reform. In particular, this research indicates the need for recognising the socio-cultural and political agency of teachers and for involving them in dialogues and decision-making processes about the future of education including questions related to pedagogy, ICT, curriculum and the purpose of education. The new Framework of ICT Literacy for Primary School Teachers developed and validated in this study provides an analytical model as well as a diagnostic tool that can be used by teachers to evaluate their ICT literacy and to map their professional journey related to new pedagogical practices with ICT.

Cases of practice emerging from classroom observations and teacher interviews suggest that pedagogical change rarely occurs in isolation. New epistemologies and

related practices are conceived in social interaction and collaboration. When thinking of facilitating change policy developers need to draw on the collective agency of communities of practice in order to enhance creativity and innovation, and improve the quality of educational outcomes with ICT. The case of Platypus Primary School provides an example of innovative, whole-school approach to ICT integration that promotes new social practices within communities of learners and communities of practice resulting in cultural and pedagogical change.

Findings of the teacher survey and the qualitative fieldwork indicate the need for shifting the focus from investing into ICT infrastructure towards providing schools with just-in-time technical support and resources for on-going professional learning in context-specific, authentic educational settings. These resources would enable teachers and school administrators to explore deep connections between technological artefacts and contemporary pedagogies, and develop a critical understanding of the socio-cultural implications of living and learning in the digital world. Special emphasis needs to be on creating cyber-safe and ergonomically sound learning spaces, and narrowing the gap between school-based and real-life applications of new technologies.

Finally, there is a need to re-examine the dichotomy between constructivist pedagogies with ICT and current assessment practices that are rooted in discourses of standardisation and accountability, in order to arrive at new assessment strategies that are intrinsic to the learning process and serve the purposes of learning.

7.5.2 *Implications for practice*

Findings of this study support Fullan's view (2007a, 2007b) that successful change draws on leadership for cultural change, improved relationships, and building on teacher depth. The story of Platypus Primary School illustrate that taking a whole-school approach to technology integration that includes creating communities of practice, building on student expertise and providing teachers with just-in-time technical support leads to cultural and pedagogical shifts, which result in more effective practices with ICT. The findings of this research therefore indicate the need for schools to:

- Shift the focus from technology acquisition to empowering teachers with on-going professional learning opportunities and assistance.
- Take into account the needs, learning styles and epistemologies of practice of "digital immigrant teachers" (Prensky, 2001a).

- Allow teachers to learn with and about teaching and learning with ICT in collaborative settings by sharing their experiences and practices, thus reducing social and professional pressures and anxiety.
- Build on and utilise student expertise, initiate practices such as peer-teaching and co-teaching, and learn from examples of effective practices established by other schools.
- Provide just –in-time technical support with well-maintained, reliable ICT infrastructure.
- Place more emphasis on bridging the gap between real-life and school uses of new technologies, including popular cyber culture, Web2.0 and Web3.0 technologies.
- Shift the focus from the acquisition of functional techno-literacy skill to the pedagogy of facilitating student learning with new technologies.
- Help teachers develop a complex understanding of the role of new and emerging technologies in human societies and cultures, which includes problematising power-relations, social intentions and divides associated with their deployment.

The Framework of ICT Literacy for Primary School Teachers developed in this study may be used as tool by schools, professional learning teams or individual teachers to assist and facilitate these pedagogical and cultural shifts. The framework can be utilised by schools as a diagnostic tool for identifying teachers' needs for professional development. It can also be employed by individuals and professional learning teams as a framework for reflecting on and evaluating current practices, and for mapping self-directed approaches to professional learning.

7.6   Recommendations for future research

The research described in this dissertation has identified some important connections between teachers' ICT literacy and pedagogical practices based on data collected in Victorian government primary schools. Findings of the study could be further explored or tested for generalisability by conducting similar projects with larger samples or samples

with different geographic and/or socio-cultural characteristics in Australian schools and elsewhere.

The new framework of ICT literacy was developed to be used by practising teachers in primary school settings. Further research may be conducted to explore possibilities of using the framework in different settings and with different populations, for example with secondary school teachers and with pre-service teachers. Considering the ever-changing context of new technologies the framework should be regularly updated or reconstructed to mirror the emergence of new technologies and shifts in pedagogical thought.

Finally, findings of the qualitative fieldwork indicate that supportive school culture and collaborative practices are crucial to successful technology integration. Further research using a range of qualitative research methods such as ethnography, or phenomenography is needed to explore and document organisational aspects of technology integration, as well as the effects of school culture(s) on pedagogical practices with ICT. This may also indicate the need for developing new analytical and theoretical frameworks for researching and documenting emerging social practices of teaching and learning with digital technologies that may result in cultural and institutional change.

References

ACCE. (2000). Teacher learning technologies competencies project: Discussion paper, Part B. Retrieved April 14, 2002, from http://www.acce.edu.au/tltc/b-comp.asp

Adler, M., & Ziglio, E. (Eds.). (1996). *Gazing into the Oracle:The Delphi method and its application to social policy and public health*. London: Jessica Kingsley Publishers.

Agger, B. (1989). *Fast capitalism*. Urbana and Chicago: University of Illinois Press.

Aiken, L. R. (1996). *Rating scales and checklists: Evaluating behaviour, personality, and attitudes*. New York: John Wiley & Sons, Inc.

Ainley, J., Banks, D., & Fleming, M. (2002). The influence of IT: Perspectives from five Australian schools. *Journal of Computer Assisted Learning, 18*(4), 395-404.

Akins, R. B., Tolson, H., & Cole, B. R. (2005). Stability of response characteristics of a Delphi panel: Application of bootstrap data expansion. *BMC Medical Research Methodology* Retrieved February 7, 2007, from http://www.biomedcentral.com/1471-2288/5/37

Anderson, R. E., & Becker, H. J. (2001). School investments in instructional technology. *Teaching, learning and computing: A national survey of schools and teachers. TLC 12 Report Series* Retrieved November 27, 2002, from http://www.crito.uci.edu/tlc/findings/report_8/startpage.htm

Annels, M., Averis, A., Brown, J., Gardner, A., Hockley, C., Surguy, S., et al. (1997). *An inquiry of research priorities in nursing and midwifery in South Australia using a Delphi technique*: Australian Institute of Nursing Research.

Anthony, G., & Walshaw, M. (2007). *Effective pedagogy in pàngarau/mathematics: Best evidence synthesis iteration*. Wellington, NZ: Ministry of Education.

Apple Computer Company. (1996). Changing the conversations about teaching and learning with technology: A report on 10 years of ACOT research. Retrieved March 24, 2002, from http://images.apple.com/education/k12/leadership/acot/pdf/10yr.pdf

Apple, M. W. (1993). *Official knowledge: Democratic education in a conservative age.* New York: Routledge.

Apple, M. W. (2003). Is the new technology part of the solution or part of the problem in education? In A. Darder, M. Baltodano & R. D. Torres (Eds.), *The critical pedagogy reader.* New York, London: RoutledgeFalmer.

Apple, M. W. (2004a). Are we wasting money on computers in schools? *Educational Policy, 18* (3), 513-522.

Apple, M. W. (2004b). *Ideology and curriculum.* New York: Routledge.

Arleck, P. L., & Settle, R. B. (2004). *The survey research handbook* (3rd ed.). Boston: McGraw-Hill.

Atkinson, P., & Coffey, A. (2003). Revisiting the relationship between participant observation and interviewing. In J. A. Hostein & J. F. Gubrium (Eds.), *Inside interviewing: New lenses, new concerns.* Thousand Oaks, CA: Sage Publications.

Audacity Development Team. (2002-2009). Audacity audio editor and recorder. Retrieved March 14, 2003, from http://audacity.sourceforge.net/about/

Australian Computer Society. (2005). *Policy Statement on Computer Literacy: ICT professionals shaping our future.* Retrieved July 27, 2006. from http://www.acs.org.au/acs_policies/docs/2005/ComputerLiteracy.pdf.

Australian Council of Deans of Education. (2001). New learning: A charter for Australian education. Retrieved February 22, 2003, from http://www.acde.edu.au/docs/CharterForAustralianEducation2004.pdf

Australian Education Council. (1989). *The Hobart declaration on schooling.* Retrieved April 16, 2003. from http://www.mceetya.edu.au/mceetya/default.asp?id=11577.

Australian Government. (2007). *Information and communications technology capability overview.* Retrieved January 27, 2008. from http://www.austrade.com/Overseas-ICT-capability-overview/default.aspx.

Ausubel, D. P. (1960). The use of advance organizers in the learning and retention of meaningful verbal material. *Journal of Educational Psychology* (51), 267-272.

Babbie, E. (2004). *The practice of social research* (10th ed.). Belmont, CA: Thomson Wadsworth.

Bábosik I., Torgyik J. (Eds.).(2007). *Pedagógusmesterség az Európai Unióban.* Budapest, Hungary: Eötvös József Könyvkiadó.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development* (Vol. 6. Six theories of child development, pp. 1-60). Greenwich, CT: JAI Press.

Barabási, A. L. (2003). *Linked: How everything is connected to everything else and what it means for business, science and everyday life* (Reprint ed.). New York: Penguin Group.

Baruch, Y. (1996). Self-performance appraisal vs. direct-manager appraisal: A case of congruence. *Journal of Managerial Psychology, 11*(6), 50-65.

Bauer, J., & Kenton, J. (2005). Toward technology integration in the schools: Why it isn't happening. *Journal of Technology and Teacher Education, 14*(4), 519-541.

Bauman, Z. (2000). *Liquid Modernity*. Cambridge: Polity Press.

Bauman, Z. (2003). Educational challenges of the Liquid-Modern Era. *Diogenes, 50*(1), 15-26.

Bauman, Z. (2007). *Liquid times: Living in an age of uncertainty*. Cambridge: Polity.

Becker, H., J. (2000). How exemplary computer-using teachers differ from other teachers: Implications for realizing the potential of computers in schools. *Contemporary Issues in Technology and Teacher Education 3*(26), 291-321.

Becker, H. J. (1998). Running to catch a moving train: Schools and information technologies. *Theory into practice, 1*(37), 20-30.

Becker, H. J., & Ravitz, J. L. (2001). *Computer use by teachers: Are Cuban's predictions correct?* Paper presented at the American Educational Research Association (AERA), Seattle, US.

Becker, H. J., & Riel, M. M. (2001). Teacher professional engagement and constructivist-compatible computer use. *Teaching, learning and computing: A national survey of schools and teachers. TLC 12 Report Series.* Retrieved November 28, 2003, from http://www.crito.uci.edu/tlc/findings/report_7/report7.pdf

Becta. (2003a). Primary schools - ICT and standards: An analysis of national data from Ofsted and QCA by Becta. Retrieved November 15, 2004, from http://partners.becta.org.uk/index.php?section=rh&catcode=_re_rp_02_a&rid=13619

Becta. (2003b). What the research says about barriers to the use of ICT in teaching. Retrieved June 18, 2004, from http://www.becta.org.uk/page_documents/research/wtrs_barriersinteach.pdf

Becta. (2006). Educational change and ICT:An exploration of Priorities 2 and 3 of the
DfES e-strategy in schools and colleges:The current landscape and
implementation issues. Retrieved June 19, 2007, from
http://partners.becta.org.uk/page_documents/research/educational_change_and_ic
t.pdf

Best, J., W., & Kahn, J. V. (1998). *Research in education*. Englewood Cliffs, NJ: Prentice
Hall INC.

Bigum, C. (1999). Schooling with a purpose: Telling ourselves different stories about
how the world might be. *Learning Matters, 4*(1), 5-9.

Bigum, C., Bleicher, B., Burbules, N., Callister, T. A. J., Doneman, M., Durrant, C., et al.
(1997). *Digital rhetorics: Literacies and technologies in education, current
practices and future directions: Executive summary*. Canberra: Department of
Employment, Education, Training and Youth Affairs, Australia (DEETYA).

Bloom, B. S. (Ed.). (1956). *Taxonomy of educational objectives: The classification of
educational goals - Handbook 1: Cognitive domain*. New York: David McKay
Company, Inc.

Boekaerts, M. (1995). Self-regulated learning: Bridging the gap between metacognitive
and metamotivation theories *Educational Psychologist, 30*(4), 195-200.

Bogdan, R. C., & Biklen, S. K. (2003). *Qualitative research for education*. Boston: Allyn
& Bacon.

Bohm, D. (1980). *Wholeness and the implicate order*. London: Routledge.

Board of Studies Victoria (1995). *Curriculum and Standards Framework (CSF)*.
Melbourne: DE&T.

Borg, W. R., & Gall, M. D. (1989). *Educational research* (5th ed.). New York: Longman.

Boston, K. (1999). *Modern times and Australian curriculum*. Paper presented at the
Curriculum Corporation 6th National Conference. Retrieved March 12, 2004,
from http://www.mceetya.edu.au/mceetya/nationalgoals/boston.htm

Bowden, J. A., & Walsh, E. (2000). *Phenomenography*. Melbourne:RMIT University
Press.

Bowers, C. A. (1998). Toward a balanced perspective on the educational uses of
computers: Advantages, myths, and the responsibilities of educators.
International Journal of Leadership in Education, 1(1), 75-83.

Brabazon, T. (2006). Socrates in earpods?: The Ipodification of education. Retrieved August 22, 2007, from http://www.uta.edu/huma/agger/fastcapitalism/2_1/brabazon.htm

Breuer, F., Mruck, K., & Roth, W.-M. (2002). Subjectivity and Reflexivity: An Introduction. Forum: Qualitative Social Research, 3(3). Retrieved February 16, 2003, from http://217.160.35.246/fqs-texte/3-02/3-02hrsg-e.pdf

Brockhoff, K. (2002). The performance of forecasting groups in computer dialogue and face-to-face discussion. In H. A. Linstone & M. Turoff (Eds.), *The Delphi method:Techniques and applications* (pp. 285-311). Retrieved April 15, 2003, from http://www.is.njit.edu/pubs/delphibook/

Bromley, H. (1998). Data-driven democracy? Social assessment of educational computing. In Bromley.H & M. Apple (Eds.), *Education/technology/power: Educational computing as a social practice* (pp. 1-25). Albany: State University of New York.

Brown, J. S. (2002). Growing up digital: How the web changes work, education, and the ways people learn. *USDLA Journal.* Retrieved May 21, 2004, from http://www.usdla.org/html/journal/FEB02_Issue/FEB02_issue.pdf

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Bruner, J. (1986). *Actual minds, possible worlds*. Cambridge, MA: Harvard University Press.

Bruner, J. (1990). *Acts of meaning: Four lectures on mind and culture*. Cambridge. MA: Harvard University Press.

Burke, J. (1998). Technology standards for teachers. Retrieved 31/05/2002, from http://www.sreb.org/programs/EdTech/pubs/techstandards.asp

Burton, J. K., Moore, D. M., & Magliaro, S. G. (2004). Behaviorism and instructional technology. in Jonassen, D, (Ed), *Handbook of research for educational communications and technology* (pp. 3-37). Available from http://www.questia.com/read/104857577?title=Handbook%20of%20Research%20on%20Educational%20Communications%20and%20Technology

Carlson, S. (2001). Logging in with... Larry Cuban. *The Chronicle of Higher Education.* Retrieved March 27, 2002, from http://chronicle.com/free/2001/11/2001110802t.htm

Carr, N. (2004). *Does IT matter? Information technology and the corrosion of competitive advantage*. Boston, MA: Harvard Business School Publishing.

Castells, M. (2004). Informationalism, networks, and the network society: A theoretical blueprint. In M. Castells (Ed.), *The Network Society: A Cross-cultural perspective* (pp. 3-48). Cheltenham, UK: Edward Elgar Publishing Limited.

Catania, A. C., & Harnad, S. R. (1988). *The selection of behavior: The operant behaviorism of BF Skinner: Comments and consequences*. Cambridge and New York: Cambridge University Press.

Chaptal, A. (2002). Is the investment really worth it? *Educational Media International, 39*(1), 87-99.

Chen, H. T. (1997). Applying mixed methods under the framework of theory-driven evaluations. In J. C. Greene & V. J. Caracelli (Eds.), *Advances in mixed-method evaluation: The challenges and benefits of integrating diverse paradigms* (pp. 61-72). San Francisco: Jossey-Bass Publishers.

Cherednichenko, B., Davies, A., Kruger, T., & O'Rourke, M. (2001). *Collaborative practices: From description to theory*. Paper presented at the AARE 2001 Conference. Retrieved June 7, 2002, from http://www.aare.edu.au/01pap/dav01436.htm

Cherednichenko, B., Hooley, N., Kruger, T., & Moore, R. (1999). *Case writing analysis as a means of profiling school change*. Paper presented at the AARE, 1999 Conference. Retrieved June 17, 2006, from http://www.aare.edu.au/99pap/hoo99316.htm

Clark, A. C., & Wenig, R. E. (1999). Identification of quality characteristics for technology education programs: A North Carolina case study. *Journal of Technology Education, 11*(1), 18-26.

Clayton, M. J. (1997). Delphi: A technique to harness expert opinion for critical decision-making in education. *Educational Psychology, 17*(4), 373-386.

Commonwealth of Australia. (1999). *National statement on ethical conduct in research involving humans*. Retrieved March 12, 2003. from http://www.nhmrc.gov.au/publications/synopses/_files/e35.pdf.

Condie, R., & Simpson, M. (2004). The impact of ICT initiatives in Scottish schools: Cultural issues. *European Journal of Teacher Education, 27*(1), 73-82.

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*(2), 137-150.

Cope, B., & Kalantzis, M. (2000). Multiliteracies: Literacy learning and the design of social futures, Available from http://www.questia.com/app/direct/SM.qst

Coppola, E. M. (2004). *Powering up: Learning to teach well with technology*. New York: Teachers College Press.

Cox, M., Abbott, C., Webb, M., Blakeley, B., Beauchamp, T., & Rhodes, V. (2003a). ICT and attainment: A review of the research literature. *ICT in schools research and evaluation series – No. 17* Retrieved November 7, 2005, from http://partners.becta.org.uk/page_documents/research/ict_attainment_summary.pdf

Cox, M., Abbott, C., Webb, M., Blakeley, B., Beauchamp, T., & Rhodes, V. (2003b). ICT and pedagogy: A review of the research literature. *ICT in schools research and evaluation series – No.18* Retrieved November 7, 2005, from http://partners.becta.org.uk/page_documents/research/ict_pedagogy_summary.pdf

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, London and New Delhi: Sage Publications.

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2nd ed.). Upper Saddle River, New Jersey: Pearson Education.

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage Publications Inc.

Creswell, J. W., Clark, V. L. P., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 209-240). Thousand Oaks, London, New Delhi: Sage Publications.

Creswell, J. W., Fetters, M. D., & Ivankova, N. V. (2004). Designing a mixed methods study in primary care. *Annals of Family Medicine 2*(1), 7-12.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into practice, 39*(3), 124-130.

Cuban, L. (1993). Computers meet classroom: Classroom wins. *Teachers College Record, 95*(2), 185-219.

Cuban, L. (1996). Techno-reformers and classroom teachers. *Education Week on the Web* Retrieved May 17, 2002, from http://ldt.stanford.edu/~jsulzen/james-sulzen-portfolio/classes/ED229b/Readings/ED229B-Readings/www.stanford.edu/class/ed229b/fall00/readings/cuban.pdf

Cuban, L. (1998). High-tech schools and low-tech teaching: A commentary. *Journal of Computing in Teacher Education, 14* (2), 6-7

Cuban, L. (2000a). *So much high-tech money invested, so little use and change in practice: How come?* Paper presented at the Council of Chief State School Officers' Annual Technology Leadership Conference in January 2000, Washington, D.C.

Cuban, L. (2000b). Taking stock: What does research say about technology's impact on education? Interview with Larry Cuban. Retrieved October 10, 2006, from http://www.techlearning.com/db_area/archives/TL/062000/archives/cuban.html

Cuban, L. (2001). *Oversold and underused: Computers in the classroom.* Cambridge: 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.

Cuhls, K. (2001). Delphi method. Retrieved April 12, 2002, from http://www.unido.org/file-storage/download/?file_id=16959

Dakich, E. (2004). *From ICT competencies to the social practice of ICT-rich pedagogies: Results of a Delphi study.* Conference presentation. AARE 2004 Conference, Melbourne Australia

Dakich, E. (2005a). Teacher survey. Retrieved February 17, 2005, from http://education.vu.edu.au/survey

Dakich, E. (2005b). *Teachers' ICT literacy in the contemporary primary classroom: Transposing the discourse.* Paper presented at the Australian Association for Research in Education (AARE) Conference 2005. Retrieved January 3, 2006, from http://www.aare.edu.au/05pap/dak05775.pdf

Dakich, E. (2006). *"Mediating the frames of meaning" through mixed methods research* Paper presented at the Mixed Methods Conference, 2006, Cambridge, UK.

Dakich, E. (2008a). *Drawing on the wisdom of the Oracle: Utilizing the Delphi method in mixed methods research in education.* Paper presented at the Mixed Methods Conference, 2008, Cambridge, UK.

Dakich, E. (2008b). Towards the social practice of digital pedagogies. In N. Yelland, G. Neal & E. Dakich (Eds.), *Rethinking education with ICT: New directions for effective practices.* Rotterdam and Taipei: Sense Publishers.

Dakich, E., Cherednichenko, B., Vale, C., & Thalathoti, V. (2008). *Are teachers ready to engage the digital natives in 21st century learning? An Australian perspective.* Paper presented at the Valuing shared and individual learning, IFIP WG 3.5 Conference, Prague, Czech Republic.

Dakich, E., Vale, C., Thalathoti, V., & Cherednichenko, B. (2008). *Factors influencing teachers' ICT literacy: A snapshot from Australia.* Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications 2008, Vienna, Austria.

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*(6), 456-470.

Dalkey, N. C. (1968). *Predicting the future.* Santa Monica, CA.

Datta, L. (1994). Paradigm wars: A basis for peaceful coexistence and beyond. In C. Reichardt & S. Rallis (Eds.), *The qualitative quantitative debate: New perspectives.* San Francisco,CA: Josey-Bass.

de Vaus, D. A. (2002). *Surveys in social research* (5th ed.). Crows Nest, NSW, Australia: Allen & Unwin.

DE&T. (1998). *Notebooks for Teachers and Principals Programme.* Retrieved July 7, 2003. from http://www.education.vic.gov.au/management/%20ictsupportservices/notebooks/default.htm.

DE&T. (2004). Schools online: Victorian government and non-government schools. Retrieved January 18, 2004, from http://www.eduweb.vic.gov.au/SchoolsOnline/

DE&T. (2007). Summary statistics for Victorian schools. Retrieved December 21, 2007, from http://www.eduweb.vic.gov.au/edulibrary/public/publ/research/publ/Summary_Statistics_for_Victorian_Schools_Brochure-July_2007.pdf

DE&T Victoria. (2002). *Improved educational outcomes: A better reporting and accountability system for schools.* Retrieved February 17, 2003. from http://www.eduweb.vic.gov.au/edulibrary/public/commrel/addresses/minister/edoutcomes-smt.pdf.

DE&T Victoria. (2003). *Blueprint for government schools: Future directions for education in the Victorian government school system.* Retrieved July 16, 2004. from

http://www.eduweb.vic.gov.au/edulibrary/public/govrel/reports/Blueprint_compl ete.pdf.

Dede, C. (2007). Chris Dede on emerging technologies and neomillennial learning styles. Podcast. Retrieved September 14, 2007, from http://connect.educause.edu/blog/jcummings/chrisdedeonemergingt/16662?time= 1189943066

DEECD. (2008). *Blueprint for early childhood development and school reform: An overview*. Retrieved November 11, 2008. from http://www.gowrie-melbourne.com.au/downloads/BLUEPRINT%20An%20Overview%20FINAL%2 0DRAFT.

Delbecq, A. L., Van De Ven, A. H., & Gustafson, D. H. (1975). *Group techniques for program planning: A guide to nominal group techniques and delphi processes*. Glenview, IL: Scott, Foresman and Company.

Demetriadis, S., Barbas, A., Molohides, A., Palaigeorgiou, G., Psillos, D., Vlahavas, I., et al. (2003). "Cultures in negotiation": Teachers' acceptance/resistance attitudes considering the infusion of technology into schools. *Computers and Education, 41*(1), 19-37.

Denzin, N. K., & Lincoln, Y. S. (2003). *Strategies of qualitative inquiry* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2000). *Handbook of qualitative research* (Second Edition ed.). Thousand Oaks, CA: Sage Publications.

Department of Education Training and the Arts Queensland. (2002). Productive pedagogies: Classroom reflection manual. Retrieved September 4, 2004, from http://education.qld.gov.au/public_media/reports/curriculum-framework/productive-pedagogies/html/manual-intro.html

DEST. (2002). Raising the Standards: A proposal for the development of an ICT competency framework for teachers. Retrieved August 22, 2003, from http://www.dest.gov.au/schools/publications/2002/RaisingtheStandards/Raisingth eStandards.pdf.

Drenoyianni, H. (2006). Reconsidering change and ICT: Perspectives of a human and democratic education. *Education and Information Technologies, 11*(3), 401-413.

Duffy, T. M., & Jonassen, D. H. (1992). Constructivism and the technology of instruction: A conversation., Available from http://www.questia.com/PM.qst?a=o&d=9212366

Dunbar, A., Clarkson, P., & Toomey, R. (2000). *Information and Communication Technologies and the process of whole school reform: An evaluation of the Navigator Schools Project. Final report - Part one*. Melbourne: The Australian Catholic University Faculty of Education.

Education Queensland. (2000). Productive Pedagogies. *Queensland Department of Education* Retrieved April 15, 2003, from http://education.qld.gov.au/corporate/newbasics/html/pedagogies/pedagog.html

Education Victoria. (1998). *Rethinking learning and teaching: The Navigator schools' experience* (Report). Melbourne: Department of Education, Victoria.

Educational Testing Service. (2007). Digital Transformation: A Framework for ICT Literacy. Retrieved March 11, 2008, from http://www.ets.org/Media/Tests/Information_and_Communication_Technology_ Literacy/ictreport.pdf

Emerson, R. M., Fretz, R. I., & Shaw, L. L. (1995). *Writing ethnographic fieldnotes*. Chicago and London: The University of Chicago Press.

Falus, I. (1996). A megfigyelés. In I. Falus (Ed.), *Bevezetés a pedagógiai kutatás módszereibe* (pp. 517-539). Budapest, Hungary: Keraban Kiadó.

Feldman, M. S. (1995). *Strategies for interpreting qualitative data*. Thousand Oaks, CA: Sage Publications.

Ferneding, K. A. (2003). *Questioning technology: Electronic technologies and educational reform*: New York: Peter Lang.

Finger, G., Jamieson-Proctor, R., & Watson, G. (2003). *Recommendations for the development of an ICT curriculum integration performance measurement instrument: Focusing on student use of ICTs*. Paper presented at the NZARE/AARE Conference Auckland, NZ.

Finger, G., Jamieson-Proctor, R., & Watson, G. (2005). *Measuring Learning with ICTs: An external evaluation of Education Queensland's ICT Curriculum Integration Performance Measurement Instrument*. Paper presented at the AARE Conference 2005. Retrieved January 12, 2006, from http://www.aare.edu.au/05pap/fin05122.pdf

Fink, A. (2003a). *How to ask survey questions?* (2nd ed. Vol. 2). Thousand Oaks, CA: Sage Publications, Inc.

Fink, A. (2003b). *How to design survey studies?* (2nd ed. Vol. 6). Thousand Oaks, CA: Sage Publications, Inc.

Fink, A. (2003c). *How to manage, analyze, and interpret survey data?* (2nd ed. Vol. 9). Thousand Oaks, CA: Sage Publications, Inc.

Fink, A. (2003d). *The survey handbook* (2nd ed. Vol. 1). Thousand Oaks, CA: Sage Publications, Inc.

Fink, A. (2006). *How to conduct surveys? A step-by-step guide*. Thousand Oaks, CA: Sage Publications.

Fluck, A. (2001). Some national and regional frameworks for integrating information and communication technology into school education. *Educational Technology and Society, 4*(3), 145-152.

Foucault, M. (2002). *The archaeology of knowledge* (Reprint ed.). London: Routledge.

Frankowicz, M., Kedzierska, B., & Mirecka, J. (2006). *New Information and Communication Technology and the changing role of the teacher*. Paper presented at the Information and Communication Technology in Natural Science Education Conference. Retrieved March 2, 2007, from http://www.iktgu.projektas.lt/Konf_2006papers/iktgu_konf06_07Frankovicz2.pdf

Friedman, T. L. (2005). *The world is flat: A brief history of the globalized world in the twenty-first century*. London, UK: Allen Lane.

Fullan, M. (1993). *Change forces probing the depths of educational reform*. London: The Falmer Press.

Fullan, M. (2007a). *Leading in a culture of change* (Revised ed.). San Francisco, CA: Jossey-Bass.

Fullan, M. (2007b). *The new meaning of educational change*. New York, NY: Teachers College Press.

Gage, N. L. (1989). The paradigm wars and their aftermath: A" historical" sketch of research on teaching since 1989. *Educational Researcher, 18*(7), 4-10.

Gagné, R. M. (1985). *The conditions of learning and theory of instruction* (4th ed.). New York: Holt, Rinehart and Winston.

Gardiner, J., & Thorpe, S. (1994). Paradigm paradoxes and the processes of educational research: Using the theory of logical types to aid clarity. *AARE, 2004 Conference* Retrieved July 19, 2004, from www.aare.edu.au/94pap/thors94453.txt

Gardner, H. (1993). Frames of mind: The theory of Multiple Intelligences In (2nd ed.). New York: Basic Books.

Garland, R. (1991). The mid-point on a rating scale: Is it desirable? *Marketing Bulletin, 2*, 66-70.

Gaynor, S. T. (2004). Skepticism of caricatures: BF Skinner turns 100. *Skeptical Inquirer, 28*(1), 26-29.

Gee, J. P., Hull, G., & Lankshear, C. (1996). *The new work order: Behind the language of the new capitalism.* St. Leonards, NSW: Allen & Unwin.

Gibbs, W., Graves, P. R., & Bernas, R. S. (2001). Evaluation guidelines for multimedia courseware. *Journal of Research on Technology in Education, 34*(1), 2-11.

Giddens, A. (1984). *The constitution of society: Outline of a theory of structuration.* Cambridge: Polity Press.

Giddens, A. (1993). *New rules of sociological method* (Second, revised ed.). Stanford, CA: Stanford University Press.

Giddens, A., & Pierson, C. (1998). *Conversations with Anthony Giddens: Making sense of modernity.* Stanford, CA: Stanford University Press.

Gillani, B. B. (2003). *Learning theories and the design of E-learning environments.* Lanham, MD: University Press of America.

Giroux, H. A. (1992). *Border crossings: Cultural workers and the politics of education.* New York and London: Routledge.

Glasersfeld, E. v. (Ed.) (1989) The international encyclopaedia of education (Vol.1.). Oxford and New York: Pergamon Press.

Glasersfeld, E. v. (1995a). A constructivist approach to teaching In L. P. Steffe & J. E. Gale (Eds.), *Constructivism in education* (pp. 3-16). Hillsdale, NJ: Lawrence Erlbaum Associates.

Glasersfeld, E. v. (1995b). *Radical constructivism: A way of knowing and learning.* London and Washington D.C.: Falmer Press.

Gleick, J. (1988). *Chaos: Making a new science* (Reprint ed.). New York: Penguin Group.

Glenberg, A. M. (1988). *Learning from data: An introduction to statistical reasoning.* San Diego: Harcourt Brace Jovanovich Publishers.

Gliem, J. A., & Gliem, R. R. (2003). *Calculating, interpreting, and reporting Cronbach's Alpha reliability coefficient for Likert-type scales.* Paper presented at the 22nd Annual Midwest research to Practice Conference in Adult, Continuing, and Community Education, Milwaukee, WI.

Goering, P. N., & Streiner, D. L. (1996). Reconcilable differences: The marriage of qualitative and quantitative methods. *Canadian Journal of Psychiatry, 41*(8), 491-497.

Goldschmidt, P. (1996). A comprehensive study of the ethical , legal, and social implications of advances in biomedical and behavioural research and technology. In M. Adler & E. Ziglio (Eds.), *Gazing into the Oracle: The Delphi method and its applications to social policy and public health* (pp. 90-130). London: Jessica Kingsley Publishers.

Goodson, I. F., & Mangan, J. M. (1995). Subject cultures and the introduction of classroom computers. *British Educational Research Journal, 21*(5), 613-628.

Goos, M., Stillman, G., & Vale, C. (2007). *Teaching secondary school mathematics: Research and practice for the 21st century* Crows Nest, NSW: Allen & Unwin.

Green, B., & Bigum, C. (1993). Aliens in the classroom. *Australian Journal of Education, 37*(2), 119-141.

Greene, J. C., & Caracelli, V. J. (1997). Defining and describing the paradigm issue in mixed-method evaluation. *New Directions for Program Evaluation, 1997*(74), 5-17.

Greenfield, A. (2006). *Everyware: The dawning age of ubiquitous computing*. Berkeley, CA: Peachpit Press

Guba, E. G. (1990). *The paradigm dialog*. Newbury Park: Sage Publications.

Guba, E. G., & Lincoln, Y. S. (1981). *Effective evaluation: Improving the usefulness of evaluation results through responsive and naturalistic approaches*. San Francisco: Jossey-Bass Publisher.

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Newbury Park, CA: Sage Publications.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). Thousand Oaks, CA: Sage.

Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education*(101), 261-315.

Hall, P. (2006). Grey matters: Interview with Joey McAllister. Podcast. Retrieved November 19, 2006, from http://www.stickyminds.com/Media/Podcast/Detail.aspx?webpage=58

Hargreaves, A. (2001). *Changing teachers, changing times: Teachers' work and culture in the postmodern age* (Reprint ed.). London: Continuum.

Harris, L. R. (2008). A phenomenographic investigation of teacher conceptions of student

engagement in learning. *Journal*, 1-30. Retrieved May 14, 2008, from http://www.articlearchives.com/education-training/academic-standards-testing/890920-1.html

Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing, 32*(4), 1008-1015.

Haynes, P., Ip, K., Saintas, P., Stanier, S., Palmer, H., Thomas, N., et al. (2004). Responding to technological change: IT skills and the academic teaching profession. *Active Learning in Higher Education, 5*(2), 152-165.

Heidegger, M. (1977). *The question concerning technology, and other essays* (W. Lovitt, Trans.). New York: Garland Publishers.

Herodotus. (1996). *Histories*. Hertfordshire: Wordsworth Editions Limited.

Hinostroza, J. E., Guzman, A., & Isaacs, S. (2002). Innovative uses of ICT in Chilean schools. *Journal of Computer Assisted Learning, 18*(4), 459-469.

Hoffman, M., & Blake, J. (2003). Computer literacy: Today and tomorrow. *Journal of Computing Sciences in Colleges, 18*(5), 221-233.

Holden, S. (2003). ICT in the curriculum. *Educare News*(133), 56-57.

Holmes, B., Tangney, B., FitzGibbon, A., Savage, T., & Mehan, S. (2001). *Communal constructivism: Students constructing learning for as well as with others*. Paper presented at the Society for Information Technology and Teacher Education International Conference (SITE) 2001, Norfolk, VA, USA.

Howe, N., & Strauss, W. (2000). *Millennials rising: The next great generation*: New York: Vintage Books.

Israel, M., & Hay, I. (2006). *Research ethics for social scientists*. Thousand Oaks, CA: Sage.

ISTE. (2000). National Educational Technology Standards for Teachers. Retrieved April 22, 2002, from http://cnets.iste.org/intro.html

Jackson, W. (1988). *Research methods: Rules for survey design and analysis*. Scarborough, Ontario: Prentice-Hall Canada Inc.

Johnson, B., & Turner, L. A. (2003). Data collection strategies in mixed method research. In C. Teddlie & A. Tashakkori (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 297-319). Thousand Oaks, CA: Sage Publications.

Johnson, D. R., & Johnson, F. P. (1999). *Learning together and alone: Cooperative, competitive, and individualistic learning* (5th ed.). Needham Heights, MA: Allyn & Bacon.

Johnson, D. R., & Johnson, F. P. (2005). *Joining together: Group theory and group skills* (9th ed.). Boston: Allyn & Bacon.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed method research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14-26.

Jonassen, D. (1999a). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory, Vol. 2* (pp. 215-239). Mahwah, NJ: Lawrence Erlbaum.

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B. B. (1995). Constructivism and computer-mediated communication in distance education. *The American Journal of Distance Education, 9*(2), 7-26.

Jonassen, D. H. (1999b). Constructivist learning environments on the web: Engaging students in meaningful learning. *Education Technology Conference and Exhibition*. Retrieved 24/08/2004, from http://www3.moe.edu.sg/edumall/mpite/edtech/papers/d1.pdf

Jonassen, D. H. (2001). Design of constructivist learning environments (CLEs). Retrieved March 14, 2005, from http://www.coe.missouri.edu/~jonassen/courses/CLE/

Jonassen, D. H. (2004). Handbook of research on educational communications and technology, Available from http://www.questia.com/PM.qst?a=o&d=104857577

Jonassen, D. H., & Land, S. M. (2000). *Theoretical foundations of learning environments*: Lawrence Erlbaum Associates.

Jones, A. (2004). *A review of the research literature on barriers to the uptake of ICT by teachers.* Coventry: Becta: British Educational Communications and Technology Agency.

Kalantzis, M., & Cope, B. (2001). New learning: A charter for Australian education. *Canberra, Australian Council of Deans of Education.*

Kalantzis, M., & Cope, B. (2008a). New learning. Retrieved May 6, 2008, from http://newlearningonline.com/

Kalantzis, M., & Cope, B. (2008b). *New learning: Elements of a science of education.* Cambridge, New York: Cambridge University Press.

Kalantzis, M., Cope, B., & and the Learning by Design Project Group. (2005). *Learning by design.* Melbourne: Victorian Schools Innovation Commission, Common Ground.

Kankaanranta, M. (2005). International perspectives on the pedagogically innovative uses of technology. *Human: technology: An Interdisciplinary Journal on Humans in ICT Environments, 1*(2), 111-116.

Karpati, A. (2003). ICT and the quality of learning in Hungarian schools: Results of the OECD Study. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2003* (pp. 980-983). Chesapeake, VA: AACE. Retrieved June 12, 2004, from http://www.editlib.org/p/18073.

Kearns, P. (2002). Towards the Connected Learning Society: An international overview of trends in policy for Information and Communication Technology in education. Retrieved April 6, 2004, from http://www.dest.gov.au/NR/rdonlyres/5526D69E-132A-454D-B916-FBA0B8E86811/912/towards_the_connected.pdf

Kearns, P., & Grant, J. (2002). *The enabling pillars: Learning, technology, community, partnership. A report on Australian policies for Information and Communication Technologies in education and training.* Retrieved May 29, 2003, from http://www.ictpolicy.edna.edu.au/sibling/go/engineName/filemanager/pid/6/The_Enabling_Pillars.pdf?actionreq=actionFileDownload&fid=69.

Keeney, S., Hasson, F., & McKenna, H. (2006). Consulting the Oracle: Ten lessons from using the Delphi technique in nursing research. *Journal of Advanced Nursing, 53*(2), 205-212.

Kennedy, H. P. (2004). Enhancing Delphi research: Methods and results. *Journal of Advanced Nursing, 45*(5), 504-511.

Kerr, S. T. (2004). Toward a sociology of educational technology In D. Jonassen (Ed.), *Handbook of research on educational communications and technology* (pp. 113-142). Mahwah, NJ: Lawrence Erlbaum Associates.

Kilderry, A., & Yelland, N. (2005). A day in the life: Rethinking numeracy in the information age. *Australian Research in Early Childhood Education, 12*(1), 113-121.

Kincheloe, J. L. (2005). *Critical constructivism.* New York: Peter Lang Primers in Education.

Kincheloe, J. L., & Berry, K. S. (2004). *Rigour and complexity in educational research: Conceptualizing the bricolage*: Open University Press.

King, A. (1993). From sage on the stage to guide on the side. *College Teaching, 41*(1), 30-35.

264

Kinnear, H., McWilliams, S., & Caul, L. (2002). The use of interactive video in teaching teachers: An evaluation of a link with a primary school. *British Journal of Educational Technology, 33*(1), 17-26.

Koehler, M. J., & Mishra, P. (2005). Teachers learning technology by design. *Journal of Computing in Teacher Education, 21*(3), 94-102.

Kolb, D. (2000). The process of experiential learning. In R. L.Cross & S. Israelit (Eds.), *Strategic learning in a knowledge economy: Individual, collective, and organizational learning process* (pp. 313-332). Woburn, MA: Butterworth-Heinemann

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development.* Upper Saddle River, NJ: Prentice Hall.

Kolb, D. A., Boyatzis, R. E., & Mainemelis, C. (2001). Experiential learning theory: Previous research and new directions. In R. J. Sternberg & L. F. Zhang (Eds.), *Perspectives thinking learning and cognitive styles* (pp. 227-248). NJ: Lawrence Erlbaum.

Kolmogorov, A. N. (1956). *Foundations of the theory of probability* (N. Morrison, Trans. 2nd ed.). New York: Chelsea Pub. Co.

Kosko, B. (1993). *Fuzzy thinking: The new science of fuzzy logic.* New York: Hyperion.

Kozma, R. (2003a). Summary and implications for ICT-based educational change. In R. B. Kozma (Ed.), *Technology, innovation, and educational change: A global perspective* (pp. 217-240). Eugene, OR: International Society for Technology in Education.

Kozma, R. B. (2003b). Technology, innovation, and educational change: A global perspective: A report of the Second Information Technology in Education Study, Module 2, Available from http://www.questia.com/read/113455286

Kozma, R. B., & Anderson, R. E. (2002). Qualitative case studies of innovative pedagogical practices using ICT. *Journal of Computer Assisted Learning, 18*(4), 387-394.

Kramer, B. S., Walker, A. E., & Brill, J. M. (2007). The underutilization of information and communication technology-assisted collaborative project-based learning among international educators: A Delphi study. *Educational Technology Research and Development, 55*(5), 527-543.

Kruger, T., & Cherednichenko, B. (2005). Social justice in teacher education. *The International Journal of Learning, 12.*

Krumsvik, R. (2005). ICT and community of practice. *Scandinavian Journal of Educational Research, 49*(1), 27 - 50.

Langdon, W. (2004). Technology as forms of life. In D. M. Kaplan (Ed.), *Readings in the philosophy of technology* (pp. 103-113). Oxford: Rowman & Littlefield.

Lankshear, C. (1998). Language and the new capitalism. *International Journal of Inclusive Education, 1*(4), 309 - 321.

Lankshear, C., Bigum, C., Durrant, C., Honan, E., Morgan, W., Murray, J., et al. (1997). *Digital rhetorics: Literacies and technologies in education. Current practices and future directions, issues and innovations*: Commonwealth of Australia.

Lankshear, C., & Knobel, M. (2003). The 'new literacy studies' and the study of new literacies. In C. Lankshear & M. Knobel (Eds.), *New literacies, changing knowledge and the classroom* (pp. 23-49). Buckingham, UK: Open University Press.

Lankshear, C., Snyder, I., & Green, B. (2000). Teachers and technoliteracy: Managing literacy, technology, and learning in schools, Available from http://www.questia.com/read/102358102?title=Teachers%20and%20Technolitera cy%3a%20Managing%20Literacy%2c%20Technology%2c%20and%20Learning %20in%20Schools

Lather, P. (2006). Paradigm proliferation as a good thing to think with: Teaching research in education as a wild profusion. *International Journal of Qualitative Studies in Education, 19*(1), 35-37.

Law, N. (2006). *ICT, pedagogical innovations and teacher learning.* Paper presented at the Society for Information Technology and Teacher Education International Conference 2006. Retrieved June 12, 2007, from http://www.editlib.org/index.cfm/files/paper_22532.pdf?fuseaction=Reader.Dow nloadFullText&paper_id=22532

Lee, L., & O' Rourke, M. (2006). Information and communication technologies: Transforming views of literacies in early childhood settings. *Early Years, 26*(1), 49 - 62.

Lewis, R. L. (1999). Cognitive modeling, symbolic. In R. Wilson & F. Keil (Eds.), *The MIT Encyclopedia of the Cognitive Sciences* (p.141). Cambridge, Massachusetts: MIT Press.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Newbury Park: Sage Publications.

Lingard, B., Hayes, D., & Mills, M. (2003). Teachers and productive pedagogies: Contextualising, conceptualising, utilising. *Pedagogy, Culture and Society, 11*(3), 399-424.

Linstone, H. A. (2002). Eight basic pitfalls: A checklist. In H. A. Linstone & M. Turoff (Eds.), *The Delphi method: Techniques and Applications* (pp. 559-571). Retrieved April 15, 2003, from http://www.is.njit.edu/pubs/delphibook/

Linstone, H. A., & Turoff, M. (Eds.). (1975). *The Delphi method: Techniques and applications*. Reading, MA: Addison-Wesley.

Linstone, H. A., & Turoff, M. (2002). The Delphi method: Techniques and applications. Retrieved April 15, 2003, from http://www.is.njit.edu/pubs/delphibook/

Lloyd, M., Cochrane, J., & Beames, S. (2005). *Dynamic not static: Characteristics of effective teacher professional development in ICT.* Paper presented at the AARE Conference, 2005. Retrieved February 17, 2006, from http://www.aare.edu.au/05pap/llo05773.pdf

Lombardi, M. M. (2007). Authentic learning for the 21st century: An overview. In D. G. Oblinger (Ed.), *Educause Learning Initiative, White Papers.* Retrieved August 22, 2008, from http://net.educause.edu/ir/library/pdf/ELI3009.pdf

Lonsdale, M., & McCurry, D. (2004). Literacy in the new millennium. *Adelaide, Australian Council for Educational Research, NCVER.*

Loveless, A. (2003). *The role of ICT.* New York: Continuum.

Loveless, A., & Ellis, V. (Eds.). (2001). *ICT, pedagogy, and the curriculum : Subject to change.* London: Routledge/Falmer.

Manca, D. P., Varnhagen, S., Brett-MacLean, P., Allan, G. M., Szafran, O., Ausford, A., et al. (2007). Rewards and challenges of family practice: Web-based survey using the Delphi method. *Canadian Family Physician, 53*(2), 277-286.

Markauskaite, L. (2005). Notions of ICT literacy in Australian school education. *Informatics in Education, An International Journal* (Vol 4_2), 253.

Markauskaite, L. (2006). Towards an integrated analytical framework of information and communications technology literacy: From intended to implemented and achieved dimensions. *Information Research, 11*(3), 11-13.

Masters, J., & Yelland, N. (2002). Teacher scaffolding: An exploration of exemplary practice. *Education and Information Technologies, 7*(4), 313-321.

Mauthner, M. (2002). *Ethics in qualitative research.* Thousand Oaks, CA: Sage.

MAV. (2005). Mathematics Talent Quest.   Retrieved June 12, 2005, from http://www.mav.vic.edu.au/index.html

McCluskey, A. (2003). Empowering the actors of tomorrow's school:Key issues from EMINENT 2003 and elsewhere.   Retrieved January 20, 2005, from http://www.ond.vlaanderen.be/ict/onderzoek/EMINENT2003%20report.pdf

MCEETYA. (2000). *Learning in an online world: The school education action plan for the information economy*. Retrieved November 13, 2006. from http://www.edna.edu.au/edna/webdav/site/myjahiasite/shared/00_learning_online world.pdf

MCEETYA. (2002). *Learning in an online world: The school education action plan for the information economy, Progress report 2002*. Retrieved 13/11/2006. from http://www.icttaskforce.edna.edu.au/icttaskforce/webdav/site/icttaskforcesite/user s/root/public/progress_report.pdf.

MCEETYA. (2003a). *Bandwidth action plan: Learning in an online world*. Retrieved November 2, 2004. from http://icttaskforce.edna.edu.au/icttaskforce/webdav/site/icttaskforcesite/users/root /public/bandwidth_plan.pdf.

MCEETYA. (2003b). *Learning architecture framework: Learning in an online world*. Retrieved November 2, 2004. from http://www.curriculum.edu.au/verve/_resources/25aagenda.pdf.

MCEETYA. (2003c). Monitoring and reporting on Australia's national goals for schooling and ICT. Retrieved February 5, 2004, from http://cms.curriculum.edu.au/anr2003/ch9_monitoring.htm

MCEETYA. (2003d). *Research strategy: Learning in an online world*. Retrieved November 2, 2004. from http://www.mceetya.edu.au/verve/_resources/16aagenda.pdf.

MCEETYA. (2004). Demand and supply of primary and secondary school teachers in Australia.   Retrieved December 17, 2007, from http://www.mceetya.edu.au/verve/_resources/-DAS_teachers-PartsA-d.pdf

MCEETYA. (2005a). *Bandwidth implementation plan: Learning in an online world*. Retrieved April 4, 2006. from http://icttaskforce.edna.edu.au/icttaskforce/webdav/site/icttaskforcesite/users/root /public/learning_online_bandwidth.pdf.

MCEETYA. (2005b). *Learning in an online world: Contemporary learning*. Retrieved
March 12, 2006. from
http://www.mceetya.edu.au/verve/_resources/Contemp_Learning_Final.pdf.

MCEETYA. (2005c). *Learning in an online world: Pedagogy strategy*. Retrieved August
5, 2006. from
http://www.mceetya.edu.au/verve/_resources/pedagogy_strategy_file.pdf.

MCEETYA. (2005d). *Online curriculum content and investment proposal: Learning in
an online world*. Retrieved April 4, 2006. from
http://icttaskforce.edna.edu.au/icttaskforce/webdav/site/icttaskforcesite/users/root
/public/OnlineContentInvestmentProposal.pdf.

MCEETYA. (2005e). *Pedagogy strategy: Learning in an online world*. Retrieved April 4,
2006. from
http://www.mceetya.edu.au/verve/_resources/ICT_LearningOnlineWorld-
PedagogyStrategy.pdf.

MCEETYA. (2006a). *Content specifications framework: Learning in an online world*.
Retrieved December 5, 2007. from
http://www.mceetya.edu.au/verve/_resources/ICT_LearningOnlineWorld-
ContentSpecificationsFWork.pdf.

MCEETYA. (2006b). *Leadership strategy: Learning in an online world*. Retrieved
October 22, 2007. from
http://www.mceetya.edu.au/verve/_resources/Leadership_Strategy.pdf.

MCEETYA. (2008). *Melbourne declaration on educational goals for young Australians*.
Retrieved December 17, 2008. from
http://www.mceetya.edu.au/mceetya/melbourne_declaration,25979.html.

McMillan. (2004). *Educational research* (4th ed.). Boston: Pearson & AB.

Meredyth, D., Russell, N., Blackwood, L., Thomas, J., & Wise, P. (1999). *Real time:
Computers, change and schooling*. Canberra: Commonwealth Department of
Education.

Meredyth, D., Russell, N., Blackwood, L., Thomas, J., Wise, P., & Australian Key Centre
for Cultural and Media Policy. (1999). Real-time computers, change and
schooling: A national sample study of the information technology skills of
Australian school students. Retrieved March 24, 2006, from
http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/
archives/real_time_computers_change_schooling.htm

269

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Miller, A. R. (1971). *The assault on privacy: Computers, data banks, and dossiers.* Ann Arbor, MI: University of Michigan Press.

Ministerial Council on Employment Education Training and Youth Affairs. (1999). *The Adeleide declaration of national goals for schooling in the twenty-first century.* Retrieved July 2, 2003. from http://www.mceetya.edu.au/mceetya/nationalgoals/keypaper.htm.

Mitroff, I. I., & Turoff, M. (1975). Philosophical and methodological foundations of Delphi. In H. A. Linstone & M. Turoff (Eds.), *The Delphi method: Techniques and applications* (pp. 559-571). Reading, MA: Addison-Wesley.

Moyle, K. (2005). *Computing technologies in school education: Policies and standards and standard policies.* Paper presented at the AARE Conference 2005. Retrieved October 9, 2006, from http://www.aare.edu.au/05pap/moy05462.pdf

Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: A review of the literature. *Journal of Information Technology for Teacher Education, 9*(3), 319-342.

Nahalka, I. (1997). Kognitív pedagógia. In Z. Bathory & I. Falus (Eds.), *Pedagógiai Lexicon* (Vol. 2, p. 250). Budapest, Hungary: Keraban Kiadó.

Nardi, P. M. (2006). *Doing survey research: A guide to quantitative methods.* Boston: Pearson Education, Inc.

Neal, G. (2007). Learning with information and communication technology. *Australian Journal of Middle Schooling, 7*(1), 5-11.

O'Rourke, M. (2005). Multiliteracies for 21st century schools. *Australian National School Network (ANSN) Snapshot, No.2* (May 2005), 1-14.

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.

O'Malley, C. (2004). *Literature review in learning with tangible technologies. Futurelab Series* (No. 12). Retrieved June 1, 2006, from http://www.oecd.org/dataoecd/28/4/35995145.pdf

OECD. (2006). Are students ready for a technology rich world?: What PISA studies tell us? Retrieved February 21, 2006, from http://www.oecd.org/dataoecd/28/4/35995145.pdf

OFSTED. (2001). 1999-2000 standards and quality in education. The annual report of
   Her Majesty's Chief Inspector of Schools.   Retrieved May 29, 2003, from
   http://www.archive.official-documents.co.uk/document/ofsted/hc102/102-01.htm

OFSTED. (2002). ICT in schools: Effect of government initiatives implementation in
   primary schools and effect on literacy. Retrieved March 16, 2003, from
   http://www.ofsted.gov.uk/Ofsted-home/Publications-and-research/Browse-all-
   by/Education/Curriculum/English/Primary/ICT-in-schools-effect-of-government-
   initiatives-implementation-in-primary-schools-and-effect-on-literacy

OFSTED. (2005). The annual report of Her Majesty's Chief Inspector of Schools
   2004/05.   Retrieved May 14, 2006, from
   http://live.ofsted.gov.uk/publications/annualreport0405/annual_report.html

Oliver, R., & Towers, S. (2000a). *Benchmarking ICT literacy in tertiary learning settings.*
   Paper presented at the 17th Annual ASCILITE Conference, Lismore, NSW.

Oliver, R., & Towers, S. (2000b). *Information and Communications Technology literacy:*
   Getting serious about IT. Paper presented at the World Conference on
   Educational Multimedia, Hypermedia and Telecommunications 2000 Montreal,
   Canada

Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of
   technology in organizations. *Organization Science, 3*(3), 398-427.

Orlikowski, W. J., & Robey, D. (1991). Information technology and the structuring of
   organizations. *Information Systems Research, 2*(2), 143-169.

Orlikowski, W. J., & Yates, J. (2006). ICT and organizational change: A commentary.
   Journal of Applied Behavioral Science, 42(1), 127-134.

Osborne, J. (2003). Literature review in Science education and the role of ICT: Promise,
   problems and future directions. *Journal, REPORT 6.* Retrieved from
   http://www.futurelab.org.uk/download/pdfs/research/lit_reviews/Secondary_Scho
   ol_Review.pdf

Owour, C. O., & Zumbo, B. D. (2001). *Implications of ordinal scale categorization on*
   regression models under different distributions and conditions: An assessment of
   the accuracy and information of Likert scales on regression analysis. Paper
   presented at the NCME Conference, Seattle, WA, USA.

Pallant, J. (2005). *SPSS survival manual: A step by step guide to data analysis using*
   SPSS for Windows: Version12 (2nd ed.). Crows Nest, NSW: Allen & Unwin.

Papert, S. (1995). Technology in schools: Local fix or global transformation? Remarks by Seymour Papert for a House of Representatives Panel on Technology and Education on October 12, 1995. Retrieved 25/07/2002, from http://kids.www.media.mit.edu/projects/kids/sp-talk.html

Papert, S. (1997). Looking at technology through school-colored spectacles. *Logo Exchange* Retrieved July 24, 2002, from http://www.papert.org/articles/LookingatTechnology/ThroughSchool.html

Papert, S. (1998). Technology in schools: To support the system or render it obsolete? Retrieved October 24, 2004, from http://www.mff.org/edtech/article.taf?_function=detail&Content_uid1=106

Papert, S. (2003). What Are You Talking About?: A Dialogue with Seymour Papert. *Convergence, 9*(2), 10-12.

Patahuddin, S. M. (2008). *Use of the internet for teacher professional development and for teaching mathematics: Supports and inhibitors*. Paper presented at the 31st Annual Conference of the Mathematics Education Research Group of Australasia (MERGA). Retrieved December 14, 2008, from http://www.merga.net.au/documents/RP472008.pdf

Pavlov, I. P. (1927). *Conditioned reflexes: An investigation of the physiological activity of the cerebral cortex* (G. V. Anrep, Trans.). London: Oxford University Press.

Pels, D. (1998). *Property and power in social theory: A study of intellectual rivalry*. London: Routledge

Pépin, Y. (1998). Pratical knowledge and school knowledge: A constructivist representation of education. In M. Larochelle, N. Bernardz & J. Garrison (Eds.), *Constructivism and education* (pp. 173-194). Cambridge: Cambridge University Press.

Petrina, S. (2000). The politics of technological literacy. *International journal of technology and design education, 10*(2), 181-203.

Phillips, D. C. (1987). *Philosophy, science, and social inquiry: Contemporary methodological controversies in social science and related applied fields of research* Oxford: Pergamon Press.

Piaget, J. (1952). The origins of intelligence in children, Available from http://www.questia.com/read/82225770?title=The%20Origins%20of%20Intelligence%20in%20Children

Piaget, J. (1970). *Válogatott tanulmányok*. Budapest: Gondolat Kiadó.

Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS Quarterly, 25*(4), 401-426.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education, 4*(33), 413-430.

Polly, D. (2003). *Anchoring student's learning in technology-rich authentic environments.* Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications 2003, Honolulu, Hawaii, USA.

Portella, E. (2003). Introduction: Indications of the knowledge society. *Diogenes, 50*(1), 5-7.

Potter, W. J. (2005). *Media literacy.* Thousand Oaks, CA: Sage.

Powell, C. (2003). The Delphi technique: Myths and realities. *Journal of Advanced Nursing, 41*(4), 376-382.

Prensky, M. (2001a). Digital natives, digital immigrants. Retrieved November 14, 2006, from http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf

Prensky, M. (2001b). Digital natives, digital immigrants. Part II: Do they really think differently? Retrieved November 14, 2006, from http://www.twitchspeed.com/site/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part2.htm

Pryor, J. H. (2004). Conducting surveys on sensitive topics. *New Directions for Institutional Research*(121), 39-50.

Rasku-Puttonen, H., Eteläpelto, A., Lehtonen, O., Nummila, L., & Häkkinen, P. (2004). Developing teachers' professional expertise through collaboration in an innovative ICT-based learning environment. *European Journal of Teacher Education, 27*(1), 47-60.

Ratcliffe, M. (2000, 7-9 September 2000). *Towards evidence-based practice in science education (EPSE)- an ESRC funded teaching and learning research network.* Paper presented at the BERA, British Educational Research Association, Annual Conference 2000, University of Cardiff.

Ravitz, J. L., Becker, H. J., & Wong, Y. T. (2000). Constructivist-compatible beliefs among US teachers. Teaching, learning and computing: 1998 national survey, Report 4. Retrieved June 7, 2002, from http://www.crito.uci.edu/tlc/html/findings.html

273

Reed, A. J. S., & Bergemann, V. E. (2005). *A guide to observation, participation, and reflection in the classroom* (5th ed.). Boston: McGraw Hill.

Resnick, M., Rusk, N., & Cooke, S. (1998). The computer clubhouse: Technological fluency in the inner city. In D. Schon, B. Sanyal & W. Mitchell (Eds.), *High technology and low-income communities: Prospects for the positive use of advanced information technology*. Cambridge, MA: MIT Press.

Reynolds, D., Treharne, D., & Tripp, H. (2003). ICT the hopes and the reality. *British Journal of Educational Technology, 34*(2), 151-167.

Robertson, J. (2002). The ambiguous embrace: Twenty years of IT (ICT) in UK primary schools. *British Journal of Educational Technology, 33*(4), 403-409.

Rocha, L. M. (1998). Selected self-organization and the semiotics of evolutionary systems. In S. Salthe, G. V. d. Vijver & M. Delpos (Eds.), *Evolutionary systems: Biological and epistemological perspectives on selection and self-organization* (pp. 341-358): Kluwer Academic Publishers.

Rockwell, K., Furgason, J., & Marx, D. B. (2000). Research and evaluation needs for distance education: A Delphi study. *Online Journal of Distance Learning Administration* Retrieved May 21, 2002, from http://www.westga.edu/~distance/ojdla/fall33/rockwell33.html

Rogers, A. (2001). The failure and the promise of technology in education. Retrieved 05/06/2002, from http://www.gsn.org/gsh/teach/articles/promise.html

Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Ruthven, K. (2006). *Understanding practitioners' use of technology in English secondary-school mathematics and science teaching*. Paper presented at the Centre for Studies in Science and Mathematics Education (CSSME) Annual Lecture. Retrieved November 17, 2006, from http://www.education.leeds.ac.uk/research/cssme/documents/cssme_annual_lectu re_2006.doc.

Ruthven, K., & Hennessy, S. (2002). A practitioner model of the use of computer-based tools and resources to support mathematics teaching and learning. *Educational Studies in Mathematics, 49*(1), 47-88.

Ruthven, K., Hennessy, S., & Brindley, S. (2004). Teacher representations of the successful use of computer-based tools and resources in secondary-school

English, Mathematics and Science. *Teaching & Teacher Education, 20*(3), 259-275.

Sackman, H. (1974). *Delphi critique: Expert opinion, forecasting, and group process. A report prepared for the United States Air Force Project RAND*: Rand Corporation.

Sacks, O. W. (1998). *The man who mistook his wife for a hat: And other clinical tales*. New York: Touchstone.

Sales, B. D., & Folkman, S. (2000). *Ethics in research with human participants*. Washington, DC: American Psychological Association.

Salomon, G., Globerson, T., & Guterman, E. (1989). The computer as a zone of proximal development: Internalizing reading-related metacognitions from a reading partner. *Journal of Educational Psychology, 81*(4), 620-627.

Salpeter, J. (2000). Taking stock: What does the research say about technology's impact on education? Interview with Larry Cuban. *Journal*, 3-27. Retrieved from http://www.techlearning.com/db_area/archives/TL/062000/archives/cuban.php

Sandelowski, M. (2000). Focus on research methods: Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. *Research in Nursing &Health, 23*(3), 246-255.

Saul, J. R. (1997). *The unconscious civilisation*. Ringwood, Victoria: Penguin.

Schamoo, A. E., & Resnik, D. B. (2003). *Responsible conduct of research*. Oxford, New York: Oxford University Press.

Scheffler, F. L., & Logan, J. P. (1999). Computer technology in schools: What teachers should know and be able to do. *Journal of Research on Computing in Education, 31*(3), 305.

Schnaars, S. P. (1989). *Megamistakes: Forecasting and the myth of rapid technological change* New York: Free Press.

Schonlau, M., Ronald Fricker, J., & Elliott, M. N. (2002). *Conducting research surveys via e-mail and the Web*: RAND.

Schütz, T., Herbst, B., & Koller, M. (2006). Methodology for the development of the ESPEN guidelines on enteral nutrition. *Clinical Nutrition, 25*(2), 203-209.

Scott, J., & Marshall, G. (2005). Oxford dictionary of sociology. Retrieved November 17, 2006, from http://www.enotes.com/oxsoc-encyclopedia/weltanschauung

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (3rd revised edition ed.). New York: Teachers College Press.

Selwyn, N. (2000). Researching computers and education: Glimpses of the wider picture. *Computers & Education, 34*(2), 93-101.

Selwyn, N., & Bullon, K. (2000). Primary school children's use of ICT. *British Journal of Educational Technology, 31*(4), 321-332.

Sewell, W. H., Jr. (1992). A theory of structure: Duality, agency, and transformation. *The American Journal of Sociology, 98*(1), 1-29.

Sharp, J. (2002). *Primary ICT: Knowledge, understanding and practice* (2nd revised ed.). University of Exeter, Devon, UK: Learning Matters.

Shirley, D., & Hargreaves, A. (2006). Data-driven to distraction. *Education Week* Retrieved May 12, 2007, from

http://www2.bc.edu/~hargrean/docs/EDWeek_Data_Driven.pdf

Shulman, J. (1992). *Case methods in teacher education*. New York: Teachers College Press.

Siemens, G. (2004). Connectivism: A learning theory for the Digital Age. Retrieved August 7, 2005, from www.elearningspace.org/Articles/connectivism.htm

Silverman, D. (2005). *Doing qualitative research*. London, Thousand Oaks and New Delhi: Sage Publications.

Siraj-Blatchford, I., & Siraj-Blatchford, J. (2006). *A Guide to developing the ICT curriculum for early childhood education*: Trentham Books Ltd.

Siraj-Blatchford, J., & Siraj-Blatchford, I. (2004). IBM Kidsmart Early Learning programme European evaluation. France, Germany, Italy, Portugal, Spain and UK. Retrieved August 28, 2005, from

http://www.ibm.com/ibm/ibmgives/downloads/kidsmart_eval_full_rep_English.pdf

Sheingold, K. (1991). *Toward an alternative teaching environment*. Technology Leadership Conference, Council of Chief State School Officers, Dallas, TX.

Skinner, B. F. (1968). *The technology of teaching*. Englewood Cliffs, NJ: Prentice-Hall.

Skinner, B. F. (1974). *About behaviorism*. New York: Knopf.

Skinner, B. F. (1984). An operant analysis of problem solving. *Behavioral and brain sciences, 7*(4), 583-613.

Skinner, B. F. (2005). Science and human behavior, Available from

http://www.bfskinner.org/f/Science_and_Human_Behavior.pdf

Skumanich, M., & Silbernagel, M. (1997). *Foresighting around the World: A review of seven best-in-kind programs*. Seattle: Battelle Seattle Research Center.

Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology, 21*(1), 43-69.

Smeets, E., & Mooij, T. (2001). Pupil-centred learning, ICT, and teacher behaviour: Observations in educational practice. *British Journal of Educational Technology, 32*(4), 403-417.

Spector, J. M. (2001). An overview of progress and problems in educational technology. *Interactive Educational Multimedia* (3), 27-37.

Staddon, J. E. R. (2004). Scientific imperialism and behaviorist epistemology. *Behavior and Philosophy, 32*(1), 231-242.

State of Victoria (1998). Learning technologies: Teacher capabilities statement. Melbourne: Community Information Service, Department of Education.

Sutherland, R., Armstrong, V., Barnes, S., Brawn, R., Breeze, N., Gall, M., et al. (2004). Transforming teaching and learning: Embedding ICT into everyday classroom practices. *Journal of Computer Assisted Learning, 20*(6), 413-425.

Talbot, M. (1992). *The holographic Universe*. New York: Harper Perennial.

Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. New York and Tokyo: McGraw-Hill.

Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches*. Thousand Oaks, London, New Delhi: Sage Publications.

Taylor, P. G. (1999). *Thinking about new learning environments*. Paper presented at the Australian Association for Research in Education and the New Zealand Association for Research in Education, Joint Conference. Retrieved July 23, 2002, from http://www.aare.edu.au/99pap/tay99147.htm

Teddlie, C., & Tashakkori, A. (2003). Major issues and controversies in the use of mixed methods in the social and behavioral sciences. In A. Tashakkori & C. Teddlie (Eds.), *Mixed methods in social and behavioral research* (pp. 3-50). Thousand Oaks, London, New Delhi: Sage Publications.

The Australian Labor Party. (2007). *The Australian economy needs an education revolution: New directions paper on the critical link between long term prosperity, productivity growth and human capital investment*. Retrieved March 8, 2008. from http://www.alp.org.au/download/now/education_revolution_r1.pdf.

The Hon Daryl Williams Minister for Communication Information Technology and the Arts. (2004). *Response to Australian Computer Society policies*. Retrieved July 15, 2006. from http://www.dbcde.gov.au/Article/0,,0_7-2_4011-4_119113,00.html.

The New London Group. (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review, 66*(1), 1-30.

The Parliament of Victoria. (1973). *Public Records Act: Version incorporating amendments as at 7 June 2006*. Retrieved February 5, 2003. from http://www.dms.dpc.vic.gov.au/Domino/Web_Notes/LDMS/PubLawToday.nsf/2 184e627479f8392ca256da50082bf3e/3EFC12B24EAFC9B2CA25718400226875 /$FILE/73-8418a033.pdf.

The Parliament of Victoria. (2000). Information and Privacy Act 2000. Retrieved January 22, 2003, from http://www.dhs.vic.gov.au/privacy/html/info_privacy_act/index.htm

Thorndike, E. L. (2000). *Animal intelligence: Experimental studies*. New Brunswick (U.S.A) and London (U.K): Transaction Publishers.

Thorndike, R. L., & Hagen, E. P. (1969). *Measurement and evaluation in psychology and education*. New York: Wiley.

Todd, J. T., & Morris, E. K. (1995). Modern perspectives on B. F. Skinner and contemporary behaviorism: Greenwood Press Westport, Conn.

Todd, Z., Nerlich, B., McKeown, S., & Cladrke, D. D. (Eds.). (2004). *Mixing methods in psychology: The integration of qualitative and quantitative methods in theory and practice*. Hove and New York: Psychology Press, Taylor and Francis Group.

Tolman, E. C. (1967). *Purposive behavior in animals and men*. New York: Appleton-Century-Crofts.

Tolman, E. C. (1990). Cognitive maps in rats and men. In G. L. Shaw, J. L. McGough & S. P. R. Rose (Eds.), *Neurobiology of learning and memory* (Reprint ed., pp. 67-86). New Jersey and London: World Scientific Publishing Co.Pte.Ltd.

Tomlinson, C. A. (1999). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: ASCD.

Tomlinson, C. A. (2003). *Fulfilling the promise of the differentiated classroom: Strategies and tools for responsive teaching* Alexandria, VA: ASCD.

Tourangeau, R., Rips, L. J., & Rasinski, K. (2000). *The psychology of survey response*. Cambridge: Cambridge University Press.

Tsui, A. B. M. (2005). *Learning as boundary-crossing in school-university partnership.* Paper presented at the Teacher education: local and global. Australian Teacher Education Association 33rd annual conference proceedings, Surfers Paradise, Gold Coast, Queensland, Australia.

Tubin, D., Mioduser, D., Nachmias, R., & Forkosh-Baruch, A. (2003). Domains and levels of pedagogical innovation in schools using ICT: Ten innovative schools in Israel. *Education and Information Technologies, 8*(2), 127-145.

Tuomela, R. (2002). *The philosophy of social practices: A collective acceptance view.* from

http://www.questia.com/read/105146933?title=The%20Philosophy%20of%20Social%20Practices%3a%20A%20Collective%20Acceptance%20View

Turoff, M., & Hiltz, S. R. (1996). Computer-based Delphi processes. In M. Adler & E. Ziglio (Eds.), *Gazing into the oracle: The Delphi method and its application to social policy and public health* (pp. 56-88). London: Jessica Kingsley Publishers.

Turoff, M., Hiltz, S. R., Yao, X., Li, Z., Wang, Y., & Cho, H. K. (2006). Online collaborative learning enhancement through the Delphi method. *Turkish Online Journal of Distance Education, 7*(6), 66-78.

Utts, J. M. (2005). *Seeing through statistics* (3rd ed.). Belmont, CA: Thomson, Brooks/Cole.

Vale, C. M., & Leder, G. C. (2004). Student views of computer-based mathematics in the middle years: Does gender make a difference? . *Educational Studies in Mathematics, 56*(2-3), 287-312.

Valenduc, G., & Vendramin, P. (2005). *Work organisation and skills in ICT professions: The gender dimension.* Paper presented at the ICT conference on the knowledge, society and changes in work, The Hauge, The Netherlands. Retrieved December 21, 2007, from http://www.ftu-namur.org/fichiers/DenHaag-SISWO-pvgv.pdf

Van Braak, J., Tondeur, J., & Valcke, M. (2004). Explaining different types of computer use among primary school teachers. *European journal of psychology of education, 19*(4), 407-422.

Van Manen, J. (1988). *Tales of the field: On writing ethnography.* Chicago and London: The University of Chicago Press.

VCAA. (2002). *Curriculum Standards Framework (CSF) II.* Retrieved September 27, 2002. from http://csf.vcaa.vic.edu.au/home.htm.

VCAA. (2005). *Victorian Essential Learning Standards*. Retrieved June 3, 2007. from http://vels.vcaa.vic.edu.au/.

Venkatesan, V. S., Eversole, R., & Robinson, K. (2004). Information access in rural communities: Bridging the digital divide. In S. Marshall, W. Taylor & X. Yu (Eds.), *Using community informatics to transform regions*. Hreshey, London, Melbourne, Singapore: Idea Group Publishing.

Victorian State Government. (2006a). *Australian first as Victorian schools go wireless*. Retrieved July 12,2007. from http://www.dpc.vic.gov.au/domino/Web_Notes/newmedia.nsf/3981a41eabfaf43b ca256d64007ae1a5/179aec8fa284ec78ca25716c000448db!OpenDocument.

Victorian State Government. (2006b). Teacher supply and demand report. Retrieved December 21, 2007, from http://www.eduweb.vic.gov.au/edulibrary/public/hr/recruit/advert/Teacher_Suppl y_and_Demand_in_Victoria_2006.pdf

Vygotsky, L. S. (1967). *Gondolkoás és beszéd*. Budapest: Akadémiai Kiadó.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and language* (A. Kozulin, Trans. Newly revised ed.). Cambridge, Massachusetts and London, England: The MIT Press

Wallen, N. E., & Fraenkel, J. R. (2001). *Educational research* (2nd ed.). New Jersey: Lawrence Erlbaum Associates, Inc.

Warschauer, M. (2003a). Demystifying the digital divide. *Scientific American 289*(2), 42-47.

Warschauer, M. (2003b). Social capital and access. *Universal Access in the Information Society, 2*(4).

Warschauer, M. (2006). Literacy and technology: Bridging the divide. In D. Gibbs & K. L. Krause (Eds.), *Cyberlines 2: Languages and cultures of the Internet*. Albert Park, Australia: James Nicholas.

Warschauer, M., Knobel, M., & Stone, L. (2004). Technology and equity in schooling: Deconstructing the digital divide. *Educational Policy, 18*(4), 562-588.

Watson, D. M. (2001). Pedagogy before technology: Re-thinking the relationship between ICT and teaching. *Education and Information Technologies, 6*(4), 251-266.

Watson, G. (2006). *Factors affecting teacher classroom internet use*. Paper presented at the Society for Information Technology and Teacher Education International Conference (SITE) 2006. Retrieved June 28, 2007, from http://www.editlib.org/index.cfm?fuseaction=Reader.ViewFullText&paper_id=2 2338

Watts, M., & Lloyd, C. (2004). The use of innovative ICT in the active pursuit of literacy. *Journal of Computer Assisted Learning, 20*(1), 50-58.

Webb, J., & Schirato, T. (2006). Communication technology and cultural politics. *Convergence: The International Journal of Research into New Media Technologies, 12*(3), 255-261.

Webb, N. M. (1982). Student interaction and learning in small groups. *Review of Educational Research, 52*(3), 421-445.

Wedley, W. (1980). *Making Delphi decisions: A new participative approach*. Melbourne: Deakin University, School of Management.

Weinreich, N. K. (1996). A more perfect union: Integrating quantitative and qualitative methods in social marketing research. *Social Marketing Quarterly* (Winter Issue), 53-57.

Wellington, J. (2005). Has ICT come of age? Recurring debates on the role of ICT in education, 1982-2004. *Research in Science & Technological Education, 23*(1), 25 - 39.

Wenger, E. (1999). *Communities of practice: Learning, meaning, and identity*. New York, Melbourne and Cape Town: Cambridge University Press.

Wenger, E., McDermott, R. A., & Snyder, W. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Boston, MA: Harvard Business School Press.

Wheeler, S. (2001). Information and communication technologies and the changing role of the teacher. *Journal of Educational Media, 26*(1), 7-17.

Wheeler, S., Waite, S. J., & Bromfield, C. (2002). Promoting creative thinking through the use of ICT. *Journal of Computer Assisted Learning, 18*(3), 367-378.

Wiersma, W. (2000). *Research methods in education: An introduction*. Boston: Allyn and Bacon.

Wiersma, W., & Jurs, S. G. (2005). *Research methods in education: An introduction* (8th ed.). Boston: Pearson.

Wiley, D. A., & Edwards, E. K. (2002). Online self-organizing social systems: The decentralized future of online learning. *Quarterly Review of Distance Education, 3*(1), 33-46.

Wilson, B. G. (2000). Situated cognition in theoretical and practical context. In D. H. Jonassen & S. M. Land (Eds.), Theoretical foundations of learning environments Available from http://www.questia.com/read/24455808?title=Theoretical%20Foundations%20of %20Learning%20Environments#

Winn, W. (2004). Cognitive Perspectives in Psychology. In D. Jonassen (Ed.), *Handbook of Research on Educational Communications and Technology* (pp. 79-112): Lawrence Erlbaum Associates.

Winship, J. (2000). Information technology literacy project. *Council of Australian University Directors of Information Technology (CAUDIT)* Retrieved 19/04/2002, from http://www.caudit.edu.au/caudit/information/projects/index.html

Wittgenstein, L. (1953). *Philosophical investigations*. Oxford, England: B. Blackwell

Wood, E., Mueller, J., Willoughby, T., Specht, J., & Deyoung, T. (2005). Teachers' perceptions: Barriers and supports to using technology in the classroom. *Education, Communication and Information, 5*(2), 183 - 206.

Woods, P. (1986). *Inside schools: Ethnography in educational research*. London: Routledge.

Woods, P. (1996). *Researching the art of teaching: Ethnography for educational use*. London: Routledge.

Wragg, E.,C. (1996). *An introduction to classroom observation*. London: Routledge.

Yelland, N. (2002). The use of ICTs in the Australian context. Retrieved November 14, 2004, from http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/infoshare5/4CASE2.PDF

Yelland, N. (2005). The future is now: A review of the literature on the use of computers in early childhood education (1994 - 2004). *AACE Journal, 13*(3), 201-232.

Yelland, N. (2007). *Shift to the future: Rethinking learning with new technologies in education*. London: Routledge.

Yelland, N. (2008). New times, new learning, new pedagogies. In N. Yelland, G. Neal & E. Dakich (Eds.), *Rethinking education with ICT: New directions for effective practices*. Rotterdam and Taipei: Sense Publishers.

Zadeh, L. A. (1973). Outline of a new approach to the analysis of complex systems and decision processes. *IEEE Transactions on Systems, Man, and Cybernetics, 3*, 28-44.

Zevenbergen, R. L. (2003). Grouping by ability: A self-fulfilling prophecy? *Australian Mathematics Teacher, 59*(4), 2-7.

Ziglio, E. (1996). The Delphi method and its contribution to desicion making. In M. Adler & E. Ziglio (Eds.), *Gazing into the Oracle: The Delphi method and its application to social policy and public health* (pp. 3-33). London: Jessica Kingsley Publishers.

Appendix A: Delphi questionnaire – First round

Dear Panel Member, welcome to the first round of the Delphi process.

Thank you very much for accepting the role of an expert in the Delphi process that will produce a list of ICT competencies required for teaching in the primary classroom.

Please, receive the working copy of the Scheffler & Logan List of Computer Competencies (1999) that consists of the following sections and groups:

Section 1	GENERAL COMPUTER COMPETENCIES
Group 1	Acquire a Basic Understanding of Computer Operation for Personal or Business Use
Group 2	Acquire Knowledge of The Impact of Computers on Society
Group 3	Operate and Maintain the Components of a Computer System for Home and Business Use
Group 4	Develop and Execute a Personal Plan for Computer Competency
Section 2	COMPUTER COMPETENCIES UNIQUE TO TEACHERS
Group 1	Evaluate and Assemble Components of a Computer System for Instructional Use
Group 2	Acquire Knowledge of the Impact of Computers on Society as It Relates to Students
Group 3	Develop a Plan for Using Computers Within Instruction
Group 4	Implement a Plan to Integrate Computers into Curricula
Group 5	Use Computers in Classroom Management
Group 6	Use Computer Information Resources

We kindly request you to propose changes to the current list by following the instructions below:

- Tick 'include', to leave the competency in its current form.
- Tick 'delete', to omit the existing competency.
- Tick 'modify', if you wish to modify the competency, and enter your suggestion in the textbox below.
- You also have the option of modifying the title of each group, by entering your suggestion in the field provided.
- At the end of each group of competencies you will find an addendum area where you can add new competencies. (We have provided five input fields, if you suggest more then five competencies, please enter them in the fifth field, separated by one blank line.)

Please note: this is a *Word Form* document that will allow you to enter data only in the checkboxes and grey input fields. To save your changes to the document, click on the 'save' icon on the toolbar, and send your response back to the researcher within 10 days.

If you experience any difficulties, or require additional information, do not hesitate to contact me at any time.

Please remember, the aim of the Delphi process is to create the most up to date list of ICT competencies required for learner–centred practices and learning environments in the primary classroom, and it cannot be realized without your valuable contribution.

Thank you very much for your time and expertise.

Sincerely,

Eva Dakich
PhD student
School of Education
Faculty of Human Development
Victoria University of Technology (Melbourne, Australia)
Office: +61 (0) 3 96884672
Mobile: +61 (0) 421573370
eva.dakich@research.vu.edu.au

1

SECTION 1   GENERAL COMPUTER COMPETENCIES   285

Group 1   **Acquire a Basic Understanding of Computer Operation for Personal or Business Use**
Modify title (optional).

Describe how computers can assist the individual.

1   ☐ Include ☐ Delete ☐ Modify

Please, enter your modification here.

Communicate effectively about computers by understanding and using appropriate technology.

2   ☐ Include ☐ Delete ☐ Modify

Identify the basic operations of a computer: input, processing, output.

3   ☐ Include ☐ Delete ☐ Modify

Demonstrate skill in using a computer keyboard.

4   ☐ Include ☐ Delete ☐ Modify

Demonstrate familiarity with the everyday operation of computer hardware and software in order to troubleshoot minor problems.

5   ☐ Include ☐ Delete ☐ Modify

Describe computer communications over local and global networks.

6   ☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 1.1
New C 1.2
New C 1.3
New C 1.4
New C 1.5

2

285

Group 2   **Acquire Knowledge of The Impact of Computers on Society**
Modify title (optional).

7

Demonstrate knowledge of the impact of computer-based technology on our society, including present and future uses of computer technology in the home, school, and work place.

☐ Include ☐ Delete ☐ Modify

8

Discuss some of the positive and negative consequences of computers in today's society.

☐ Include ☐ Delete ☐ Modify

9

Discuss irresponsible behaviors associated with computer technology, such as computer crimes, violation of copyright laws, and unauthorized use of information.

☐ Include ☐ Delete ☐ Modify

10

State health hazards associated with computer usage.

☐ Include ☐ Delete ☐ Modify

11

Describe how computers can assist the individual.

☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 2.1
New C 2.2
New C 2.3
New C 2.4
New C 2.5

Group 3   **Operate and Maintain the Components of a Computer System for Home and Business Use**
Modify title (optional).

12

Use various diagnostic strategies to ascertain the cause of a malfunction and to determine if the problem is related to hardware or software.

☐ Include ☐ Delete ☐ Modify

13

Identify, describe, and demonstrate the function and operation of various components of computers and related peripheral devices (e.g., keyboards, printers, modems, graphic tablets, etc.)

☐ Include ☐ Delete ☐ Modify

14

Demonstrate the proper care of technology systems and related software.

☐ Include ☐ Delete ☐ Modify

3

Describe the basic components of hardware used for networked communications.

15 ☐ Include ☐ Delete ☐ Modify

Respond appropriately to common error messages when using software.

16 ☐ Include ☐ Delete ☐ Modify

Use the operating system software and utility software programs that accompany the computer being used to initialize disks, load, run, save, and copy programs.

17 ☐ Include ☐ Delete ☐ Modify

Identify applications of networked communications.

18 ☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 3.1

New C 3.2

New C 3.3

New C 3.4

New C 3.5

Group 4
Develop and Execute a Personal Plan for Computer Competency
Modify title (optional).

Use the computer to assist in making better personal, instructional, and business decisions.

19 ☐ Include ☐ Delete ☐ Modify

Construct and implement a personal plan for computer competency.

20 ☐ Include ☐ Delete ☐ Modify

Evaluate and modify when necessary personal computer competency plan based on computer innovations.

21 ☐ Include ☐ Delete ☐ Modify

Use manuals and other reference materials.

22 ☐ Include ☐ Delete ☐ Modify

Use electronic calendars and other time management tools.

23 ☐ Include ☐ Delete ☐ Modify

4

287

ADD NEW COMPETENCIES

New C 4.1	
New C 4.2	
New C 4.3	
New C 4.4	
New C 4.5	

SECTION 2

COMPUTER COMPETENCIES UNIQUE TO TEACHERS

Group 1

Evaluate and Assemble Components of a Computer System for Instructional Use

Modify title (optional).

Evaluate software for instructional purposes.

24 ☐ Include ☐ Delete ☐ Modify

Use software to facilitate instruction.

25 ☐ Include ☐ Delete ☐ Modify

Evaluate computer hardware configurations for use in instructional applications.

26 ☐ Include ☐ Delete ☐ Modify

Establish computer hardware/software security.

27 ☐ Include ☐ Delete ☐ Modify

Assemble or connect computer systems typically used in instructional situations.

28 ☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 1.1	
New C 1.2	
New C 1.3	
New C 1.4	
New C 1.5	

Group 2

Acquire Knowledge of the Impact of Computers on Society as It Relates to Students

Modify title (optional).

Identify career fields related to microcomputer use.

29 ☐ Include ☐ Delete ☐ Modify

5

30

Develop learning situations for instructing students in moral, psychological, physiological and sociological issues of computing in society

☐ Include ☐ Delete ☐ Modify

31

Develop and implement strategies to address equality issues in computer education, (equal access for all students, such as minorities, males/females, and different ability levels of students).

☐ Include ☐ Delete ☐ Modify

32

Identify social-cultural groups and forums in online communities and describe how these relate to instruction.

☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 2.1

New C 2.2

New C 2.3

New C 2.4

New C 2.5

Group 3　Develop a Plan for Using Computers Within Instruction
Modify title (optional).

33

Differentiate between instructional computer applications such as drill and practice, tutorial, simulation and problem solving.

☐ Include ☐ Delete ☐ Modify

34

Assess students' needs for specific computer-based instruction applications.

☐ Include ☐ Delete ☐ Modify

35

Develop lesson plans using computers in instruction.

☐ Include ☐ Delete ☐ Modify

36

Identify, evaluate, select and develop instructional materials for specific teaching and learning situations using computer facilities.

☐ Include ☐ Delete ☐ Modify

37

Plan methods to integrate computer awareness and literacy into the existing curriculum.

☐ Include ☐ Delete ☐ Modify

38

Plan effective pre- and post computer interaction activities for students (e.g., debriefing after a science simulation).

☐ Include ☐ Delete ☐ Modify

6

39

Develop, teach and update computer-related curriculum in one or more areas, such as computer operations, programming robotics, or telecommunications.

☐ Include ☐ Delete ☐ Modify

40

Demonstrate appropriate use of computer technology for basic skills instruction.

☐ Include ☐ Delete ☐ Modify

41

Define elements of a local education agency technology plan.

☐ Include ☐ Delete ☐ Modify

42

Develop a plan to integrate computers in the learning environment.

☐ Include ☐ Delete ☐ Modify

43

Project resource needs (supplies, materials, and equipment) for computer-based instruction.

☐ Include ☐ Delete ☐ Modify

44

Assist in design and implementation of a computer lab and system of computer usage to accommodate school, teacher, and student needs.

☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 3.1	
New C 3.2	
New C 3.3	
New C 3.4	
New C 3.5	

Group 4

Implement a Plan to Integrate Computers into Curricula
Modify title (optional).

45

Use the computer for instruction, as an instructional medium, and as a problem-solving tool.

☐ Include ☐ Delete ☐ Modify

46

Use computer courseware to individualize instruction and increase student learning.

☐ Include ☐ Delete ☐ Modify

47

Evaluate and modify applications of computer instruction in curricula as needed.

☐ Include ☐ Delete ☐ Modify

7

Demonstrate how to use computerized simulations of real life as a teaching tool.

48 ☐ Include ☐ Delete ☐ Modify

Demonstrate an awareness of microcomputer-based curricula.

49 ☐ Include ☐ Delete ☐ Modify

Use a modem for communication between computers.

50 ☐ Include ☐ Delete ☐ Modify

Integrate, where appropriate, applications of the computer in a variety of subject content areas, in a variety of teaching and learning strategies.

51 ☐ Include ☐ Delete ☐ Modify

Demonstrate to students and other classroom teachers the computer as a beneficial tool that increases efficiency and productivity.

52 ☐ Include ☐ Delete ☐ Modify

Evaluate effectiveness of computer-based instruction based on student achievement.

53 ☐ Include ☐ Delete ☐ Modify

Demonstrate ways to integrate the use of computer-related materials with non-computer materials, including manipulatives

54 ☐ Include ☐ Delete ☐ Modify

Describe possible effects of instructional computer use on he existing structure of schools.

55 ☐ Include ☐ Delete ☐ Modify

Use computer technology to help students develop higher-order thinking skills.

56 ☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 4.1

New C 4.2

New C 4.3

New C 4.4

New C 4.5

8

291

Group 5 **Use Computers in Classroom Management**
Modify title (optional).

Use a database program to maintain student records and resource files.

57. ☐ Include ☐ Delete ☐ Modify

Use presentation software to create lessons.

58. ☐ Include ☐ Delete ☐ Modify

Use software programs to create and score tests.

59. ☐ Include ☐ Delete ☐ Modify

Use an electronic spreadsheet program to store and report student grades.

60. ☐ Include ☐ Delete ☐ Modify

Maintain inventory of teaching supplies, materials, and equipment.

61. ☐ Include ☐ Delete ☐ Modify

Utilize word processor to prepare lesson plans, class notes, correspondence, course syllabi and other written documents.

62. ☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 5.1
New C 5.2
New C 5.3
New C 5.4
New C 5.5

Group 6 **Use Computer Information Resources**
Modify title (optional).

Describe what producers of instructional materials are doing to integrate computers with other electronic and print media.

63. ☐ Include ☐ Delete ☐ Modify

Read, evaluate, and apply information about technology research and publications in education that appear in the professional literature and trade magazines

64. ☐ Include ☐ Delete ☐ Modify

Use electronic mail as a personal and professional tool.

65. ☐ Include ☐ Delete ☐ Modify

9

Utilize network resources such as the Internet to conduct research and communicate ideas

66.
☐ Include ☐ Delete ☐ Modify

Describe online sources of information dealing with instruction.

67.
☐ Include ☐ Delete ☐ Modify

ADD NEW COMPETENCIES

New C 6.1

New C 6.2

New C 6.3

New C 6.4

New C 6.5

THANK YOU FOR YOUR CONTRIBUTION

10

Appendix B: The competency framework proposed by Panellist 837

Competency Framework for Technological Literacy in Teaching and Learning

AREA OF COMPETENCE 1: TECHNOLOGICAL LITERACY IN THE TEACHING
PROFESSION
Group 1: Personal and professional technological literacy
Group 2: Technological competency for teaching
Group 3: Informed, critically reflective perspectives and values related to technology in
education and in society
Group 4: Technology resourced learning environments

AREA OF COMPETENCE 2: TECHNOLOGICALLY LITERATE TEACHING
Group 1: Technology and the curriculum
Group 2: Technology and the organization of learning
Group 3: Technological literacy for students
Group 4: Technology and assessment

AREA OF COMPETENCE 3: TECHNOLOGICAL LITERACY AND REFLECTIVE PRACTICE
Group 1: Critical reflection and evaluation continuous improvement
Group 2: Teacher research and contributing to educational knowledge

---

Competency Framework for Technological Literacy in Teaching and Learning

AREA OF COMPETENCE 1: MANAGING TECHNOLOGY IN THE LEARNING ENVIRONMENT

Group 1: Personal and professional technological literacy

b2 1. Understands technology and the term computer more broadly than "PC + screen", and recognizes that technology is a tool that may support learning, but does not cause learning. Identifies and explores different ways education is (or could be) supported by technology.

b2 2. Knows basic computer functions in relationships to professional and educational goals: including but not limited to: word-processing, data storage and analysis, spreadsheet and calculation, graphic production, artistic expression, music production, research, communication (via internet and collaborate classroom processes) etc.

b2 3. Uses computer (and appropriate software packages) for time and project management, budgeting and record keeping related to professional role.

b2 4. Active in developing and applying technological knowledge as it relates to professional goals and planning for professional development. Includes technological literacy in professional development plans.

b2 5. Uses technology, email and the internet to support professional learning, i.e., for research, writing, communication with other professionals, and participation in on-line study.

b2 6. Participates in the development of local area (school/district/state) technology plans, maximize use of resources available and develop programs in line with published policies.

b2 7. Participates in shared technology related learning with other teachers in school and local area. Shares knowledge with other teachers.

Group 2: Technological competency for teaching

b2 8. Understands and can use a range of input processes, relevant to teaching and students, including but not limited to text (manual and voice), images (graphic, photo, film etc), sound (e.g.   ) – Note: I'm not expert on the relevant types) (extension of S&L 3).

b2 9. Understands and can use a range of processing options, relevant to teaching and students, including but not limited to text (editing etc), data (analysis) images etc), sound (e.g.   ) etc. – Note: I'm not expert on the relevant types) (extension of S&L 3).

b2 10. Understands and can use a range of output processes, relevant to teaching and students, including but not limited to text (printing), communication (phone, email, fax) etc etc – Note: I'm not expert on the relevant types) (extension of S&L 3).

b2 11. Knows the difference between software, hardware and different modes of connectivity between computers and computer parts.

b2 12. Starts up computer based equipment and systems as required in teaching and learning, and uses software related to classroom and professional work.

b2 13. Maintains knowledge of everyday operation of computer hardware and software in order to trouble shoot minor problems and seek assistance when required. (adaptation of S&L 5).

Group 3: Informed, critically reflective perspectives and values related to technology in education and in society

b2 14. Values diversity, and the right of all children to learn, and recognizes different levels of access related to gender, home environment, language, culture, health/disability and socio-economic status. Develops strategies to ensure equity in computer usage in classroom and schools. Accesses information and support, as required, for students with various disabilities.

b2 15. Maintains a critically reflective approach to information available through the computer, in particular the vulnerably of children to misinformation, marketing, propaganda and inappropriate relationships.

b2 16. Continually updates knowledge of the impact of technology on society including present and future uses of computer technology in the home, school and work, and positive and negative consequences (similar to S&L 7, 8 & 9).

b2 17. Understands (and operates within) appropriate ethical positions related to professional and student use of technology.

b2 18. Operates within the framework of law and regulation as it applies to technology in schools and the community.

Group 4: Technology resourced learning environments

b2 19. Knows basic ergonomic and health principles related to position, light, radiation etc. and organizes working areas involving technology accordingly.

b2 20. Ensures that basic resource materials are available to teachers, students and volunteers.

b2 21. Uses the arrangement of technological equipment to facilitate spaces for both individual and cooperative work, and flexible and integrated use of technology across the curriculum.

b2 22. Ensures that rules and conventions of technology and/or laboratory use are developed with students and families and displayed/communicated (including: (1) security for computer-based information and protection for the confidentiality/privacy of student's work and student records, and (2) age-appropriate limitations particular sites – Note: I don't quite know how to word this). (Related to S&L 27)

b2 23. Communicates with parents about technology and the curriculum, particularly in relation to discussing and questioning computer generated information with their children, balanced usage of the computer etc. Develops a classroom/home computer usage policy.

b2 24. Educates support personnel (assistants, teaching aides, volunteers) to understand and apply school-based laboratory and classroom conventions and relevant educational policies when working with students.

AREA OF COMPETENCE 2: TECHNOLOGICALLY LITERATE TEACHING

Group 1: Technology and the curriculum

b2 25. Uses technology to research and extend curriculum options

b2 26. Uses technology to support cooperative work with others on curriculum design and implementation.

b2 27. Reviews and evaluates software for curriculum use using a range of pedagogical and program design criteria. Recognizes that many software programs are focused on specific tasks (such as drill and practice, tutorial, simulation, problem solving or tests of information retention), evaluates the strengths and limitations of these programs, and integrates them (where useful) into complex learning projects. (extension of S&L 33,34,35)

b2 28. Integrate reviewed software programs, and technology (across a range of functions) into curriculum units.

b2 29. Develops multi-layered, interrelated units of work using a range of computer functions.

b2 30. Uses technology to support students in actively developing knowledge and pursuing educational inquiry.

Group 2: Technology and the organization of learning

b2 31. Uses technology to design and present units of work

b2 32. Prepares resources, student task outlines and student activities. Maintains classroom inventory (related to S&L 36)

b2 33. Maintains time-tables, rosters, student records etc. (related to S&L 57)

Group 3: Technological literacy for students

b2 34. Integrates computer awareness and literacy into the existing curriculum (S&L 37). Research impact of technology in society in the culture with students (integrate this question within all aspects of student inquiry and learning)

b2 35. Introduces students to a range of input options, relevant to their learning and life needs, including but not limited to text (manual and voice), images (graphic, photo, film etc), sound (e.g.   ) – Note: I'm not expert on the relevant types) (extension of S&L 3).

b2 36. Introduces students to a range of processing options, relevant to their learning and life needs, including but not limited to text (editing etc), data (analysis) images etc), sound (e.g.   ) etc. – Note: I'm not expert on the relevant types) (extension of S&L 3).

b2 37. Introduces students to a range of output options, relevant to their learning and life needs, including but not limited to text (printing), communication (phone, email, fax) etc etc – Note: I'm not expert on the relevant types) (extension of S&L 3).

b2 38. Ensure that students know the difference between software, hardware and different modes of connectivity between computers and computer parts.

b2 39. Teach students to start up computer based equipment and systems as required in teaching and learning, and uses software related to classroom and personal work and in order to trouble shoot minor problems and seek assistance when required.

b2 40. Researches the place of technology in information and entertainment media with students, and critically evaluates educational and other computer materials with students. Develops age-appropriate critical frameworks for such analysis with students.

b2 41. Introduces students (in age appropriate ways) to ethical, legal and regulatory positions related to the use of technology to technology in schools, homes and the community.

Group 4: Technology and assessment

b2 42. Uses a range of hardware and software options to develop and maintain records of student progress including, electronic portfolios, text publications etc.

b2 43. Develop text and electronic reports for (and with) students and parents.

b2 44. Record students' progress through the curriculum in ways that take into account the relationship between teaching, learning and assessment.

AREA OF COMPETENCE 3: TECHNOLOGICAL LITERACY AND REFLECTIVE PRACTICE

Group 1: Critical reflection and evaluation and planning for continuous improvement

b2 45. Use computer records, electronic journals and student assessment information to monitor and critically reflect on practice and evaluate teaching and learning programs.

b2 46. Develop and review action plans to develop and report on professional skills and capacity and meet long term professional goals.

Group 2: Teacher research and contribution to educational knowledge

b2 47. Uses technological resources to plan, record and evaluate teacher research on classroom practice (including the pace of technology in teaching and learning).

b2 48. Uses technology to support professional communication with other teachers and the analysis and interpretation of data.

b2 49. Uses technology information about classroom research with teachers, parents and others beyond the school community.

Appendix C: Feedback to the Delphi Panel – Second round

Dear Member of the Delphi Panel,

Thank you for your valuable contribution to the first round of the Delphi process aiming to construct a list of ICT competencies required for teaching and learning in the primary classroom.
All invited experts have responded to the first round and have generated some interesting results.

The initial list published by Scheffler and Logan (1999) comprised of 67 competencies.

As a result of the first round:
- 4 competencies (11, 49, 59 and 63) have been deleted (majority vote > 66%)
- 69 modifications have been accepted (some have been edited)
- 24 new competencies have been suggested
- An entire list comprising of 49 competencies has been submitted.

The distribution of responses could be summed up as follows:
Group I   questionnaires completed without challenging the structure of the existing list of competencies (8 panelists)

Group II   disagreement with the focus of the competencies (1 panelist)

Group III   severe disagreement with the existing structure of the Scheffler & Logan list of competencies and its approach to teachers' "technological literacy" (1 panelist; go to: Original Responses, link to response 837)

The panelist, providing the new list of competencies, has been interviewed and requested to submit a rationale for her/his response (see: collection of original responses; code No. 837).

This divergent view and the unwillingness to comply with the offered format made me reflect on both theoretical and methodological aspects of the study. It raised a question of whether to serve a *"dogmatic drive for conformity"* (Linstone, 1975, p.582) that can swamp the "outlier" or to accommodate the divergent view that may further inspire the social construction of the new knowledge.

This dilemma urged me to:
- Revisit the purpose of the process,
- Analyze the implications of the research,
- Reevaluate the process,
- See it as a real opportunity for social construction of new knowledge (in the light of constructivist methodologies) implying *"that the enquiry must be carried out in a way that will expose the constructions of the variety of concerned parties, open each to critique in the terms of other constructions, and provide the opportunity for revised or entirely new constructions to emerge."* (Guba &Lincoln, 1989, p.89)

Although the Delphi study originally intended to be a "semi-structured" process, offering a heterogeneous group of experts the possibility to modify and /or radically change an already existing (peer-reviewed) list of competencies, its structure as well as its focus proved to be constraining for some of the panelists. It also created obstacles for the facilitator in trying to accommodate the divergent views.

After two meetings with the Advisory and Monitoring Team, and numerous attempts to untie the Gordian Knot or cut it with a sword (as Alexander the Great did), we have decided to utilize the "inherent strength" of the Delphi process – its ability *"to expose uncertainty and divergent views"* (Linstone, 1975, p.578), and consult the experts on the Delphi Panel about the way the divergent views should be accommodated.

The facilitator and the Advisory and Monitoring Team are proposing the following approaches:
(However other solutions suggested by the panelists will be also considered.)

☐   To open the structure of the questionnaire and merge the two lists
☐   To adopt the new list of competencies and refine it ☐   To open the process to complete revision
(Please indicate your preference for further action by ticking the appropriate box, or by suggesting a solution in the field provided)

Please, enter your suggestion here:

By modifying the process, we would like to provide all respected experts on the Delphi panel with an equal opportunity to contribute to the process of constructing a list of ICT competencies required for teaching and learning in the primary classroom, looking at teachers technological literacy through the lances of contemporary pedagogical thinking.

Please send your responses to the facilitator regarding your preference for how we conduct the second and indicate your willingness to continue participating in a modified process by the _ of June.

This mail is accompanied by the following attachments:

Attachment A

- This word document contains the Scheffler & Logan list of ICT competencies, including the suggested modifications as well as new competencies.
  (To avoid repetition competencies similar in wording /or meaning have been compiled and edited.)

  Modifications proposed for an already existing competence are listed under the same number as a, b, c, etc. (e.g. modifications proposed for competence 37 are listed 37.a, 37.b etc.)

  New competencies are listed as 1NC1a, or 2N3c, where the first number stands for the section, while the second number indicates the group.

- A Competency Framework comprising of 49 new competencies submitted by Panel Member 837.

Attachment B

This Adobe Acrobat PDF[1] document contains:

- Statistically interpreted data that was observed for the frequency of responses (include, delete, modify) (The response of Panel Member 837 has been treated as "delete" for all competencies included in the questionnaire.)

- Qualitative data, including the modified and new competencies in their original form.

Attachment C

This Adobe Acrobat PDF document contains the original responses submitted by the members of the Delphi Panel. Hyperlinks will make it easier for you to access individual responses.

Looking forward to your expert opinion with regards to this interesting project.

Sincerely,

Eva Dakich
Ph.D. student
School of Education
Faculty of Human Development
Victoria University of Technology
Office: + 61 3 9688 4672
Mobile: + 61 (0) 401 176 817
Email: eva.dakich@research.vu.edu.au

---

[1] To read this document you will need the Adobe Acrobat Reader that can be downloaded from www.adobe.com for free.

Appendix D: Proposal for a new framework of ICT literacy – Third round

A Framework of ICT Competencies for Primary Teachers Proposal

The prop... ist of competencies...

- Scheffler and Logan List of Computer Competencies (1999),
- Expert responses collected in the first round of the Delphi process, and individual interviews (2003)
- List of Competencies submitted by expert 837 (2003)
- Learning Technologies Capabilities Guide – DE&T, VIC (1998)
- National Educational Technology Standards and Performance Indicators for Teachers - ISTE (2000)
- Contemporary literature on ICT and innovative practices in the primary classroom, teachers' professional learning and engagement, policy documents and initiatives.
- Consultations with supervisors and Advisory and Monitoring Team

1   OPERATIONAL UNDERSTANDING AND APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

Please enter the modified title here. (Optional)

1   Demonstrates understanding and knowledge of information and communication technologies (ICT).

☐ Include ☐ Delete ☐ Modify

Please enter your modification here.

2   Demonstrates application of common computer hardware including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards and graphic tables).

☐ Include ☐ Delete ☐ Modify

3   Demonstrates skill in the use and application of common computer software (word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.)

☐ Include ☐ Delete ☐ Modify

4   Demonstrates familiarity and utilizes network resources such as the Internet intranets and Local Area Networks to communicate, conduct research and exchange ideas.

☐ Include ☐ Delete ☐ Modify

5   Demonstrates ability to utilize basic diagnostic strategies in order to ascertain causes of malfunction related to computer hardware and software.

☐ Include ☐ Delete ☐ Modify

New C 1.1   Please enter your suggestion here.

New C 1.2

New C 1.3

2 DESIGNING ICT-RICH LEARNING ENVIRONMENTS AND CURRICULUM FOR IMPROVED STUDENT LEARNING

Please enter the modified title here. (Optional)

6   Plans for the effective management/ application of ICT resources to create a learner-centered environment

☐ Include ☐ Delete ☐ Modify

Please enter your modification here.

7   Makes informed choices in the application of appropriate hardware.

☐ Include ☐ Delete ☐ Modify

8   Makes informed decisions about the relevance and educational value of software before applying it to teaching and learning by consulting educational websites and relevant literature.

☐ Include ☐ Delete ☐ Modify

9   Differentiates between applications of ICT supporting drill and practice, presentation, tutorials, simulation, problem solving, (electronic) collaboration and communication and applies them to appropriate learning activities and situations.

☐ Include ☐ Delete ☐ Modify

10   Chooses and designs developmentally appropriate and inclusive pedagogical strategies and teaching practices supported by technology that respond to the diverse needs of learners.

☐ Include ☐ Delete ☐ Modify

11   Integrates ICT into range of learning activities to facilitate both individual and collaborative group work.

☐ Include ☐ Delete ☐ Modify

12   Promotes innovative uses of technology amongst students, encouraging creativity and originality.

☐ Include ☐ Delete ☐ Modify

13 Facilitates on-line communication and collaboration of students at a local and global level.

☐ Include ☐ Delete ☐ Modify

14 Ensures that students develop competence and confidence in using ICT.

☐ Include ☐ Delete ☐ Modify

15 Critically reflects on these experiences and plans for improved practice/teaching and student learning.

☐ Include ☐ Delete ☐ Modify

16 Consults current literature on ICT pedagogies when planning learning experiences and activities.

☐ Include ☐ Delete ☐ Modify

17 Designs and integrates ICT enhanced learning experiences across the curriculum.

☐ Include ☐ Delete ☐ Modify

18 Uses technology to design and present units of work and prepare handouts.

☐ Include ☐ Delete ☐ Modify

19 Applies ICT enriched curricular activities to facilitate inquiry, problem solving, critical thinking and knowledge construction.

☐ Include ☐ Delete ☐ Modify

20 Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.

☐ Include ☐ Delete ☐ Modify

21 Supports inter-/multidisciplinary curricular activities with ICT.

☐ Include ☐ Delete ☐ Modify

22 Communicates with parents about ICT and curriculum as well as about appropriate and balanced use of computers at home.

☐ Include ☐ Delete ☐ Modify

23 Uses technology to research and extend curriculum options.

☐ Include ☐ Delete ☐ Modify

NEW COMPETENCI 3

New C 2.1 Please enter your suggestion here.

New C 2.2

New C 2.3

3 CLASSROOM MANAGEMENT, ASSESSMENT AND EVALUATION

Please enter the modified title here. (Optional)

24 Uses information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.

☐ Include ☐ Delete ☐ Modify

Please enter your modification here.

25 Manages electronic databases/electronic spreadsheets in order to collect/record data on student progress (such as electronic publications, electronic portfolios, etc.), interprets results and communicates/reflects on findings in order to improve practice and maximize student learning.

☐ Include ☐ Delete ☐ Modify

26 Maintains electronic databases of resources and classroom inventory, equipment and budgets.

☐ Include ☐ Delete ☐ Modify

27 Uses electronic time management and organizational tools / software packages for time and project management, budgeting and record keeping related to professional role

☐ Include ☐ Delete ☐ Modify

28 Demonstrates familiarity and applies measures of hardware and software security with special emphasis on protection of privacy of students' work and records.

☐ Include ☐ Delete ☐ Modify

New C 3.1   Please enter your suggestion here.

New C 3.2

New C 3.3

4   ICT FOR PROFESSIONAL LEARNING AND ENGAGEMENT

Please enter the modified title here. (Optional)

29   Develops a personal plan for continuous professional learning related to ICT pedagogies.

☐ Include ☐ Delete ☐ Modify

Please enter your modification here.

30   Demonstrates continual growth in understanding and applying ICT to educational settings by keeping abreast of current and emerging technologies and pedagogical approaches.

☐ Include ☐ Delete ☐ Modify

31   Understands and uses conventions of ICT aided research communication and collaboration.

☐ Include ☐ Delete ☐ Modify

32   Uses technology to communicate ideas and collaborate with parents, peers, and larger community.

☐ Include ☐ Delete ☐ Modify

33   Engages in ongoing professional development related to integration of ICT to support student learning.

☐ Include ☐ Delete ☐ Modify

34   Shares, discusses and evaluates effective practices and strategies with other teachers and participates in collaborative projects for designing ICT- rich learning environments.

☐ Include ☐ Delete ☐ Modify

35   Contributes to on-line resources for educational community.

☐ Include ☐ Delete ☐ Modify

305

36   Demonstrates familiarity and critical understanding of national, state and school policies related to the integration of ICT in teaching and learning.

☐ Include ☐ Delete ☐ Modify

37   Demonstrates understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and school context for improved student learning.

☐ Include ☐ Delete ☐ Modify

38   Actively participates in school and community-based projects promoting the integration of ICT into the process teaching and learning and broader school or communal context.

☐ Include ☐ Delete ☐ Modify

NEW COMPETENCIES

New C 4.1   Please enter your suggestion here.

New C 4.2

New C 4.3

5   SOCIO-CULTURAL, ETHICAL, LEGAL, AND HEALTH-RELATED ISSUES IN THE USE OF ICT IN EDUCATIONAL SETTINGS

Please enter the modified title here. (Optional)

39   Understands and communicates the positive and negative consequences of ICT on a global and local level, including its current and future uses in the home, school, workplace and community.

☐ Include ☐ Delete ☐ Modify

Please enter your modification here.

40   Applies appropriate ethical positions and responsible behaviors associated with the use of ICT, such as network/internet policies, copyright laws and use of information.

☐ Include ☐ Delete ☐ Modify

41   Develops and consciously implements strategies to address equity issues related to equal access for all students including different levels of ability, race, gender, socioeconomic status, language and culture.

☐ Include ☐ Delete ☐ Modify

42   Identifies health hazards related to the use of ICT and creates/ensures a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.)

☐ Include ☐ Delete ☐ Modify

43   Maintains a critically reflective approach in the use of electronic information in particular the vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc.

☐ Include ☐ Delete ☐ Modify

44   Demonstrates familiarity with the role of technology in youth culture and recreational uses of ICT.

☐ Include ☐ Delete ☐ Modify

45   Develops critical awareness of the role of ICT in entertainment and media/recreational activities and creates an age-appropriate framework in collaboration with students.

☐ Include ☐ Delete ☐ Modify

NEW

New C 1.1   Please enter your suggestion here.

New C 1.2

New C 1.3

Appendix E: Post-Delphi evaluation form

Post-Delphi Evaluation Form

Dear Panelist,
Please complete this questionnaire, by indicating the degree of your agreement with the statements below.

1. In general, I agreed with the analyses of the responses and the way they were presented in the feedback.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

2. My ideas were understood and incorporated.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

3. I was introduced to new ideas during the process.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

4. The timelines provided for my responses suited me.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

5. The feedback was concise and timely.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

6. The confidentiality agreement was respected throughout the process.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

7. It is highly likely that I would participate in a Delphi study again.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

8. What did you like best about the Delphi process?

Please enter your comments into this field.

9. What did you like least about the Delphi process?

Please enter your comments into this field.

10. In my opinion, the findings of the Delphi Process may be a valuable contribution to the professional discourse.

strongly disagree ☐ ☐ ☐ ☐ strongly agree

Teacher Survey

This survey consists of two sections:
1 General background information
2 A framework of ICT literacy for teaching in the primary classroom (developed by an international panel of experts in the previous stage of the project, utilising the Delphi Method).

Section 1   Please provide some background information in the section below:

1a) The postcode of your school: ☐☐☐☐

b) Student population:
☐ up to 100   ☐ 101-250   ☐ 251-500   ☐ 500+

2   Your current position:
☐ permanent ☐ casual contract

3   Your most recent teaching qualifications:
☐ less than 4 years (e.g. Diploma in Teaching)
☐ 4 year course (e.g. BEd/BA + Dip Ed, etc.)
☐ postgraduate studies (MEd/MA+Dip Ed/BEd, etc.)

4   Years of teaching experience:
☐ less than 4 years   ☐ 5-10 years   ☐ 11-20 years   ☐ more than 20 years

5a) Your age group:
☐ under 25   ☐ 25-39   ☐ 40+

b) Your gender:
☐ female   ☐ male

6   What subject areas do you teach?
a) ☐ Generalist classroom teacher (including most subjects)
(If so, please proceed with question No. 7.)

b) ☐ Specialist primary teacher
(Please tick all that applies.)

☐ Visual Arts
☐ Language
☐ Music
☐ Science
☐ ICT
☐ PE
☐ Library
☐ Non-teaching/administrative
☐ Other - please specify: _____

7   What grade levels have you been teaching in 2004? (Please tick all that applies.)
☐ Prep   ☐ 1   ☐ 2   ☐ 3   ☐ 4   ☐ 5 ☐ 6   ☐ Combined year

8   How long have you been using computers regularly (at least weekly)?

	less then 1 year	1- 4 years	5-10 years	more than 10 years
a) In the classroom	☐	☐	☐	☐
b) In the staff room	☐	☐	☐	☐
c) At home	☐	☐	☐	☐

9   To what extent have each of the following been important in developing your ICT literacy?

	not important	somewhat important	very important
a) Pre-service education	☐	☐	☐
b) In-service professional development	☐	☐	☐
c) Workplace experience	☐	☐	☐
d) Having a computer at home	☐	☐	☐
e) Support from colleagues	☐	☐	☐
f) Support from school leadership	☐	☐	☐
g) Other - please specify _____	☐	☐	☐

1

In the following section

a) please rate the importance of the items below for designing learning in the primary classroom;
b) indicate the level of your competence and confidence in applying them to your teaching.

The column headers (rotated):
- Very important
- Important
- Moderately important
- Not important at all
- Beginner
- Intermediate
- Advanced
- Expert

When integrating ICT into teaching and learning, in your opinion how relevant is for the teacher to:

10 Demonstrate up to date understanding and knowledge of information and communication technologies (ICT) used in home, school, workplace and community.

11 Demonstrate professional judgment in the selection and application of common computer hardware, including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards etc.).

12 Demonstrate skill in the use and application of common computer software (e.g.: word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.).

13 Utilize network resources such as the Internet, Intranets and Local Area Networks to communicate, conduct research and exchange ideas.

When thinking about designing ICT-rich learning environments and curriculum for improved student learning, in your opinion how important is for a teacher to:

14 Plan for the effective management / application of ICT resources to create learner-centered environments.

15 Make informed choices in the selection and application of appropriate hardware to suit the needs of the learners and the context of learning.

16 Make informed decisions about the relevance and educational value of software, based on professional principles related to student learning, teaching goals, authentic curriculum design and technological infrastructure, by relying on existing professional competence, collaboration with colleagues, educational websites and relevant literature.

17 Design and integrate ICT-enhanced learning experiences across the curriculum.

18 Understand and support the diverse needs of learners by choosing and designing inclusive pedagogical strategies and practices supported by ICT.

19 Make informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.

20 Differentiate between applications of ICT that support routine tasks; and those that require higher order cognitive skills; problem solving and collaboration; and apply them to appropriate learning activities and situations.

21 Use technology to design and present units of work and prepare handouts.

2

#	Statement	Very important	Important	Moderately Important	Not important at all	Beginner	Intermediate	Advanced	Expert
22	Apply ICT-enriched curricular activities to facilitate enquiry, problem solving, critical thinking and knowledge construction.	☐	☐	☐	☐	☐	☐	☐	☐
23	Integrate ICT into a range of learning activities to facilitate both individual and collaborative work.	☐	☐	☐	☐	☐	☐	☐	☐
24	Support inter-/multidisciplinary curricular activities with ICT.	☐	☐	☐	☐	☐	☐	☐	☐
25	Promote innovative uses of technology amongst students, encouraging creativity and originality.	☐	☐	☐	☐	☐	☐	☐	☐
26	Explore innovative uses of ICT such as being connected across multiple dimensions: local and global communication.	☐	☐	☐	☐	☐	☐	☐	☐
27	Facilitate on-line communication and collaboration of students at a local and global level.	☐	☐	☐	☐	☐	☐	☐	☐
28	Encourage students to become members of local and extended communities of learning.	☐	☐	☐	☐	☐	☐	☐	☐
29	Ensure that students develop competence, confidence, and critical awareness in using ICT.	☐	☐	☐	☐	☐	☐	☐	☐
30	Communicate with parents about ICT and curriculum as well as about appropriate and balanced use of computers at home.	☐	☐	☐	☐	☐	☐	☐	☐
31	Critically reflect on these experiences and design plans based on professional inquiry for improved student learning and innovative learning environments.	☐	☐	☐	☐	☐	☐	☐	☐
32	Extend students' ability to evaluate assess and monitor their own work (e.g.: by creating digital projects, electronic portfolios, etc.).	☐	☐	☐	☐	☐	☐	☐	☐
33	Use information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.	☐	☐	☐	☐	☐	☐	☐	☐

When thinking about professional learning and engagement related to ICT, in your opinion how important is for a teacher to:

#	Statement	Very important	Important	Moderately Important	Not important at all	Beginner	Intermediate	Advanced	Expert
34	Conduct professional enquiry using current literature and research on ICT pedagogies when planning learning experiences and activities.	☐	☐	☐	☐	☐	☐	☐	☐
35	Use technology to research and extend curriculum options.	☐	☐	☐	☐	☐	☐	☐	☐
36	Develop a personal plan for continuous professional learning related to ICT pedagogies.	☐	☐	☐	☐	☐	☐	☐	☐
37	Demonstrate continual growth in understanding and applying ICT to educational settings, by keeping abreast of current and emerging technologies and pedagogical approaches.	☐	☐	☐	☐	☐	☐	☐	☐
38	Use technology to communicate ideas and collaborate with parents, colleagues, and larger community.	☐	☐	☐	☐	☐	☐	☐	☐

3

39. Engage in ongoing professional development related to integration of ICT to support student learning. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

40. Share, discuss and evaluate effective practices and strategies with other teachers and participate in collaborative projects for designing ICT- rich learning environments. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

41. Demonstrate understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and schools for improved student learning. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

When considering socio-cultural, ethical, legal and health-related issues in the use of ICT, in your opinion how important is for the teacher to:

42. Develop and consciously implement strategies to address equity issues related to equal access for all students; including different levels of ability, race, gender, socioeconomic status, language and culture. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

43. Demonstrate familiarity with the role of technology in youth culture and recreational uses of ICT. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

44. Apply appropriate ethical positions and responsible behaviors associated with the use of ICT, such as network/Internet policies, copyright laws and intellectual property. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

45. Maintain a critically reflective approach in the use of electronic information in relation to vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

46. Identify health hazards related to the use of ICT and create a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.). ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

If anything that you would find important has been left out from the above framework, please include below:

Other comments or suggestions:

Thank you for participating in this research project.

4

Appendix G: Informed consent: An example

Victoria University
PO Box 14428
MELBOURNE CITY MC VIC 8001
Australia

Telephone:
(03) 9688 4672
Facsimile:
(03) 9919 4267

Faculty of Human Development
School of Education
Name: Eva Dakich
Position: PhD student

Email:
eva.dakich@research.vu.edu.au

VICTORIA UNIVERSITY

O F   T E C H N O L O G Y

Footscray Park Campus
Ballarat Road
Footscray

Appendix C

CONSENT FORM FOR PARTICIPANTS INVOLVED IN A RESEARCH PROJECT

CERTIFICATION BY PARTICIPANT (School Principal)

I, _____ certify that as a School Principal of _____ Primary School, I am voluntarily giving my consent to staff participation in the research project titled: **Teaching and Learning with Technology: Exploring the Relationship Between Teachers' ICT Literacy and Pedagogical Practices** being conducted online at: http://education.vu.edu.au/survey/ by Eva Dakich, PhD student from Victoria University of Technology.

I certify that the objectives of the proposed research, together with any risks associated with the procedures listed below to be carried out in the proposed study, have been fully explained to me by Eva Dakich, and that I freely consent to participation involving the application of these procedures:

Procedures and tasks:

The **survey study** will utilize a descriptive survey method. It will collect teachers' self-reports about their ICT-related knowledge and the level of their competence and confidence in implementing ICT-rich pedagogies into their classrooms for improved student learning.

Primary school teachers from Victorian Government Schools are invited to participate in the study.

Participants will be requested to fill in an online survey. Responses will be automatically entered into a database for anonymity and confidentiality.

Approximate time of completion will be 30-40 minutes.

The survey was previously reviewed and piloted on a group of post-registration primary school teachers studying at VUT. Modifications have been made according to the recommendations and suggestions.

I have been informed that data collected by the survey will not be used for any other purposes, and that anonymity and confidentiality of the information provided by me and my colleagues will be ensured in accordance with the Information Privacy Act (2000): Schedule 1 – The information Privacy Principles (pp. 28-34) and the Victorian Privacy Policy Statement (2002).

The study will be monitored by the principal supervisor Dr Brenda Cherednichenko and associate supervisor Dr Maureen O'Rourke.

I certify that I have had the opportunity to have any questions answered and that I understand that I and my colleagues can withdraw from this research at any time, and that this withdrawal will not jeopardize me or them in any way.

Signed by School Principal: _____

Witness other than the researcher: _____   Date: _____
_____ (important to be signed)

Any queries, concerns about your participation in this project may be directed to the researcher (Eva Dakich, ph. 03 96884672). If you have any queries or complaints about the way you have been treated, you may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MC, Melbourne, 8001 (ph. 03-9688 4710) or contact Dr Darko Hajzler, Head of VU Counselling Services. (ph. 03-9688 2399)

Campuses at:
Footscray, Melbourne City, Melton, Newport, St Albans, South Melbourne, Sunbury, Sunshine and Werribee

Appendix H: Semi-structured observation protocol

Classroom observation protocol
Key patterns/themes and issues to look for:

1. Subject matter(area)/Curriculum (intended learning) objectives,

2. ICT used (software and hardware utilized),

3. Student engagement (including the role of the student),

4. Teacher's pedagogical approaches including:

   - teacher's role,
   - teaching style,
   - teaching and learning strategies, and
   - degree of responsiveness to learner diversity.

5. The role of technology in the classroom,

6. Teacher's ICT literacy,

7. Outcomes of the learning process,

8. Overall description of the learning environment,

9. Other resources used by the teacher.

Appendix I: Semi-structured interview protocol

Semi-structured interview protocol
Anticipated themes:

1. Importance of ICT for student learning (as perceived by the teacher),

2. Factors that facilitate and hinder teacher's successful integration of ICT in teaching and learning,

3. Changes to learning and teaching relationships, roles, learning environment and teaching philosophies,

4. Factors contributing to changes,

5. Connections between teachers' ICT literacy and practices (as perceived by the teacher), and

6. Vision/ future plans with regards to integrating ICT and pedagogy.

Appendix J: Extended classroom observation protocol

Single subject area/integrated unit?

Curriculum/intended learning objectives

Focus: Does the ICT used effectively support or reflect the learning objectives?

ICT used (software and hardware utilized)

E.g.:
- E-mail,
- Asynchronous Communication tools,
- Synchronous Communication tools,
- Word Processor,
- Presentation software,
- Web page/multimedia production tool,
- Internet Browser and Search Engines,
- Learning Support Resources/Reference Resource Materials (knowledge based),
- Lap Top Computer,
- LAN,
- Media Capture Equipment, [1]
- Other

Teacher's pedagogical approaches and practices

Teacher's role

Focus: does the ICT used influences the role of the teacher?

- Give task instruction,
- Monitor students¡¦ task progression,
- Assess students,
- Provide feedback to students,
- Develop teaching Materials,
- Design curriculum and learning activities,
- Co-teaching,
- Support/model enquiry process for students,
- Support team building and collaborative process of students,
- Mediate communication between students and experts, [2]
- Other

Teaching style[3]
- Prefers teaching situations that allow interaction and discussion with students
- Uses questions to check on student learning following instruction
- Viewed by students as teaching facts

---

[1] Adopted from SITES M2 (2003)

[2] Adopted from SITES M2 (2003)

[3] Adapted from: [online] Internet path: http://www.aismissstate.edu.\ALS/Unit9modulers.num and Dean Boyd, computer system coordinator, Mississippi State University of Starkville, MS, College of Agriculture and Life Sciences, September 22, 1999.

- Provides feedback, avoids negative evaluation
- Strong in establishing a warm, personal learning environment
- Tells students the objectives of the lesson
- Uses a variety of media and technological resources
- Has students work in small groups
- Prefers impersonal teaching situations
- Uses questions to introduce topics and probe student answers
- Uses teacher-organized learning situations
- Viewed by students as encouraging them to apply principles
- Provides feedback, uses negative evaluation
- Strong in organizing and guiding student learning

Teaching and learning strategies (learning activities) designed/used by the teacher

- Teacher –led whole class discussion
- Student –led discussion or presentation
- Individual assignments
- Tests
- Working with manipulatives/concrete materials
- Textbook and worksheet-based tasks
- Creative/reflective writing
- Cooperative teamwork
- Drill and practice
- Project-based learning
- Creating portfolios of selected work samples
- Problem solving tasks/ inquiry learning
- Hands-on experiences/ authentic learning
- Oral or written reflection on their work
- Developing multimedia /hypermedia products
- Conducting research via Internet / CD Rom or DVD
- Using tools of electronic communication and collaboration
- Recreational use of ICT
- Other _____

Also:
- Active Learning Strategies: Active learning strategies focus on exploration.

   --learners interacting with an environment

   --learners manipulating the objects in that environment

   --learners observing the effects of their interventions

2

--learners constructing their own interpretations

--focus on exploration

- Constructive Learning Strategies: Constructive learning strategies bring context to learning as students begin from a point of already existing personal experience, knowledge, or interests.
--learners construct models to explain observations
--multiple solutions to problems accepted
--errors used to clarify and refine knowledge in activity
--builds on prior knowledge

- Cooperative Learning Strategies: Cooperative (collaborative/group) strategies take advantage of and build upon shared individual knowledge.
--learners working in groups
--learners working to complete a common task
--requires communication
--individuals have different roles/responsibilities

- Intentional/Reflective Learning Strategies: Reflective learning strategies provide opportunities for students to construct their own knowledge and understandings.
--learners articulate the learning goals
--learners explain what they are doing or strategies they use
--learners explain how they find answers
--learners manage and/or monitor their own learning

- Authentic Learning Strategies: All of the above strategies can be based on authentic tasks that reach beyond text book learning and engage students in the application of knowledge as they participate in real-word tasks. Authentic tasks discourage the asking of that age-old student question, "Why do we have to know this?"
--meaningful, real-world tasks
--case-based or problem-based environment
--connections to community, state, world outside of school
--personal connections[4]

Level of general responsiveness to learner diversity

Does the ICT provides increased opportunity for responding to student diversity with regards to learning styles, multiple intelligences, ability and skill levels, gender, socio-economic and cultural backgrounds?

---

[4] Source:
http://knowledgeloom.org/practice_basedoc.jsp?t=1&bpid=1182&aspect=1&location=2&parentid=1163&bpinterid=11
63&spotlightid=1163&testflag=yes

3

Focus of enquiry: classroom environment, verbal and nonverbal communication, classroom relationships, multicultural activities, etc.

(data will be interpreted utilizing the following theoretical tools: Kolb's Learning Styles; Gardner's Multiple I; Bloom's Taxonomy)

Teaching practices, which accommodate diversity of learning styles[6]

Visual

- writes directions on board as well as giving them orally
- uses flash cards, printed in bold letters
- uses resources that require reading and seeing
- uses transparencies
- uses models, graphs, charts
- assigns written reports
- has students write/draw comic strips related to lessons/projects
- has students take notes on important words, concepts
- gives a written copy of boardwork if student has difficulty copying
- uses videos

Tactile

- uses manipulative objects especially when teaching abstract concepts (measurement, geometry)
- allows students to build models, draw/paint pictures, make a display instead of written reports

Auditory

- gives oral rather than written tests
- uses lectures
- uses audiotapes
- uses music related to themes/holidays
- allows students to use tape recorder to recite then play back
- substitutes oral reports for written assignments
- uses CDs
- uses books-on-discs

Kinesthetic

- allows students to make multimedia production (PowerPoint)
- allows students to use computers and calculators
- uses role playing and simulations
- provides opportunities for movement, games, activities

---

[5] Adapted from (Reed & Bergemann, 2005, pp. 37-38)

4

Curricular strategies that respond to Gardner's Multiple Intelligences[6]

Visual Spatial
__ charts
__ graphs
__ photography
__ visual awareness
__visual analogies
__ organizers
__ visual metaphors
__ visual analogies
__ visual puzzles
__ 3-D experiences
__ painting
__ illustrations
__ story maps
__ visualizing
__sketching
__patterning
__mind maps
__ color
__ symbols

Logical /Mathematical
__ problem solving
__ tangrams
__ geometry
__ measuring
__ classifying
__ predicting
__ logic games
__ data collecting
__ serialing
__ attributes
__experimenting
__puzzles
__manipulatives
__scientific model
__money
__time
__sequencing
__critical thinking

Verbal/Linguistic
__stories
__retelling
__journals
__process writing
__reader's theatre
__storytelling
__choral speaking
__rehearsed reading
__bookmaking
__speaking
__ nonfiction reading
__research
__speeches
__presentations
__listening
__reading
__read-aloud
__drama

Bodily/Kinesthetic
__field trips
__activities
__creative
    movement
__hands-on
    experiments
__body language
__manipulatives
__physical
    education
__crafts
__drama

Musical/Rhythmic
__singing
__humming
__rhythms
__rap
__background music
__music appreciation
__mood music
__patterns
__form
__playing instruments

Interpersonal
__cooperative learning
__sharing
__group work
__peer teaching
__social awareness
__conflict mediation
__discussion
__peer editing
__cross-age tutoring
__social gathering
__study group
__clubs
__brainstorming

Intrapersonal
__individual study
__personal goal setting
__individual projects
__journal keeping
__personal choice
__individualized reading
__self-esteem activities
__clubs
__brainstorming

Naturalist
__studies the structure of
    plants
__plants seeds
__observes animal growth

__studies the animal kingdom[1]

---

[6] Adapted from (Reed & Bergemann, 2005, pp. 69-70)

5

320

Multicultural responsiveness (Reed & Bergemann, 2005, p. 72)

Communication
Verbal

- Questions asked by the teacher:

- Words used by the teacher:[7]

Analyse using cognitive behaviours and verbs based on blooms cognitive domain (Reed & Bergemann, 2005, p. 33)

Nonverbal (Miller, 2000)

- Facial Expressions

- Paralanguage (vocal qualities, such as tone, inflection, volume, emphasis, and pitch)

- Kinesics including gestures, posture and regulation of space

Teachers' ICT literacy

Teachers' ICT literacy will be looked at through the newly developed framework for ICT literacy based on the following major categories:

- **Operational understanding and application of ICT**
  Focus of enquiry: to what extent does the teacher demonstrate an understanding and
  application of technology operation and concepts?

- **Designing ICT-rich learning Environments and curriculum for improved student learning**
  Focus of enquiry: how does the teacher plan and design ICT-rich learning
  environments for improved student learning? How does she/he facilitate learning by
  choosing appropriate learning activities and pedagogical approaches?

- **ICT for professional learning and engagement**
  Data to be obtained from the interviews

  How does the teacher design effective strategies for the evaluation and assessment
  of learning? Whether she/he involves the student in this process?

- **Socio-cultural ethical legal and health related issues in the use of ICT**
  Focus of enquiry:
  How does the teacher respond to the complex issues surrounding ICT?

6

The role of the student   passive   active   interactive

- Listen and understand presentation,
- Data gathering and processing,
- Analyzing and drawing conclusion from data,
- Search for information,
- Presentation of own learning,
- Electronic presentation of own learning,
- Engage in enquiry,
- Engage in collaborative task with other students,
- Peer tutoring,
- Determine own learning schedules and strategies,
- Reflect on own learning, [8]
- Other

Level of interaction with peers	Low	Med	High
Level of student-teacher interaction	L	M	H
Level of collaboration	L	M	H

The role of technology in he classroom

To facilitate:

- Critical thinking skills,
- Collaborative & organizational Skills ,
- Information skills,
- Empower students¡¦ learning with ICT skills,
- Motivate students,
- Self-access learning ,
- Provide authentic learning contexts to students,
- Students can evaluate their own learning, [9]
- Other

Outcomes of the learning process

Evaluating the outcomes of the based on evidence such as artefacts, teacher assessment of student work, student evaluation and /or reflection on their own work.

---

[8] Adopted from SITES M2 (2003)

[9] Adopted from SITES M2 (2003)

7

Overall description of the learning environment

Evaluating the learning environment using Jonassen's (2001)model for constructivist learning environments

How do we know if students are engaged in meaningful learning?

The following characteristics of meaningful learning provide guidelines for designing constructivist learning environments.
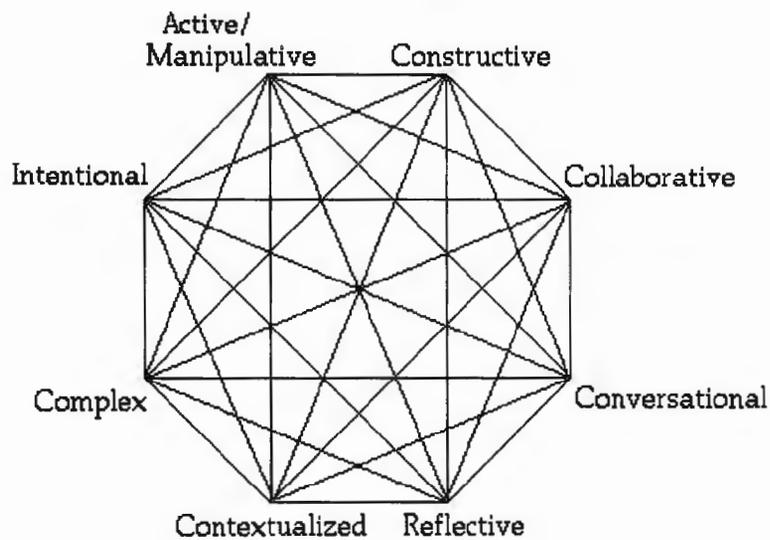
[Figure 1]

Learning environments should emphasize the qualities illustrated in Figure 1.

Resources used by the teacher in the process of designing the learning

Such as: books, journals, digital resources (e.g. Sofweb, Ideabank), collaboration with colleagues, students; connectedness with the community, etc.

8

Appendix K: Agenda for a meeting with supervisors

Supervisory meeting   24/05/05   3.00-4.00 pm
Head of School's Office /School of Education ETS Park

Supervisors: Dr Brenda, Cherednichenko, Dr Maureen O'Rourke, Dr Colleen Vale

Student: Eva Dakich

today:

Fieldwork resumed in May 2005 (5')
- Participants
- Data obtained
- Data to be collected?

Making meaning of data (45')
- The process of meaning making:
- Deconstructing teachers' voices
- The process of reconstruction: how do we arrive to meaning (merging voices perceptions reflections with current body of knowledge)

Dilemmas related to quantification of qualitative data:
- To what extent is qualitative data quantifiable?
- How to quantify and compare meaning?
- The use of mind maps to bring together labels into themes

How to write up data analysis?
- The case by case approach
- Integrated approach

Survey study: Preparing for the final follow-up (10')
- A brief report on the current status of the survey study:
- Number of schools responded,
- Number of teacher responses,
- Quality of data
- Follow-up techniques to be implemented

Work submitted: qualitative data structures emerging from teacher interviews

Notes, comments, suggestions: Thank you

Integrating ICT into student learning (Joanne's perspective)

ICT promoting social connectednes

ICT as a research tool- raising awareness about critical issues

Students may loose focus when searching the net

Students use multiples sources of information: internet, papers, live conversation

Using it as a tool, not teaching it as a subject

To support learning where appropriate

ICT as a tool – one of the tools for learning

ICT as part of natural learning

The sharing of ideas opens the forum for me

Integrating skills with the work

Students confident users of ICT

Education as a co-learnig experience

Learning to use ICT, so it facilitates and supports

Working together promotes communication, problem-solving and supports development

ICT as a medium for developing student creativity and extend their knowledge

Developing skills and awareness using the programs

Taking focus session on Excel

Taking the pressure of the studnets

Learning the skills to be effective users of ICT

Glving a session with Sandy/MICE student

ICT as a tool for collaboration

Celebrating cultural diversity

Collaborative problem-solving fights disengagement

ICT Catering for student diversity

With iCT it's easier for him to complete a tsk

Authentic tasks more engageing

Studenst working at different levels of ability

Integrated student enjoys working with ICT

Market Garden Challange

Integrated topic on history

Providing students with authentic, meaningful, real-world learning tasks

Gifted students interested and looking for learning with ICT

ICT empowering students with special needs

Applying (Numeracy) skills to realistic, and meaningful projects

Using ICT for research, presenting timelines, creating graphes and tables

Merging expectations for aasessment

Integrated student using maths made easy

Using information to come up with a collaborative project

Students work towards expecations

Performance based assessment

Presentation as evidence of learning

I don't create a task around ICT but I use it to support learning

Appendix M: Outcomes of the third round of the Delphi process

A Framework of ICT Competencies for Primary Teachers Proposal

The proposed list of competencies is on:

- Scheffler and Logan List of Computer Competencies (1999),
- Expert responses collected in the first round of the Delphi process, and individual interviews (2003)
- List of Competencies submitted by expert 837 (2003)
- Learning Technologies Capabilities Guide – DE&T, VIC (1998)
- National Educational Technology Standards and Performance Indicators for Teachers - ISTE (2000)
- Contemporary literature on ICT and innovative practices in the primary classroom, teachers' professional learning and engagement, policy documents and initiatives.
- Consultations with supervisors and Advisory and Monitoring Team
- Expert responses collected in the third round of the Delphi process (2004)

1 OPERATIONAL UNDERSTANDING AND APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

1　Demonstrates understanding and knowledge of information and communication technologies (ICT).

1a　Demonstrates up to date understanding and knowledge of information and communication technologies (ICT) used in home, school, workplace and community.

2　Demonstrates application of common computer hardware including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards and graphic tables).

2a　Demonstrates professional judgment in the selection and application of common computer hardware including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards and graphic tables

3　Demonstrates skill in the use and application of common computer software (word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.)

3a　Demonstrates confidence in the use and application of common computer software (word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.)

4　Demonstrates familiarity and utilizes network resources such as the Internet intranets and Local Area Networks to communicate, conduct research and exchange ideas.

4a　Demonstrates confidence in the use of network resources such as the Internet intranets and Local Area Networks to communicate, conduct research and exchange ideas.

4b　Demonstrates confidence in the use of network resources such as the Internet intranets and Local Area Networks to communicate, retrieve relevant information and exchange ideas.

5　Demonstrates ability to utilize basic diagnostic strategies in order to ascertain causes of malfunction related to computer hardware and software.

1

No new competencies for the above section.

2 DESIGNING ICT-RICH LEARNING ENVIRONMENTS AND CURRICULUM FOR IMPROVED STUDENT LEARNING

6 Plans for the effective management/ application of ICT resources to create a learner-centered environment

7 Makes informed choices in the application of appropriate hardware.

7a Makes informed choices in the selection application of appropriate hardware to suit the needs of learners and the context of learning.

8 Makes informed decisions about the relevance and educational value of software before applying it to teaching and learning by consulting educational websites and relevant literature.

8a Makes informed decisions about the relevance and educational value of software before applying it to teaching and learning by consulting colleagues, educational websites and relevant literature.

8b Makes informed decisions about the relevance and educational value of software before applying it to teaching and learning.

8c Makes informed decisions about the relevance and educational value of software based on professional principals related to student learning, teaching goals, authentic curriculum design, technological infrastructure by relying on existing professional competence, collaboration with colleagues, educational websites and relevant literature.

9 Differentiates between applications of ICT supporting drill and practice, presentation, tutorials, simulation, problem solving, (electronic) collaboration and communication and applies them to appropriate learning activities and situations.

9a Differentiates between applications of ICT that support routine tasks; and those that require higher order cognitive skills; problem solving and collaboration; and applies them to appropriate learning activities and situations.

9b Differentiates between a range of applications of ICT and integrates them into appropriate learning activities and situations (e.g.: drill and practice, presentation, tutorials, simulation, problem solving, electronic collaboration and communication).

10 Chooses and designs developmentally appropriate and inclusive pedagogical strategies and teaching practices supported by technology that respond to the diverse needs of learners.

10a Chooses and designs inclusive pedagogical strategies and teaching practices supported by technology that responds to the diverse needs of learners.

10b Understands the diverse needs of learners and chooses and designs inclusive pedagogical strategies and practices supported by technology.

11 Integrates ICT into a range of learning activities to facilitate both individual and collaborative group work.

11a Integrates ICT tools into a range of learning activities to facilitate independent and interdependent learning.

2

12   Promotes innovative uses of technology amongst students, encouraging creativity and originality.

13   Facilitates on-line communication and collaboration of students at a local and global level.

14   Ensures that students develop competence and confidence in using ICT.

14a   Ensures that all students develop competence and confidence in using ICT.

14b   Ensures that students develop competence and confidence, as well as critical awareness in using ICT.

15   Critically reflects on these experiences and plans for improved practice/teaching and student learning.

15a   Critically reflects on these experiences and designs plans based on professional inquiry for improved student learning and innovative learning environments.

16   Consults current literature on ICT pedagogies when planning learning experiences and activities.

16a   Consults current literature and research on ICT pedagogies when planning learning experiences and activities.

16b   Conducts professional inquiry using current literature and research on ICT pedagogies when planning learning experiences and activities.

17   Designs and integrates ICT enhanced learning experiences across the curriculum.

18   Uses technology to design and present units of work and prepare handouts.

19   Applies ICT enriched curricular activities to facilitate inquiry, problem solving, critical thinking and knowledge construction.

20   Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.

21   Supports inter-/multidisciplinary curricular activities with ICT.

22   Communicates with parents about ICT and curriculum as well as about appropriate and balanced use of computers at home.

23   Uses technology to research and extend curriculum options.

NEW

New C 2.1   Extending students ability to evaluate assess and monitor their own work (e.g.: by creating electronic portfolios, etc.)

New C 2.2   Enabling students to become members of local and extended communities of learning.

New C 2.3   To explore innovative uses of ICT such as being connected across multiple dimensions- local, global inter-communication.

3

3 CLASSROOM MANAGEMENT ASSESSMENT AND EVALUATION

24 Uses information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.

25 Manages electronic databases/electronic spreadsheets in order to collect/record data on student progress (such as electronic publications, electronic portfolios, etc.), interprets results and communicates/reflects on findings in order to improve practice and maximize student learning.

26 Maintains electronic databases of resources and classroom inventory equipment and budgets.

Item Deleted

27 Uses electronic time management and organizational tools / software packages for time and project management, budgeting and record keeping related to professional role

28 Demonstrates familiarity and applies measures of hardware and software security with special emphasis on protection of privacy of students' work and records.

NEW COMPETENCIES

No new competencies for the above section.

4 ICT FOR PROFESSIONAL LEARNING AND ENGAGEMENT

29 Develops a personal plan for continuous professional learning related to ICT pedagogies.

30 Demonstrates continual growth in understanding and applying ICT to educational settings by keeping abreast of current and emerging technologies and pedagogical approaches.

31 Understand and uses conventions of ICT aided research communication and collaboration.

32 Uses technology to communicate ideas and collaborate with parents, peers, and larger community.

33 Engages in ongoing professional development related to integration of ICT to support student learning.

34 Shares, discusses and evaluates effective practices and strategies with other teachers and participates in collaborative projects for designing ICT- rich learning environments.

35 Contributes to on-line resources for educational community.

4

36 Demonstrates familiarity and critical understanding of national, state and school policies related to the integration of ICT in teaching and learning.

37 Demonstrates understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and school context for improved student learning.

37a Demonstrates understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and schools for improved student learning.

38 Actively participates in school and community-based projects promoting the integration of ICT into the process teaching and learning and broader school or communal context.

No new competencies for the above section.

5 SOCIO-CULTURAL, ETHICAL, LEGAL, AND HEALTH-RELATED ISSUES IN THE USE OF ICT

39 Understands and communicates the negative and positive consequences of ICT on a global and local level including its current and future uses in the home, school, workplace and community.

39a Demonstrates familiarity with debates about the benefits and risks of ICT on a global and local level; including its current and future uses in the home; school; workplace and community.

40 Applies appropriate ethical positions and responsible behaviors associated with the use of ICT, such as network/internet policies, copyright laws and use of information.

41 Develops and consciously implements strategies to address equity issues related to equal access for all students including different levels of ability, race, gender, socioeconomic status, language and culture.

42 Identifies health hazards related to the use of ICT and creates/ensures a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.)

43 Maintains a critically reflective approach in the use of electronic information in particular the vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc.

44 Demonstrates familiarity with the role of technology in youth culture and recreational uses of ICT.

45 Develops critical awareness of the role of ICT in entertainment and media/recreational activities and creates an age-appropriate framework in collaboration with students.

No new competencies for the above section.

5

Delphi Process - Results of Third Round

OPERATIONAL UNDERSTANDING AND APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

Demonstrates understanding and knowledge of information and communication technologies (ICT)

4 response(s) for include, comprising 50.00% of the total number of responses
**2 response(s) for Modify, comprising 25.00% of the total number of responses**
1 response(s) for Delete, comprising 12.50% of the total number of responses
1 response(s) are invalid response(s), comprising 12.50% of the total number of responses

Distribution of responses
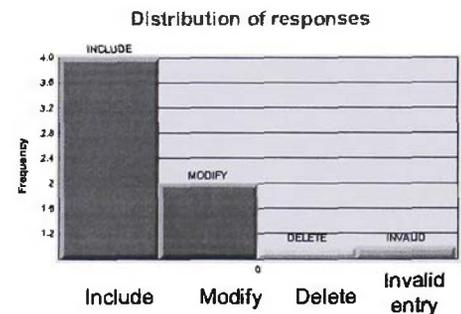
Modifications suggested:

* "I like the front end of this one (understanding and knowledge sound like attributes of a professional). While I think the item should be quite general; I suggest elaborating on the back end a little.

eg. Demonstrates understanding and knowledge of a range of information and communication technologies (ICT) used in the home; school; workplace and community."
* "Demonstrates state-of-the art (or up-to-date) understanding (ctd. as above) "

2 **Demonstrates application of common computer hardware including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards and graphic tables).**

7 response(s) for include, comprising 87.50% of the total number of responses
**1 response(s) for Modify, comprising 12.50% of the total number of responses**

Distribution of responses
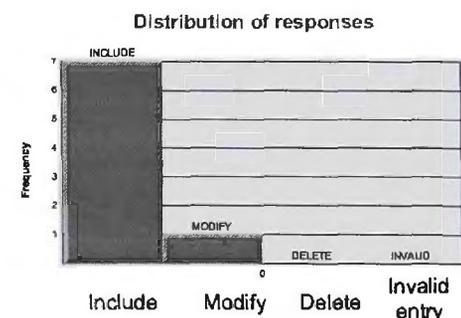
Modifications suggested:

* "Demonstrates professional judgement in the selection and application of common computer hardware including peripheral devices.

Actually; what I've suggested here looks very much like item 7 below. If I modify item two so it focuses on skills/confidence then it looks like item 3; so I (now) suggest omitting this one (item 2)."

3 **Demonstrates skill in the use and application of common computer software (word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.)**

7 response(s) for include, comprising 87.50% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses
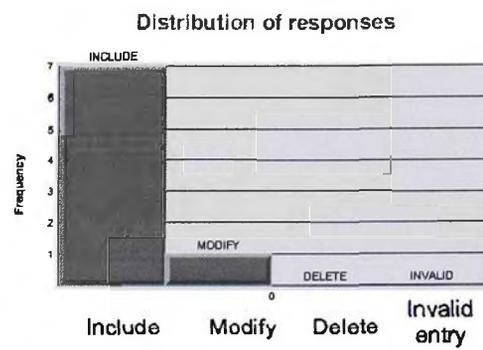
Modifications suggested:

* "Demonstrates confidence in the use and application of common computer software."

| 4 | **Demonstrates familiarity and utilizes network resources such as the Internet intranets and Local Area Networks to communicate, conduct research and exchange ideas.** |

Distribution of responses

6 response(s) for include, comprising 75.00% of the total number of responses
2 response(s) for Modify, comprising 25.00% of the total number of responses
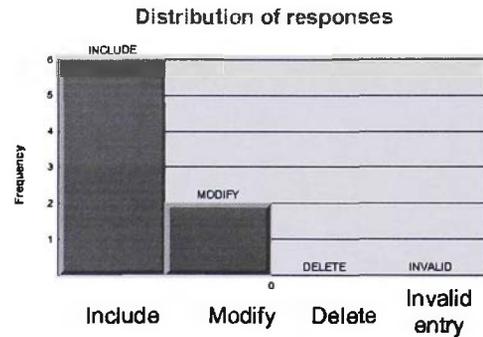
Modifications suggested:

* "Demonstrates confidence in the use of network resources such as the Internet; intranets and Local Area Networks to communicate; conduct research and exchange ideas."
* "Instead of conduct research: retrieve relevant information. (Teachers are not necessarily research-oriented!)"

| 5 | **Demonstrates ability to utilize basic diagnostic strategies in order to ascertain causes of malfunction related to computer hardware and software.** |

Distribution of responses

7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses
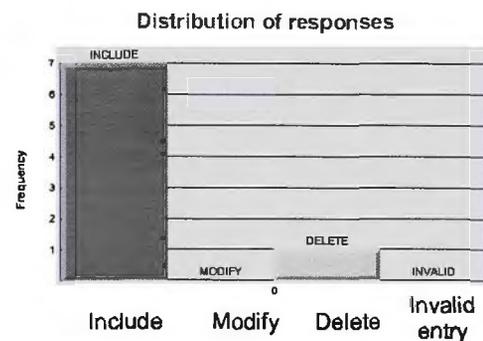

Modifications suggested:

*

DESIGNING ICT-RICH LEARNING ENVIRONMENTS AND CURRICULUM FOR IMPROVED STUDENT LEARNING

6 Plans for the effective management/ application of ICT resources to create a learner-centered environment

Distribution of responses

7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) are invalid response(s), comprising 12.50% of the total number of responses
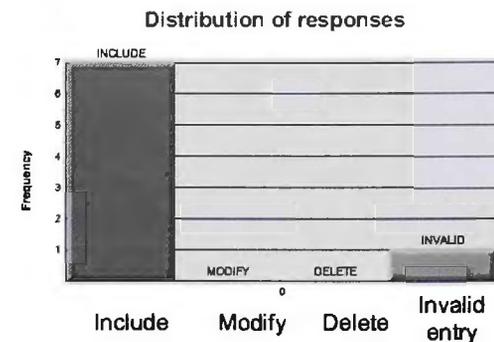
Modifications suggested:

*

7 Makes informed choices in the application of appropriate hardware.

Distribution of responses

6 response(s) for include, comprising 75.00% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses
1 response(s) for Delete, comprising 12.50% of the total number of responses
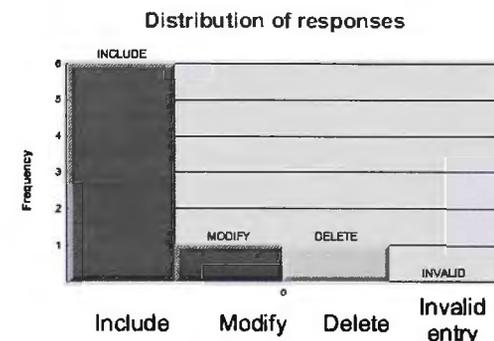
Modifications suggested:

* "What is it about the hardware that makes a difference to designing ICT Rich learning environments? I can't think of how to make this question relevant -- perhaps it is in making your use of the word "appropriate" more explicit? "

8 Makes informed decisions about the relevance and educational value of software before applying it to teaching and learning by consulting educational websites and relevant literature.

Distribution of responses

5 response(s) for include, comprising 62.50% of the total number of responses
3 response(s) for Modify, comprising 37.50% of the total number of responses

333
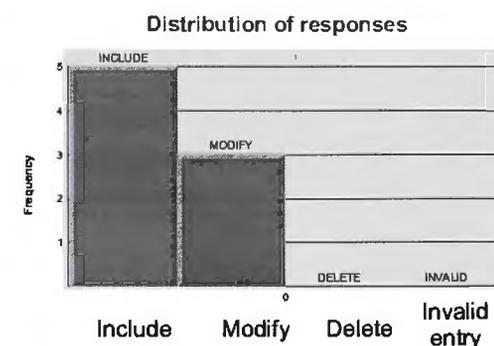
Modifications suggested:

* "add " and colleagues" to the end of the sentence"

* "Makes informed decisions about the relevance and educational value of software based on professional principals [protocols?] related to students' learning and teaching goals; authentic curriculum design; techcnological capacity; aesthetic design; and efficiency [cost-effectiveness?]. These decisions will be based on existing professional comeptence and experience informed by research with colleagues; educational web-sites and relevant literature. Note this wording is a bit rough but I hopw will illustrate the areas that seem to be missing from the draft competency."

* "Makes informed decisions about the relevance and educational value of software before applying it to teaching and learning."

Differentiates between applications of ICT supporting drill and practice, presentation, tutorials, simulation, problem solving, (electronic) collaboration and communication and applies them to appropriate learning activities and situations.

6 response(s) for include, comprising 75.00% of the total number of responses
2 response(s) for Modify, comprising 25.00% of the total number of responses

Distribution of responses
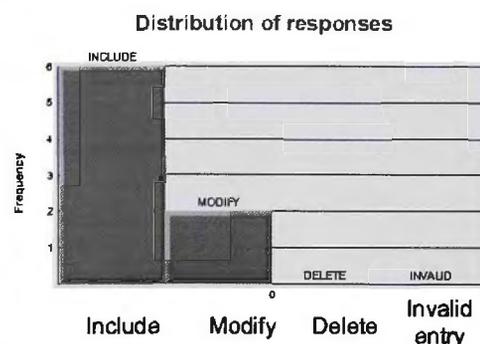
Modifications suggested:

* "Differentiates between the range of possible applications of ICT and applies then to appropriate learning activities and situations (For example etc etc as above) - this format does not essentialise the selected examples "

* "Differentiates between applications of ICT that support routine tasks; and those that require higher order cognitive skills; problem solving and collaboration; and applies them to appropriate learning activities and situations."

10 Chooses and designs developmentally appropriate and inclusive pedagogical strategies and teaching practices supported by technology that respond to the diverse needs of learners.

7 response(s) for include, comprising 87.50% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses

Distribution of responses
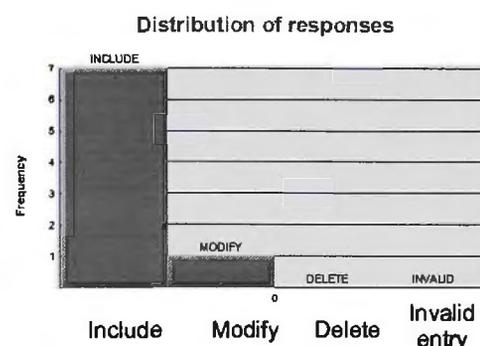
Modifications suggested:

* "I cringe at "developmentally appropriate" because it logically leads to a deficit view of learners and what they can achieve. I suggest;

  Understands the diverse needs of learners and chooses and designs inclusive pedagogical strategies supported by technology.
  "

11 Integrates ICT into range of learning activities to facilitate both individual and collaborative group work.
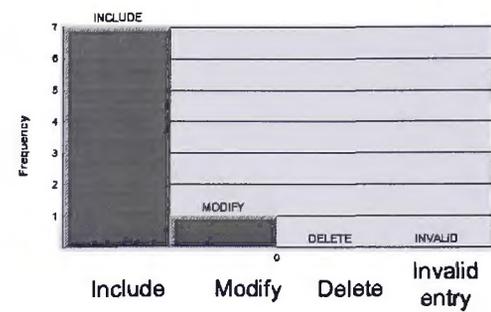
7 response(s) for include, comprising 87.50% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses

Modifications suggested:

* "Integrates ICT tools and strategies into a range of learning activities to facilitate independent and interdependent learning"

12 **Promotes innovative uses of technology amongst students, encouraging creativity and originality.**
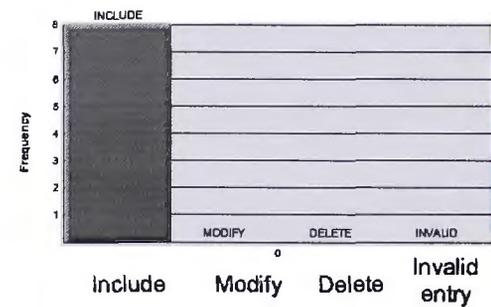
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

13 **Facilitates on-line communication and collaboration of students at a local and global level.**
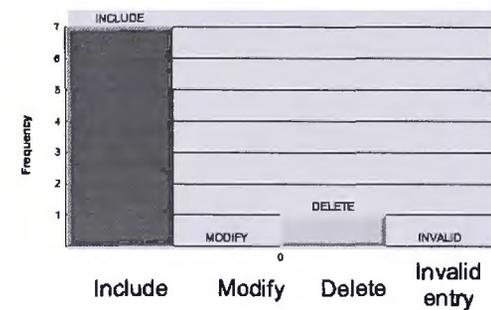
7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses

Modifications suggested:

*

14 **Ensures that students develop competence and confidence in using ICT.**
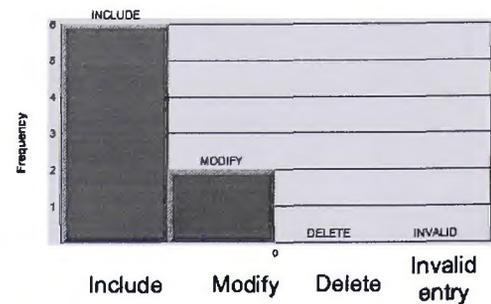
6 response(s) for include, comprising 75.00% of the total number of responses
2 response(s) for Modify, comprising 25.00% of the total number of responses

Modifications suggested:

* "Either in this competency or somewhere else I think there schould be reference to students' capacity for critical reflection"
* "Ensures that all students develop competence and confidence in using ICT."

15 │ Critically reflects on these experiences and plans for improved practice/teaching and student learning.

Distribution of responses
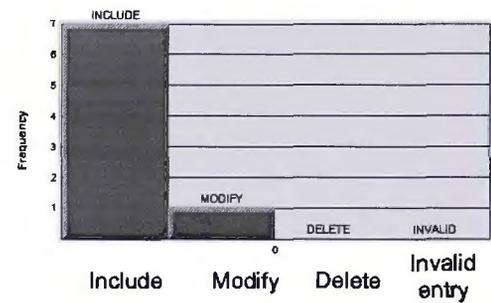
7 response(s) for include, comprising 87.50% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses

Modifications suggested:

* "Could the wording be a little clearer here - by using one of the following two approaches - (1) a more global statement about the key elements of teachers' reflective practice and then making explicit that reflection on the use of ICT is incorporated - or (2) a more clearly stated outline of what it is that teachers should be reflecting on related to ICT - I tend to think that the first approach is best - because teachers reflective practice is based on their inquiry into the learning of children and as they face up to the demands of this inquiry they bring to bear on it the various aspects of teaching; learning; context; etc - I'm not sure ......"

16 │ Consults current literature on ICT pedagogies when planning learning experiences and activities.

Distribution of responses
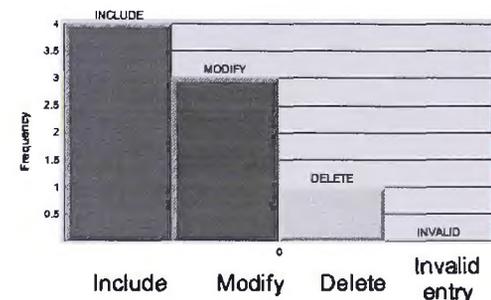
4 response(s) for include, comprising 50.00% of the total number of responses
3 response(s) for Modify, comprising 37.50% of the total number of responses
1 response(s) for Delete, comprising 12.50% of the total number of responses

Modifications suggested:

* "insert "and research" after literature in above sentence"

* "What is the essence if this competency - is it the consulting the literature or is this just one example of the professional inquiry (i.e.; may be be literature; colleagues; PD etc) ...... By the way I prefer the language of "inquiry" rather than "consulting" --- inquiry is more related to a sense of professional agency of the teacher - whereas consulting is more like they come to the experts for the answer.)"

* "Consults current professional literature on ICT pedagogies when planning learning experiences and activities."

17 Designs and integrates ICT enhanced learning experiences across the curriculum.

6 response(s) for include, comprising 75.00% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses
1 response(s) for Delete, comprising 12.50% of the total number of responses

Distribution of responses
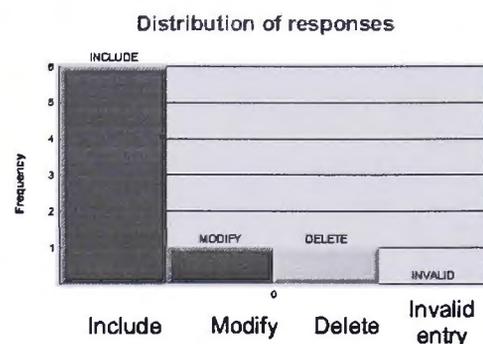
Modifications suggested:

* "I would either add to this competency or make into an extra competency some reference to the absolute importance of authentic teaching and learning (i.e.; learning and teaching as instrinsically bound to accomplishing real world tasks that are important and useful to the student and the community) - This is important in ICT for at least 2 reasons (1) so much of the software that will be marketed to students and teachers (even those examples that are fun to use and very visually and activity wise enticing to children) may be focused on simulating authentic tasks when the learning will be better achieved by simply doing the real task; (2) ICT has authentic uses in the community - how do these become part of authentic curriculum"

18 Uses technology to design and present units of work and prepare handouts.

7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses

Distribution of responses
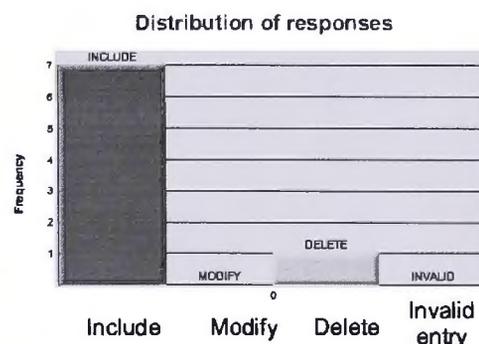
Modifications suggested:

*

19 Applies ICT enriched curricular activities to facilitate inquiry, problem solving, critical thinking and knowledge construction.

337
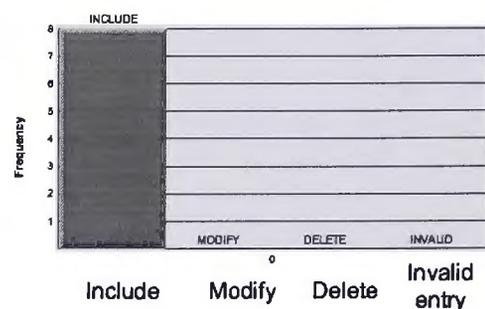
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

| 20 | **Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.** |

Distribution of responses
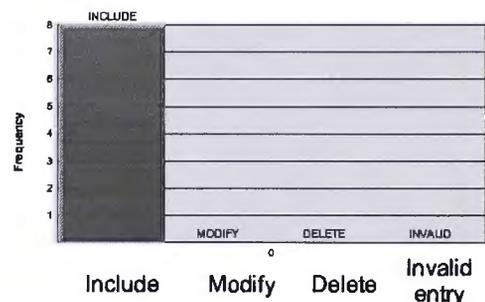
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

| 21 | **Supports inter-/multidisciplinary curricular activities with ICT.** |

Distribution of responses
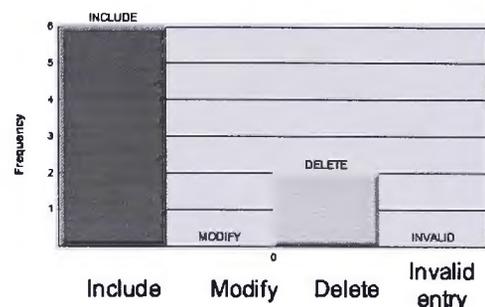
6 response(s) for include, comprising 75.00% of the total number of responses

2 response(s) for Delete, comprising 25.00% of the total number of responses

Modifications suggested:

*

| 22 | **Communicates with parents about ICT and curriculum as well as about appropriate and balanced use of computers at home.** |

Distribution of responses
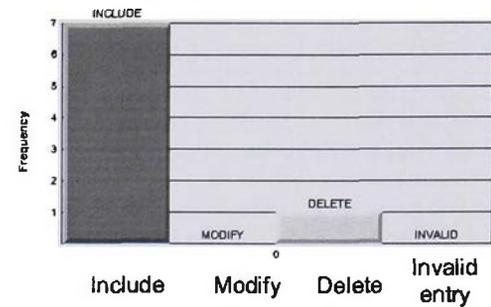
7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses

Modifications suggested:

*

---

23 | Uses technology to research and extend curriculum options.
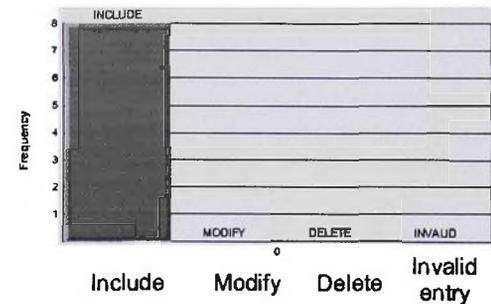
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

New competencies proposed:

*   "Not sure if this is a new cometency but the thought did occur that one of the key elements that may be in some ways unique to ICT is what could be loosely called hypermedia --- the ability to be connected across multiple dimensions through hyperlinks - is this relevant that teachers see this as one of the key things that ICT offers rather than simply an extension of wordprocessing - another area that is included above but may need more emphasis is the place of ICT in personal; local and global inter-communication "

*   "
    something about extending students ability to self assess; self evaluate monitor; constructing electronic portfolios etc..."

*   "Something about students being able to use ICT to form; join or become members of local and extended communities of learning - e.g.; joinging us with a group of students from 3 schools internationally who are researching bird migration and sharing information and observations etc etc."

CLASSROOM MANAGEMENT, ASSESSMENT AND EVALUATION

24 | Uses information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.

Distribution of responses
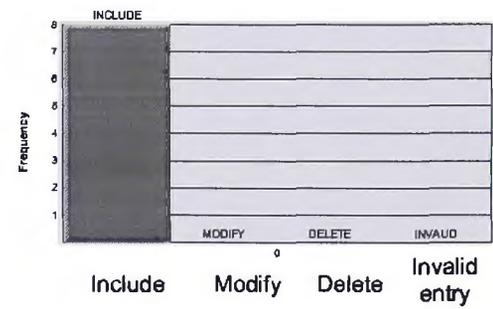
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

---

25 Manages electronic databases/electronic spreadsheets in order to collect/record data on student progress (such as electronic publications, electronic portfolios, etc.), interprets results and communicates/reflects on findings in order to improve practice and maximize student learning.

Distribution of responses
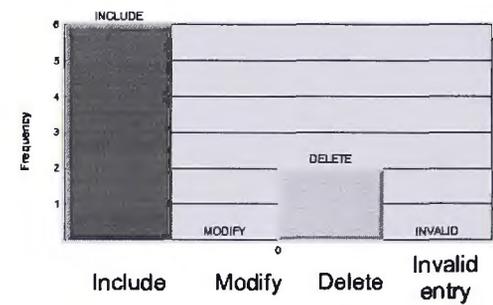
6 response(s) for include, comprising 75.00% of the total number of responses

2 response(s) for Delete, comprising 25.00% of the total number of responses

Modifications suggested:

*

---

26 Maintains electronic databases of resources and classroom inventory, equipment and budgets.

Distribution of responses
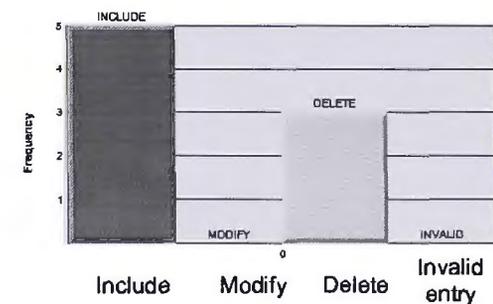
5 response(s) for include, comprising 62.50% of the total number of responses

3 response(s) for Delete, comprising 37.50% of the total number of responses

Modifications suggested:

*

---

27 Uses electronic time management and organizational tools / software packages for time and project management, budgeting and record keeping related to professional role

340
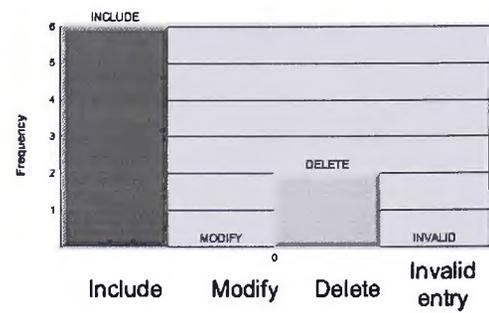
6 response(s) for include, comprising 75.00% of the total number of responses

2 response(s) for Delete, comprising 25.00% of the total number of responses

Modifications suggested:

*

28 **Demonstrates familiarity and applies measures of hardware and software security with special emphasis on protection of privacy of students' work and records.**

Distribution of responses
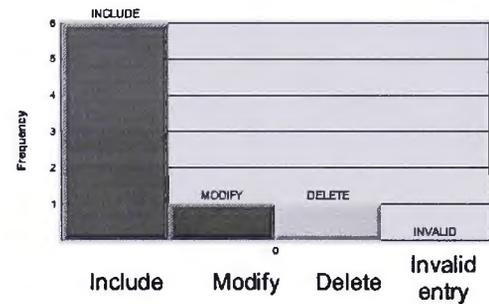
6 response(s) for include, comprising 75.00% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses
1 response(s) for Delete, comprising 12.50% of the total number of responses

Modifications suggested:

* "Demonstrates familiarity with measures for maintaining hardware and software security with special emphasis on protection of privacy of students' work and records."

ICT FOR PROFESSIONAL LEARNING AND ENGAGEMENT

29 **Develops a personal plan for continuous professional learning related to ICT pedagogies.**

Distribution of responses
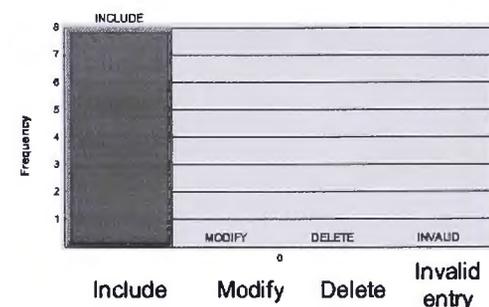
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

341

30 Demonstrates continual growth in understanding and applying ICT to educational settings by keeping abreast of current and emerging technologies and pedagogical approaches.

Distribution of responses

7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses
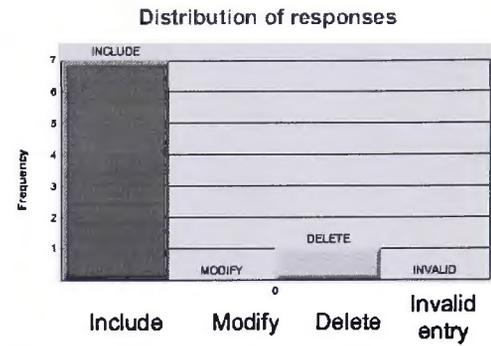
Modifications suggested:

*

31 Understands and uses conventions of ICT aided research communication and collaboration.

Distribution of responses

6 response(s) for include, comprising 75.00% of the total number of responses

2 response(s) for Delete, comprising 25.00% of the total number of responses
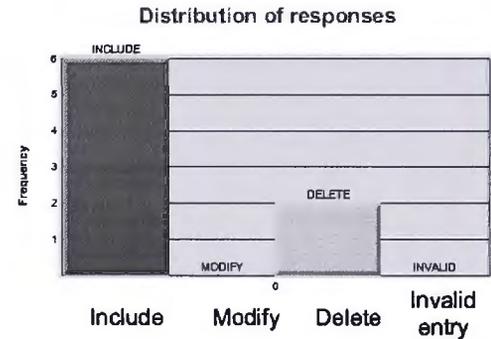
Modifications suggested:

*

32 Uses technology to communicate ideas and collaborate with parents, peers, and larger community.

Distribution of responses

8 response(s) for include, comprising 100.00% of the total number of responses
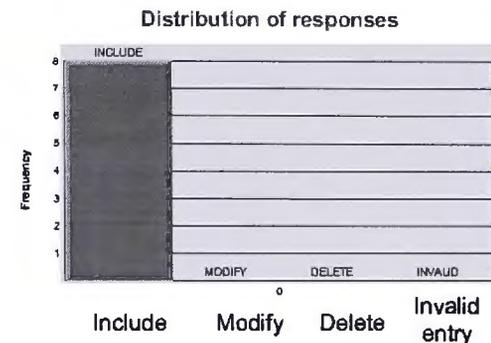

Modifications suggested:

*

33 Engages in ongoing professional development related to integration of ICT to support student learning.
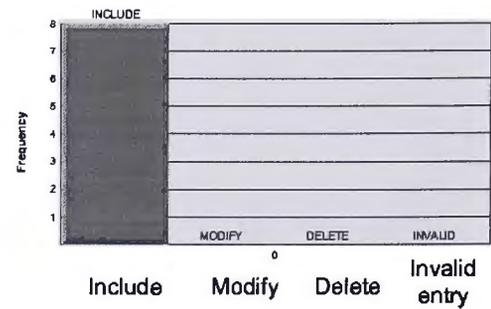
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

| 34 | **Shares, discusses and evaluates effective practices and strategies with other teachers and participates in collaborative projects for designing ICT- rich learning environments.** |
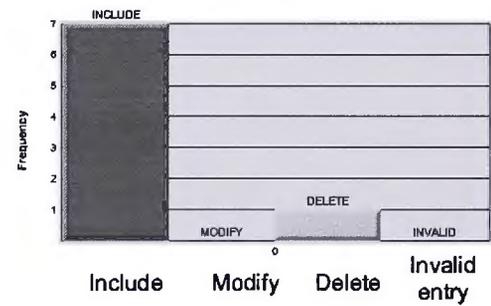
7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses

Modifications suggested:

*

| 35 | **Contributes to on-line resources for educational community.** |
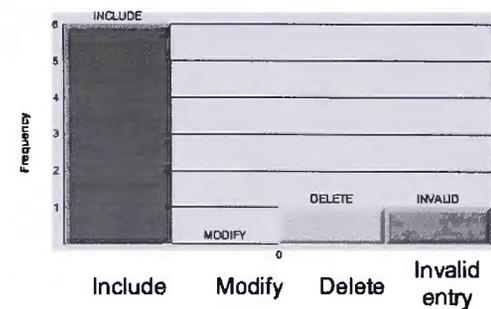
6 response(s) for include, comprising 75.00% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses
1 response(s) are invalid response(s), comprising 12.50% of the total number of responses

Modifications suggested:

*

| 36 | **Demonstrates familiarity and critical understanding of national, state and school policies related to the integration of ICT in teaching and learning.** |

8 response(s) for include, comprising 100.00% of the total number of responses
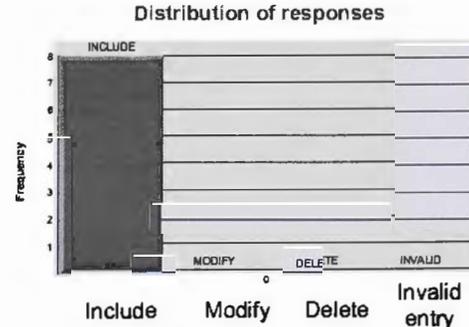
Modifications suggested:

*

37 Demonstrates understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and school context for improved student learning.

6 response(s) for include, comprising 75.00% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses
1 response(s) for Delete, comprising 12.50% of the total number of responses
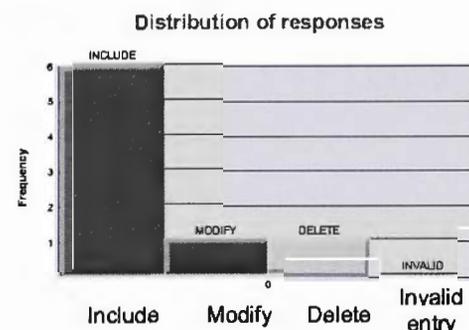
Modifications suggested:

* "Demonstrates understanding of how the integration of ICT can influence/support the restructuring/reorganisation of classrooms and schools for improved student learning."

38 Actively participates in school and community-based projects promoting the integration of ICT into the process teaching and learning and broader school or communal context.

7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses
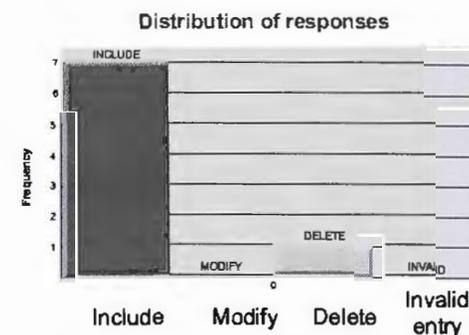
**Modifications suggested:**

*

SOCIO-CULTURAL, ETHICAL, LEGAL, AND HEALTH-RELATED ISSUES IN THE OF ICT IN EDUCATIONAL SETTINGS

39 Understands and communicates the positive and negative consequences of ICT on a global and local level, including its current and future uses in the home, school, workplace and community.

Distribution of responses

7 response(s) for include, comprising 87.50% of the total number of responses
1 response(s) for Modify, comprising 12.50% of the total number of responses

Modifications suggested:

* "Demonstrates familiarity with debates about the benefits and risks of ICT on a global and local level;
  including its current and future uses in the home; school; workplace and community."

40 Applies appropriate ethical positions and responsible behaviors associated with the use of ICT, such as network/internet policies, copyright laws and use of information.

Distribution of responses

8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

41 Develops and consciously implements strategies to address equity issues related to equal access for all students including different levels of ability, race, gender, socioeconomic status, language and culture.

Distribution of responses

8 response(s) for include, comprising 100.00% of the total number of responses
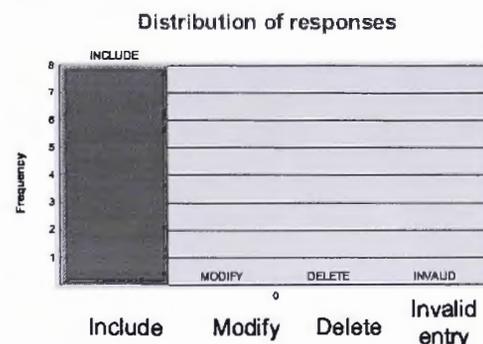
Modifications suggested:

*

42 Identifies health hazards related to the use of ICT and creates/ensures a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.)
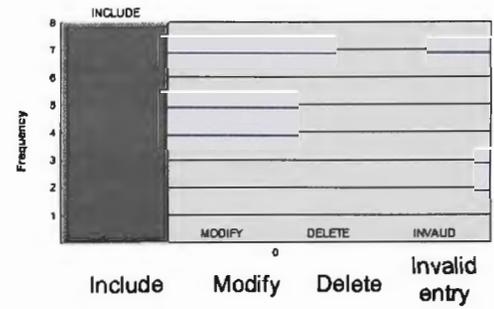
8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*

43 Maintains a critically reflective approach in the use of electronic information in particular the vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc.

Distribution of responses

8 response(s) for include, comprising 100.00% of the total number of responses

Modifications suggested:

*
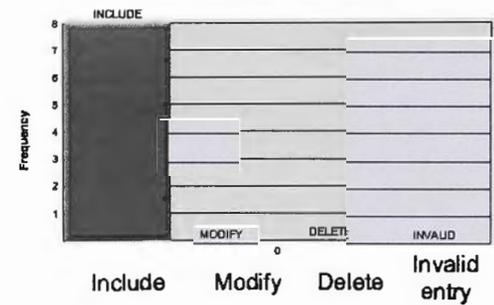
Demonstrates familiarity with the role of technology in youth culture and recreational uses of ICT.

Distribution of responses

8 response(s) for include, comprising 100.00% of the total number of responses
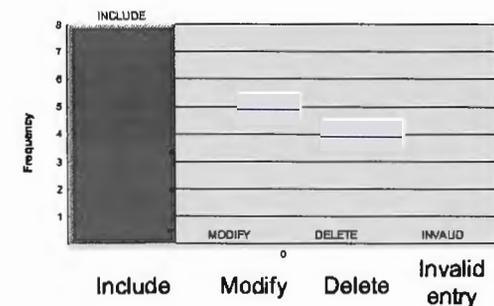
Modifications suggested:

*

Develops critical awareness of the role of ICT in entertainment and media/recreational activities and creates an age-appropriate framework in collaboration with students.

7 response(s) for include, comprising 87.50% of the total number of responses

1 response(s) for Delete, comprising 12.50% of the total number of responses

Modifications suggested:

*
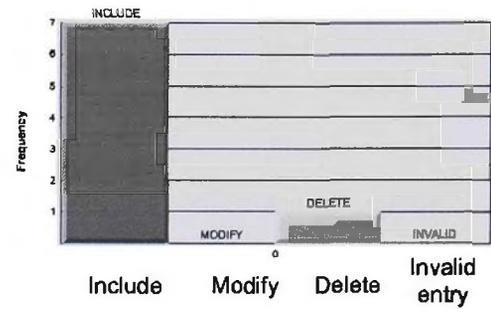
New competencies proposed:

* "This isn't exactly a new competency but rather an over all redflection - one of the problems in developing competencies which I think is evident here and in may cometency based systems - is the balance on the one hand between exactitude or clarity on the one hand openness to professional self awareness; reflectiona nd growth on the other - It is hard to get the balance right - i don't know how it can be done effetively - at quite a nuymber of places where you have used words like "appropriate" etc one part of me was saying "this has no meaning - how does one decide if something is appropriate or not?" However as soon as I would try to think about how it could be tightened up or made more explicit I realised that my ideas were verging towards simplistic critereon referenced lists that too narrowly defined the topic - I see this played out in the different ways that I have seen the whole notion of competencies used here and in the US - the US tends to the behavioural with a focus on exacititude and here there seems to be more an approach that this is a framework for professiona reflection ---- I'm not sure what to suggest except perhaps to begin your competencies with a brief intorduction which establishes how you suggest that the list of competencies may be used within a professional approach to teaching???? - vaue late at night thoughts!!! "

Delphi Process - A Framework of ICT Competencies for Primary Teachers

Report Date:
24/06/200

OPERATIONAL UNDERSTANDING AND APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

1

Demonstrates up to date understanding and knowledge of information and communication technologies (ICT) used in home, school, workplace and community.   Mean: 2.63   SD: 0.48

2

Demonstrates professional judgment in the selection and application of common computer hardware including peripheral devices (e.g.: keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards and graphic tables, etc.).   Mean: 2.25   SD: 0.43

3

Demonstrates skill in the use and application of common computer software (e.g.: word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.).   Mean: 2.25   SD: 0.83

4

Demonstrates familiarity and utilizes network resources such as the Internet, Intranets and Local Area Networks to communicate, conduct research and exchange ideas.   Mean: 2.00   SD: 0.87

DESIGNING ICT-RICH LEARNING ENVIRONMENTS AND CURRICULUM FOR IMPROVED STUDENT LEARNING

5

Plans for the effective management / application of ICT resources to create a learner-centered environment.   Mean: 2.63   SD: 0.70

Makes informed choices in the selection and application of appropriate hardware to suit the needs of the learners and the context of learning.   Mean: 2.50   SD: 0.50

7

Makes informed decisions about the relevance and educational value of software, based on professional principles related to student learning, teaching goals, authentic curriculum design and technological infrastructure, by relying on existing professional com competence, collaboration with colleagues, educational websites and relevant literature.   Mean: 2.38   SD: 0.48

8

Differentiates between applications of ICT that support routine tasks and those that require higher order cognitive skills, problem solving and collaboration, and applies them to appropriate learning activities and situations.   Mean: 2.25   SD: 0.83

9

Understands and supports the diverse needs of learners by choosing and designing inclusive pedagogical strategies and practices supported by ICT.   Mean: 2.63   SD: 0.48

10

Integrates ICT into a range of learning activities to facilitate both individual and collaborative group work.   Mean: 2.38   SD: 0.70

11

Promotes innovative uses of technology amongst students, encouraging creativity and originality.   Mean: 2.63   SD: 0.48

348

No.	Description				
12	Facilitates on-line communication and collaboration of students at a local and global level.	Mean:	2.63	SD:	0.48
13	Ensures that students develop competence, confidence, and critical awareness in using ICT.	Mean:	2.75	SD:	0.43
14	Critically reflects on these experiences, and designs plans based on professional inquiry for improved student learning and innovative learning environments.	Mean:	2.25	SD:	0.83
15	Conducts professional inquiry using current literature and research on ICT pedagogies, when planning learning experiences and activities.	Mean:	2.13	SD:	0.60
16	Designs and integrates ICT enhanced learning experiences across the curriculum.	Mean:	2.50	SD:	0.71
17	Uses technology to design and present units of work and prepare handouts.	Mean:	2.00	SD:	0.71
	Applies ICT enriched curricular activities to facilitate inquiry, problem solving, critical thinking and knowledge construction.	Mean:	2.63	SD:	0.48
19	Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.	Mean:	2.75	SD:	0.43
	Supports inter-/multidisciplinary curricular activities with ICT.	Mean:	2.38	SD:	0.48
21	Communicates with parents about ICT and curriculum, as well as about appropriate and balanced use of computers at home.	Mean:	2.13	SD:	0.93
22	Uses technology to research and extend curriculum options.	Mean:	2.13	SD:	0.60
23	Extends students ability to evaluate assess and monitor their own work (e.g.: by creating electronic portfolios, etc.).	Mean:	2.75	SD:	0.66
24	Encourages students to become members of local and extended communities of learning.	Mean:	2.13	SD:	0.78
25	Explores innovative uses of ICT such as being connected across multiple dimensions - local and global inter-communication.	Mean:	2.25	SD:	0.66

26			
Uses information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.	Mean: 2.25	SD:	0.66

ICT FOR PROFESSIONAL LEARNING AND ENGAGEMENT

27			
Develops a personal plan for continuous professional learning related to ICT pedagogies.	Mean: 2.38	SD:	0.48

28			
Demonstrates continual growth in understanding and applying ICT to educational settings by keeping abreast of current and emerging technologies and pedagogical approaches.	Mean: 2.50	SD:	0.50

29			
Uses technology to communicate ideas and collaborate with parents, peers, and larger community.	Mean: 2.13	SD:	0.33

Engages in ongoing professional development related to integration of ICT to support student learning.	Mean: 2.25	SD:	0.43

31			
Shares, discusses and evaluates effective practices and strategies with other teachers and participates in collaborative projects for designing ICT- rich learning environments.	Mean: 2.38	SD:	0.70

32			
Demonstrates understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and schools for improved student learning.	Mean: 2.25	SD:	0.83

SOCIO-CULTURAL, ETHICAL, LEGAL, AND HEALTH-RELATED ISSUES IN THE USE OF ICT

33			
Applies appropriate ethical positions and responsible behaviors associated with the use of ICT, such as network/Internet policies, copyright laws and use of information.	Mean: 2.50	SD:	0.50

34			
Develops and consciously implements strategies to address equity issues related to equal access for all students including different levels of ability, race, gender, socioeconomic status, language and culture.	Mean: 2.50	SD:	0.50

35			
Identifies health hazards related to the use of ICT and creates/ensures a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.)	Mean: 2.25	SD:	0.66

Maintains a critically reflective approach in the use of electronic information in particular the vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc.	Mean: 2.50	SD:	0.71

37			
Demonstrates familiarity with the role of technology in youth culture and recreational uses of ICT.	Mean: 2.38	SD:	0.70

Appendix P: The Framework of ICT Literacy for Primary School Teachers
(Final version)

D1   Operational Understanding and Application of Information and Communication Technologies

C1   Demonstrates up-to-date understanding and knowledge of Information and Communication Technologies (ICT) used in home, school, workplace and community.

C2   Demonstrates professional judgment in the selection and application of common computer hardware, including peripheral devices (e.g. keyboards, printers, scanners, digital video cameras, digital microscopes, electronic whiteboards etc.).

C3   Demonstrates skill in the use and application of common computer software (e.g. word processing, text and image editing, data and file management, graphics and design, multi- and hypermedia, etc.).

C4   Utilizes network resources such as the Internet, Intranets and Local Area Networks to communicate, conduct research and exchange ideas.

D2   ICT-Rich Pedagogies and Learning Environments

C5   Plans for the effective management and application of ICT resources to create learner-centred environments.

C6   Makes informed choices in the selection and application of appropriate hardware to suit the needs of the learners and the context of learning.

C7   Makes informed decisions about the relevance and educational value of software, based on professional principles related to student learning, teaching goals, authentic curriculum design and technological infrastructure, by relying on existing professional competence, collaboration with colleagues, educational websites and relevant literature.

C8   Designs and integrates ICT-enhanced learning experiences across the curriculum.

C9   Understands and supports the diverse needs of learners by choosing and designing inclusive pedagogical strategies and practices supported by ICT.

C10   Makes informed decisions about the relevance and usefulness of ICT applications to meet particular learning outcomes.

C11   Differentiates between applications of ICT that support routine tasks and those that require higher order cognitive skills, problem solving and collaboration, and applies them to appropriate learning activities and situations.

C12   Uses technology to design and present units of work and prepare handouts.

C13   Applies ICT-enriched curricular activities to facilitate enquiry, problem solving, critical thinking and knowledge construction.

C14   Integrates ICT into a range of learning activities to facilitate both individual and collaborative work

C15   Supports inter-/multidisciplinary curricular activities with ICT.

C16   Promotes innovative uses of technology amongst students, encouraging creativity and originality.

C17   Explores innovative uses of ICT, such as being connected across multiple dimensions: local and global communication.

C18   Facilitates on-line communication and collaboration of students at a local and global level.

C19   Encourages students to become members of local and extended communities of learning.

C20   Ensures that students develop competence, confidence, and critical awareness in using ICT.

C21   Communicates with parents about ICT and curriculum, as well as about appropriate and balanced use of computers at home.

C22   Critically reflects on these experiences, and designs plans based on professional inquiry for improved student learning and innovative learning environments.

C23   Extends students' ability to evaluate, assess and monitor their own work (e.g.: by creating digital projects, electronic portfolios, etc.).

C24   Uses information and communication technologies to support the implementation of a variety of monitoring, assessment and evaluation strategies.

D3   **ICT for Professional Learning and Engagement**

C25   Conducts professional enquiry using current literature and research on ICT pedagogies, when planning learning experiences and activities.

C26   Uses technology to research and extend curriculum options.

C27   Develops a personal plan for continuous professional learning related to ICT pedagogies.

C28   Demonstrates continual growth in understanding and applying ICT to educational settings, by keeping abreast of current and emerging technologies and pedagogical approaches.

C29   Uses technology to communicate ideas and collaborate with parents, colleagues, and larger community.

C30   Engages in ongoing professional development related to integration of ICT to support student learning.

C31   Shares, discusses and evaluates effective practices and strategies with other teachers, and participates in collaborative projects for designing ICT- rich learning environments.

C32   Demonstrates understanding of how the integration of ICT can influence the restructuring/ reorganization of classrooms and schools for improved student learning.

C33   Develops and consciously implements strategies to address equity issues related to equal access for all students, including different levels of ability, race, gender, socioeconomic status, language and culture.

C34   Demonstrates familiarity with the role of technology in youth culture and recreational uses of ICT.

C35   Applies appropriate ethical positions and responsible behaviours associated with the use of ICT, such as network/Internet policies, copyright laws and intellectual property.

C36   Maintains a critically reflective approach in the use of electronic information in relation to vulnerability of children/youth culture to misinformation, marketing, inappropriate relationships, etc.

C37   Identifies health hazards related to the use of ICT and creates a safe learning environment that complies with basic ergonomic and health principles (including position, light, radiation, etc.).

Technology box

1　2

Student work exhibited

4

Books

1

3

Small Board

White board

Hallway

2

Birds

3

LT　LT

Teacher' office

4

Technology box

1　2　3　printer　Books

Small board

1

2

White board
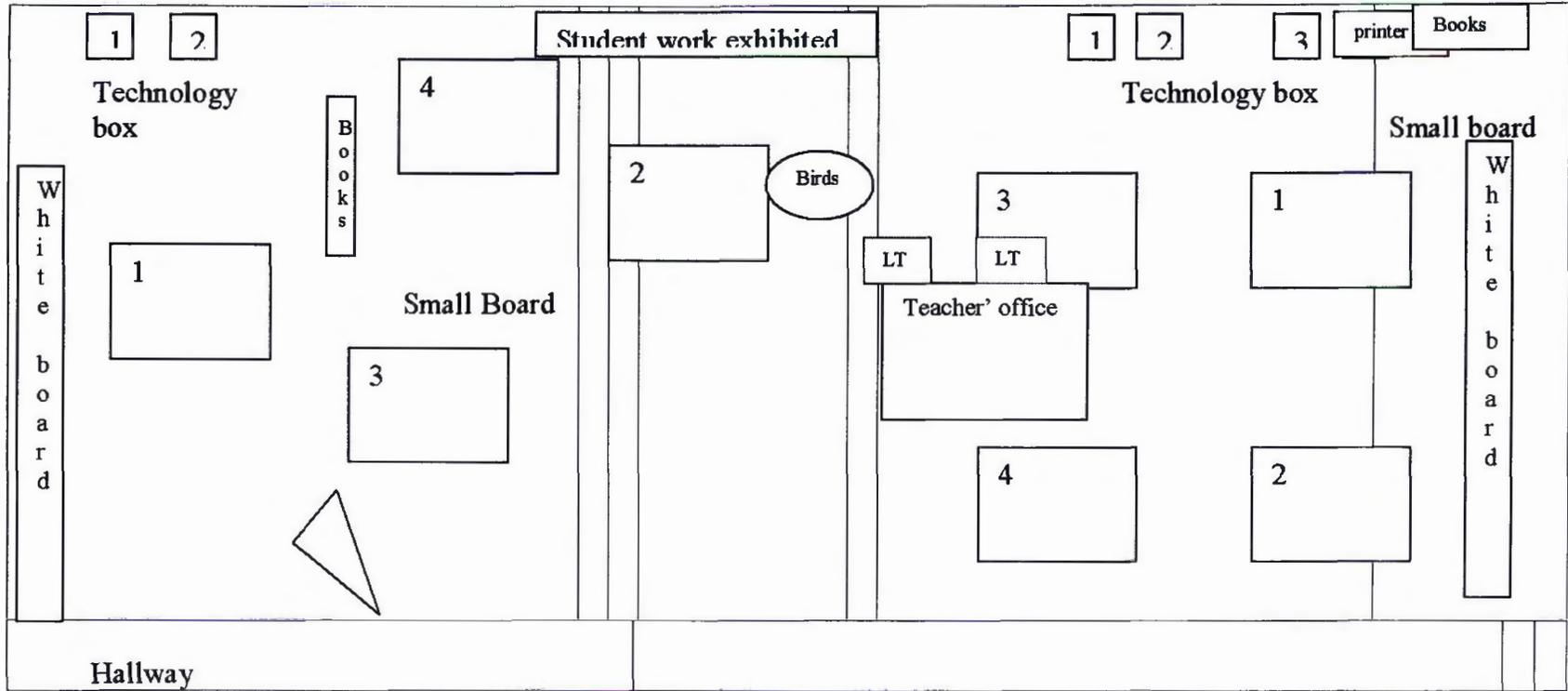
Date and time 22/03/05; 9.30-11.00
Teachers, Kate Maria (working in a team teaching environment)
Grade level: 3/4
Subject area: Literacy /Arts – integrated unit
Number of students: 26 in each class;
Topic: Blurb
Focus Questions: What is a blurb? What makes it interesting?
Consent formes signed: Request for school participation (1 by the principal; 1 by the school council);Staff participation (1 – by the school principal, 1 by the teacher)

Confidential field data (work in progress)　1
Exploring the Relationship Between Teachers' ICT Literacy and Teaching Practices
Eva Dakich, PhD student
22/03/2005

Students with special need: one child (speech problems and ADD)
Helper:: an integration aid and two parent volunteers (parents take turns in volunteering and helping the teachers organize the learning activities and facilitate student learning.
Kate starts the class with greeting the two groups of students who are sitting in half circle listening quietly and attentively in front of the two teachers
She introduces the activity, by reading out a blurb; and asks two students to look up the word 'blurb'in the dictionary; further exploring the term by building on students' experiences related to blurbs found on books, videos, DVDs.   She also assigns a homework to students to find a blurb on their DVDs and books at home
Following the exploration about what a blurb is students are working in four groups.
Group I   Read a blurb and make up a story. Type and print your story using the technology box. (Technology box refers to the four networked computers located in each classroom.)
Books are supplied from the book corner located in the classroom.
Group II   Handwriting – students practice handwriting using notebooks specifically designed for copying handwritten letters and words.
Group III   Write your own blurb – reader boxes – read a story and write up your own blurb (what makes the book interesting). =When you finish type up your blurb in the technology box.
Group IV   Create your favourite character from the book you read – art supplies provided paper, fabric, strings, pegs, etc. for students to create three dimensional characters from the stories they read.
Students work in groups on individual tasks. When task completed they rotate and engage the next activity. Each group completes all four tasks.
The teacher walks around and helps the children settle down with the task. Both teachers, the integration aids and the parent volunteers help facilitate student learning.
The instructions are clear, easy to follow;
The teacher (Kate) gives example of how to write a blurb, by making one herself.
Non verbal communication: Teachers voice - friendly but authoritative;
Q   (parent)   How long is a blurb?
A   (teacher)   It's about a paragraph.
ICT use – a student (B)(Kate) from table one approaches one of the computers (CSA) located in the Technology Box to write up the blurb. Another student (G) approaches and turns on the computer (CSB) located next to the previous one (please refer to classroom map). They start talking to each other. A parent comes to them and askK: "Are we getting work done here or just chatting?" The students open word and start working on the task; they keep talking to each other (with relation to their task) and seem to be comfortable with what they are doing.
Student B uses word art and concentrates on how his work is going to be presented. Student G stands up leaves computer CSB and moves to CSC.

IC_D_007 Interview No.3 with J, PPS Western Suburbs Date: 24/03/05	**Anticipated themes (set by the loosely structured interview guidelines)** * Importance of ICT for student learning * Factors that facilitate and hinder teacher's successful integration of ICT into their practices * Changes to learning classroom relationships, roles, learning environment, thinking/teaching philosophies (is it too complex?) * Factors contributing to changes *Connections between teachers' ICT literacy and practices (as perceived by teachers) *Vision/ future plans with regards to integrating ICT and pedagogy [1]		
Conversation		**General meaning**	**Major theme/pattern/metaphor**
E: Is there anything that you feel hinders effective integration of ICT with your teaching practices?			
J: Hm, as a tool technology when you have glitches with (laugh) it can present problems quite often. And it is one of the things that you learn to cope with, that you will have something planned and for some reason or the other the network is down, or so therefore we can't access the program, or students have forgotten their logon codes, or have been some glitch with technology, that can become frustration at times but we learn to get around that, I mean, I dearly.... you would like to have all students having access to the computer at times and today because there were a number of students away with the Easter holidays, the majority of students actually had access. Normally on this program they are working together. Which provides for communication between them, the problem solving and the support and development. But sometimes it's easier if they've got individual access to them.		Learning to cope with difficulties of technical and human nature and being that can be frustrating. Having access to technology for all students. Although working together promotes collaboration and social skills, sometimes I is necessary that all students have access to technology	Barriers to successful technology integration: Difficulties of technical and human nature Access Access
E: You talked about some changes in classroom relationships and roles. Today I saw you handing the role of the expert over to one of your students. How would you describe these changes?			

---

[1] these would be expected to be the descriptors of the clusters (?) "reoccurring patterns themes, or "gestalts", which will pull together many separate pieces of data." (Miles and Huberman 1994)

J: Since technology has arrived I think <u>our understanding of students has developed</u>, from, when I started teaching, it was very much the <u>role when the teacher was the person to instruct</u> and to teach. Um I believe nowadays, <u>whit the expertise of students and the knowledge of students</u>, **that a lot of times the teacher's role is more to facilitate and to draw on the expertise of others, we can't be experts in all areas**. And we need to be able to draw on the expertise that is around us. This is the MICE program which is a mentors in computer education program provides an opportunity for students who have a talent in a particular area, to have that talent explored further, and are the expert's program enables all children to have an opportunity to develop those leadership roles, and I think if you are encouraging students to take on those leadership roles it is really important to provide the opportunities for them to refine their skills in that area and give the opportunity to use them. <u>Education particularly in my classroom and I think education in general is a co-learning experience that we learn from each other, where the children feel confident to lead to develop their leadership skills, where they feel confident to explore new understandings, and question things that are happening and to offer alternatives to them</u> which is addressing their needs. More so that where as <u>we develop the scaffold that we.. and the plan that we want to work with them to use their skills and expertise to work together to actually developing those understandings.</u>	Since technology arrived into our classroom our understanding of students have developed.

When I started teaching the role of the teacher was to instruct

Teachers' drawing on the expertise of others (including students)

Encouraging students to take up leadership roles

Education is a co-learning experience

Questioning things around us and offering alternatives

Teacher's to develop the scaffold, to extend the skill and expertise of students and facilitate collaboration and the development of shared understandings. | Changes in understanding how students learn. Uncritical view of the power of technology?

Changes in the role of the teacher

Teacher's as learners, teachers as collaborative practitioners

Students as teachers (changing roles)

Learning as a collaborative process (social construction, negotiated meaning making)

Developing critical and thinking and creativity.

Teacher's as facilitators of learning and student collaboration. |
| How would you describe your own confidence in integrating ICT in learning and teaching? | | |
| J: As I said from probably from a pedagogical practice idea of co-learners <u>I see myself as learning to use ICT</u>. And [I am] very fortunate here that we have some extremely um exceptionally talented people in that area to work with us, to provide that guidance for us. So quite often and I'm not and I often say to my students that I am learning this with you. And so that we can use and build on the skills, and students are aware that some of the other students have a grater knowledge in particular area and that I will learn from them. | I see myself as learning to use ICT.

Being supported and learning from colleagues.
Learning from students, some of the students are aware that they have a greater knowledge in particular areas, that I will learn from them. | Being a learner in using ICT.

Learning from colleagues and students
Teachers as learners |