Faculty of Arts and Education

A longitudinal study of beginning teachers' pedagogical identity and their use of ICT

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This thesis is presented for the Degree of Doctor of Philosophy of Murdoch University

[Date to be added]
DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

Signed:

Date:
ABSTRACT

The educational policy environment in Australia explicitly supports the integration of information and communications technologies (ICT) through targeted initiatives covering infrastructure, equipment, electronic learning materials and professional development. However, for all the energy expended to encourage teachers to use ICT, it is reported that few teachers take full advantage of the significant opportunities that ICT present. A number of reasons have been cited to explain this, the most compelling of which are bound up with teachers’ knowledge and skills in harnessing ICT and their beliefs about ICT and teaching itself.

This research presents a 3 year longitudinal study of a cohort of 35 beginning teachers located in Western Australia. The focus on beginning teachers is purposeful. It is suggested that this segment of the teaching profession can provide useful insights into the affordances and risks that teachers face in harnessing ICT. Beginning teachers may also provide a window into how ICT will be taken up in the future. The aim of the research, therefore, is to describe and explain beginning teachers’ beliefs, knowledge, dispositions and skills in using ICT within the context of their school environment(s).

The research literature characterises beginning teachers as having positive self-perceptions of their ability to use ICT, and embracing contemporary, student-centred theories of learning. Given these preconditions, it might seem likely that beginning teachers would seek to integrate ICT into their teaching in innovative ways. The seven research questions that underpin and guide the research are aimed, at least in part, at confirming or challenging this assertion.
The study adopts a mixed method approach in seeking to understand and interpret the dynamic nature of participants’ beliefs about teaching and their knowledge, dispositions and skills in using ICT within their socio-cultural context. A rich data set, gathered over 3 years and using qualitative and quantitative techniques, is presented to provide evidence in relation to the study’s research questions. The longitudinal nature of the study provides opportunities to interpret this data set over time, adding to the strength and credibility of the research.

Participants articulated pedagogical beliefs that aimed to engage students in active meaning-making. However, the way in which participants used ICT was generally limited to presentation-style teaching, completion of worksheets using a narrow range of productivity software and the use of the World Wide Web for simple inquiries or reinforcement. There was a clear mismatch between the ideals that participants claimed to hold to be important and their capacity to use ICT to help realise these ideals. Four interrelated factors are posited to explain this: lack of clarity over beliefs and how ICT can support these beliefs; variability of perceptions within schools of the affordances and risks of using ICT; embedded structural constraints that stall the creative use of ICT; and, deficiencies in technological-pedagogical-content knowledge.

The study may interest educational policy-makers, school leaders, managers, teachers and other learning professionals who are considering how to conceptualise, plan, implement and/or enhance the use of ICT within their local context. A model is presented to help educators grapple with the implications of using ICT in the classroom and explore its transformative potential.
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Glossary

**Digital Education Revolution**

An Australian funding initiative that seeks to contribute sustainable and meaningful change to teaching and learning in Australian schools that will prepare students for further education, training and to live and work in a digital world. ("Experience the Digital Education Revolution", 2009)

**Epistemological beliefs**

Beliefs about the nature of knowledge.

**Government schools**

Schools that are predominantly funded by government. Also called public or state schools.

**ICT**

Information and communications technologies. Refers to any technologies used for processing information and communicating (Anderson, 2008). This can include computers, mobile devices such as laptops, phones and iPods electronic games and software.

**K-12**

An expression describing the years of education between kindergarten and the final year of schooling in Australia (Year 12).
Learning Federation

The Learning Federation is a collaborative venture between all Australian states and territories. Coordinated by the Curriculum Corporation, the purpose of the Learning Federation is to manage the national resource pool and infrastructure of digital curriculum resources.

Pedagogical beliefs

Teachers' beliefs about teaching and learning (Lim & Chai, 2008, p. 808).

Private schools

Schools that are predominantly funded by private sources. In Australia, these include catholic and independent schools.

Public schools

Schools that are predominantly funded by government. Also called government or state schools.

State schools

Schools that are predominantly funded by government. Also called government or public schools.

Statements of learning for ICT

Statements released by the Australian Commonwealth Government in 2006 that make explicit to teachers, the types of uses that ICT should be put. Five categories are identified: inquiring, creating, communicating, and operating with ICT as well as ethics, and issues associated with ICT.
Web 2.0

Refers to a perceived second generation of web-based communities and hosted services, including social networking sites (e.g. blogs, wikis, Facebook, Twitter), which facilitate collaboration and sharing between users (Sutherland, Robertson, & John, 2009).
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CHAPTER 1

Introduction

1.1 Introduction to the research study

This chapter introduces the research and provides a background to the study including its purpose and objectives. The chapter then outlines the significance of the study within the context of the current research agenda in Information and Communications Technologies (ICT) and teaching and learning. The chapter closes with a brief overview of the organisation of the thesis.

The proliferation of ICT at home and in workplaces (Somekh, 2007) presents significant opportunities for teachers to develop learning environments that help to ensure students are motivated, exhibit minimal behavioural problems in the classroom, and generally engage more effectively in the learning process. However, there is widespread consensus in the research literature indicating that teachers tend not to take full advantage of these opportunities (Becker, Ravitz, & Wong, 1999; Cuban, 2001; Groff & Mouza, 2008; Harris, Mishra, & Koehler, 2009; Levin & Wadmany, 2008; Sutherland, Robertson, & John, 2009; Voogt, 2008). A number of recent studies offer explanations as to why this is so, and some suggest ways in which ICT can be better used by teachers (Jamieson-Proctor, Burnett, Finger, & Watson, 2006; Newhouse, Clarkson, & Trinidad, 2005; Pegg, Reading, & Williams, 2007; Vannatta & Fordham, 2004; Webb, 2005; Webb & Cox, 2004). One of the features of recent research into the use of ICT in education is an acknowledgement that it is problematic. The combined impact of the diversity of teaching approaches that attempt to stimulate learning in a variety in socio-cultural contexts, coupled with differing beliefs and knowledge about what constitutes ICT, and variable skills in using ICT, all cast within an environment of
rapid change, suggest that there is no silver bullet solution to incorporating ICT into the classroom. Rather, an eclectic array of approaches and avoidance strategies that have the potential to enrich the literature on the relationship between ICT and education.

This research endeavours to distinguish itself from previous research in three important ways. Firstly, it focuses on beginning teachers as they establish themselves in their profession. Beginning teachers are a potentially fruitful cohort to investigate as they might provide a window into the future use of ICT in education. Many teaching graduates now enter the profession with a basic ICT skill set having undertaken targeted learning that deals with ICT skills and pedagogy as part of their undergraduate studies. In addition, many of the recent generation of teaching graduates have grown up with ICT and it is, therefore, likely that they are open to the application of digital technologies in their own teaching.

Secondly, the research responds to a gap in the literature identified by Hew and Brush (2007), who after reviewing 48 studies, concluded that current research into ICT use is overly reliant on short-term, self-reported data that focuses purely on the teacher without observing the classroom context and wider school environment in which the teacher is set. The research proposes a line of inquiry that examines the use of ICT within the context of teachers’ socio-cultural circumstances.

Thirdly, a number of studies (Auld et al., 2008; Hammond et al., 2009) have targeted exemplary practices as the focus of their research, anticipating that the identification of good practices will help practitioners in their own journeys in transforming their pedagogical approaches using ICT. Whilst this might be considered a sensible approach, some of these studies (Auld et al., 2008, p. 11) identified the focus on exemplary school case studies as a methodological weakness:
Our methodology of selecting schools did not explore how exemplary teachers working with ICT in an ‘ordinary’ school manage to instigate sustained pedagogical change beyond their classroom context…The contested struggle of this group of teachers was not exposed in our research. (Auld et al., 2008, p. 11)

The current research encouraged teacher involvement across a range of contexts, and whilst it is acknowledged that the methodology adopted also has its weaknesses, the rich set of examples that emerged permitted the research to observe, first hand, the contested struggles that beginning teachers engaged in to implement ICT.

The role of research has applied and theoretical dimensions. Through dispassionate and critical examination of the subject (the use of ICT in schools) research can discern and discover themes that might have application for improved practices. Equally by empirically and/or scientifically observing the use of ICT in schools, research can help form explanatory and analytical tools that can be used by others. This research attempts to do both and, therefore, articulates a theoretical framework in which the findings of the research can be considered and discussed. A discussion of this framework along with its assumptions are provided in Chapter 2.

By describing and explaining teachers’ use of ICT in different contexts, this research aims to build upon and strengthen the current body of knowledge which explores the transformative potential of ICT. The study is interested in teachers’ beliefs, knowledge and skills in using ICT, their dispositions towards ICT, but also in how the environment in which they operate impacts upon their overall approach to using ICT. A longitudinal design is adopted whereby the researcher engaged, and built relationships, with participants over a 3 year period. It was anticipated that this approach would yield a rich data set across a range of contexts to augment the current knowledge-base on the use of ICT in K-12 education settings.
1.2 Background to the study

1.2.1 ICT integration

ICT is an umbrella term that refers to devices that have the ability to manipulate and communicate information. These devices usually have a central processor and software that supports their operation (MCEETYA, 2006).

There are a growing range of ICT devices available to teachers including computers, laptops, television, digital cameras, mobile phones, MP3 and MP4 players, interactive whiteboards, computer and video games, the Internet, the World Wide Web (Web), email and Web 2.0 tools like blogs and wikis. This list is not exhaustive; indeed one of the features of ICT is that it is constantly and rapidly evolving. For example, the Horizon Report (NMC & EDUCAUSE, 2008) predicts that the immediate future of ICT in education will be influenced by a range of Web 2.0 applications like grassroots video (e.g. YouTube) and data mash-ups (e.g. integration of visual and textual data from the Web).

Teachers have a good deal of autonomy over when and how to use ICT in the classroom (Judson, 2006). Given that the proliferation of ICT options poses different pedagogical and technical challenges to teachers, it is important that the dialogue over the use of ICT is deepened and extended. It is teachers’ use of ICT, often referred to as ICT integration, that forms the basis of this study. Moore (2006, para. 4) defines ICT integration as occurring “when a teacher or learner selects a technology and uses it effectively to achieve a desired outcome.” The level of autonomy implied by this definition gives rise to a variety of applications of ICT to teaching and learning, both teacher- and learner-centred. Applications range from simple capturing devices (e.g. digital cameras) to complex cognitive tools that help students to develop their own knowledge (Jonassen, 2002).
Contemporary learning theory suggests that possibilities for learning are most likely when students are active and cooperative in the classroom, build upon prior learning and engage in authentic activities (Jonassen, Peck, & Wilson, 1999). In these situations the teacher becomes a facilitator of learning. The development of capabilities that respond to individual learner’s needs (i.e. to personalise learning) and help to scaffold their understandings is a worthy goal for teachers. This research acknowledges the importance of articulating the uses to which ICT are put, and will work within a framework that differentiates between various applications from traditional routines that are enhanced by ICT use, to knowledge construction that is only possible through the purposeful use of ICT (Stager, 2008).

1.2.2 Policy environment

Australian governments have been consistent in supporting the use of ICT in schools for over a decade. In 2001, the Australian Ministerial Council for Employment, Education, Training and Youth Affairs (MCEETYA, 2001, para. 2) declared that ICT has a crucial role in both schools and society:

> When students leave school, they should…be confident creative and productive users of new technologies, particularly information and communication technologies (ICT), and understand the impact of those technologies on society.

Whereas early announcements focused on skilling students in the use of ICT, subsequent policy directions have highlighted the potential of ICT to support teaching and learning across the curriculum. For example, in a subsequent action plan, MCEETYA (2005, p. 3) reaffirmed and strengthened its support for ICT integration by suggesting that ICT has: “the potential to transform all aspects of school education and contribute to the achievement of all learning goals.” This confirms a shift in thinking from learning from computers to learning with computers (Jonassen, 2002).
In 2008, Australia committed to a *Digital Education Revolution*, an ambitious plan to transform educational practices through the use of digital technologies. In a recent address to the Australian Computers in Education Conference, the Commonwealth Government Minister for Education, Julia Gillard, (2008, p. 4) spelt out the four key components of the Digital Education Revolution:

First, there must be universal access to high quality computers. It is just common sense that students and teachers cannot make effective use of the potential of information and communications technology unless they have access to appropriate computers.

Second, the computers must be networked. The educational power of computers comes only when they are connected. Teachers and learners must be connected with each other, with information and with learning tools wherever they are located around the world.

Third, there must be compelling educational content and there must be tools which can make that content available to learners and help them to actively use it.

Fourth, teachers must be provided with the training necessary to become skilled users of technology in education and they must be offered effective support, both technical and pedagogical, to use the technology.

According to the 2008/09 Australian Commonwealth Government budget for the Digital Education Revolution ("Budget 2008/09," 2008), computer hardware comprised 87% of available funding ($1.1 billion). $100 million (8%) was allocated for network connectivity (Broadband) and, in acknowledgement of the significant work already undertaken in Australia by the Learning Federation initiative, $32.6 million was allocated for online curriculum tools and resources. In his work on the use of ICT by teachers in the Silicon Valley, Cuban (2001) noted that equipment provision is relatively easy, albeit expensive, to execute. He notes, however, that the crux of implementation hinges on professional learning and support. It is interesting that the Digital Education Revolution allocates $11.25 million through the Australian Government Quality Teacher Program for school-based activities related to ICT professional development, and $10 million over 3 years to technical support. It is in
this realm - teachers’ beliefs, knowledge dispositions and skills development - that the study is set.

Until recently, little direction was provided to teachers themselves on how they might become creative and productive users of ICT. In 2005, however, MCEETYA (2005) released *Learning in an online world: The school education action plan for the information economy* which set out a clear set of principles articulating how ICT could be used as a vehicle for developing effective pedagogical practices. The focus of the action plan was clearly on teachers assisting students to use ICT in the construction and creation of their own knowledge.

A year later MCEETYA released the Statements of Learning for ICT (MCEETYA, 2006) making explicit to teachers, the types of uses that ICT should be put. Five categories are identified in the Statements of Learning: inquiring, creating, communicating, and operating with ICT as well as ethics, and issues associated with ICT. The Australian Government’s Schools Assistance Act (2004) required that the Statements of Learning for ICT be implemented in Australian schools by 2008.

Table 1.1 provides some examples of how ICT can be used in the ways that are suggested in the Statements of Learning. Two additional categories are also added: ICT for productivity and ICT as a teaching tool (Shelly, Cashman, Gunter, & Gunter, 2006).
Table 1.1: 
Possible Ways in Which ICT can be Used in Teaching and Learning

<table>
<thead>
<tr>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiring</td>
<td>Exploration of the Web to discover ideas and different perspectives.</td>
</tr>
<tr>
<td>Creating</td>
<td>Use of graphic organisers to brainstorm ideas, develop action plans and manage projects.</td>
</tr>
<tr>
<td>Communicating</td>
<td>Creation of blog sites for expressing ideas and commenting on other students’ points of view.</td>
</tr>
<tr>
<td>Operating ICT</td>
<td>Learning how to effectively touch type and use a word processing application.</td>
</tr>
<tr>
<td>Ethics and issues</td>
<td>Consideration of copyright implications of using graphics and music files.</td>
</tr>
<tr>
<td>ICT for productivity</td>
<td>Use of a spreadsheet for capturing and manipulating data freeing up capacity for higher order thinking (e.g. interpretation and analysis).</td>
</tr>
<tr>
<td>Teaching tool</td>
<td>Presentation software used to play an interactive game on the electronic whiteboard involving the whole class.</td>
</tr>
</tbody>
</table>

In essence, these categories represent some of the breadth of pedagogical options available to teachers. However, research indicates that the types of uses to which ICT are put in classrooms tends to be unimaginative, resulting in dubious learning outcomes (Cuban, 2001; Kember, 2008; Macnish & Trinidad, 2005). The reasons for this are complex and multifaceted.

1.2.3 The “problem” with ICT

In a recent evaluation commissioned by the Western Australian Department of Education and Training (WADT, 2006) it was reported that although 95% of teachers were said to have used a basic suite of ICT applications, only 18% of teachers regularly used ICT in the classroom (i.e. on a weekly to daily basis). Further, of the 18% who used ICT regularly, most did so as an inquiry tool in the preparation of their lessons or
to improve the computer skills of their students. Recent research in the UK suggests that there is a chasm between the use of ICT outside the classroom and its use inside the classroom (Somekh, 2007). This indicates that there are some important barriers that need to be addressed in order to pave the way for teachers to build ICT into their teaching repertoire. Some of these might be:

- Physical barriers (e.g. lack of computers and other technologies in relation to class sizes; lack of software and technical support).

- Logistical barriers (e.g. difficulties in accessing limited ICT facilities at the school in computer laboratories; managing the integration of ICT in classrooms with students at different levels).

- Curriculum and assessment barriers (e.g. requirements to cover curriculum and assess understanding in particular ways).

- Cultural barriers (e.g. resistance to ICT use; misconceptions about ICT; absence of leadership in schools to explore ICT applications in teaching and learning).

- Pedagogical barriers (e.g. scarcity of opportunities for teachers to experiment with ICT; lack of professional learning opportunities).

- Lack of technical knowledge about how to best use ICT in teaching and learning (e.g. how to use an interactive whiteboard or communicate using a blog).

Some of these barriers are intrinsic to the teacher. That is, they may be about teachers’ knowledge, skills and dispositions in relation to ICT and teaching itself. Other barriers are extrinsic, forming part of the socio-cultural environment in which the teacher is set. Both intrinsic and extrinsic barriers (Ertmer, 1999) are considered in this research and these constructs are further developed in the review of the literature that follows in Chapter 2.
The resultant effect of the barriers described above, according to Williams (quoted in Finger, Russell, Jamieson-Proctor, & Russell, 2007, p. 24), are classrooms which are “old school, out of date and tired.” Using recent data from the OECD’s Programme for International Student Assessment (PISA), Jamieson-Proctor and Finger (2008) estimate that ICT is integral to learning for only 1 in 5 Australian 15 year old students. This estimate mirrors research at the national level in Australia where it is suggested that teachers remain largely sceptical about the use of ICT in the classroom (Pegg et al., 2007). It also resonates with the claims made by Cuban (2001) nearly a decade ago when he suggested that less than 20% of teachers used computers even on a weekly basis.

Some research calls for a fundamental re-think of the role that ICT can play in enhancing learning with a key theme being on transformation at all levels of education (Finger et al., 2007; Matejka & Tanti, 2008; Somekh, 2007). The British Educational Communications and Technology Agency (BECTA) has commissioned a number of research studies to gather evidence on the effectiveness of ICT in educational contexts (BECTA, 2009). A good deal of this research indicates that ICT has a positive impact on educational outcomes even in circumstances where relatively low level ICT interventions took place. For example, the embedding of interactive whiteboards into teachers’ practices were said to have a positive impact on student attainment (Somekh, 2007).

Other research has also found that ICT can have a positive impact even without teacher or school involvement. In analysing data from a national survey involving 15,000 adolescent students in the UK, Chowdry, Crawford, and Godman (2009) found that simply owning a computer reduced truancy rates and also increased student achievement. Clearly ICT can influence educational outcomes through a range of
circumstances that are initiated for educational and other objectives. The problem, as far as Australian schools are concerned, is that apart from a small number of isolated examples, the uptake of ICT has been slow and unimaginative. It would seem that some transformative energy along with a pragmatic approach to initiating and sustaining change is required.

Zhao and Cziko (2001) contend that to understand the lack of ICT adoption in the teaching profession, the focus should be on the hierarchy of teachers’ goals. In deciding whether to integrate ICT, it is posited that teachers ask themselves three questions: does the ICT help to maintain my higher level goals? Does the ICT disturb other goals? Do I have the skills and aptitudes to control the environment that will change as a result of the introduction of the ICT?

Zhao and Cziko (2001) framed their study around Perceptual Control Theory and this brings a pragmatic perspective to the challenge of transforming learning using ICT, focusing on how teacher goals impact upon their adoption and use. This thesis acknowledges the importance of the teacher, but also proposes that the teacher’s workplace (the school) has a crucial role in shaping the way in which teachers use ICT.

### 1.3 Purpose of the study

This research tracks 35 beginning teachers for 3 years as they establish themselves in their profession. Its aim is to provide a rich and potentially illuminating set of examples that can inform other contexts. Using an interpretive approach (Erickson, 1986; Neuman, 2003), the research seeks to develop new knowledge about how teachers’ use of ICT is shaped. Specifically, the objectives of the research are to:

- Describe participants’ beliefs, knowledge, dispositions and skills in using ICT.
Examine if and how these beliefs, knowledge, dispositions and skills change over time.

Explore the role of the school environment in influencing participants’ beliefs, knowledge, dispositions and skills in using ICT.

To achieve these objectives, seven core research questions have been framed to guide the study. These are shown in Table 1.2.

**Table 1.2: Research Questions that Guide the Study**

<table>
<thead>
<tr>
<th>Research questions</th>
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</thead>
<tbody>
<tr>
<td>1. What are the characteristics of beginning teachers’ pedagogical beliefs?</td>
</tr>
<tr>
<td>2. What are the characteristics of beginning teachers’ knowledge, dispositions and skills in using ICT?</td>
</tr>
<tr>
<td>3. What are the relationships among beginning teachers’ pedagogical beliefs, knowledge, skills and dispositions in using ICT?</td>
</tr>
<tr>
<td>4. To what extent do beginning teachers’ pedagogical beliefs and their knowledge, skills and dispositions in using ICT influence the way in which they employ ICT in their classrooms?</td>
</tr>
<tr>
<td>5. What aspects of the socio-cultural environment impacts on beginning teachers’ pedagogical beliefs, and their knowledge, skills and dispositions in using ICT?</td>
</tr>
<tr>
<td>6. To what extent have beginning teachers’ pedagogical beliefs and their knowledge, skills and dispositions in using ICT changed during their time as teachers in the workplace? What factors have contributed to these changes?</td>
</tr>
<tr>
<td>7. What implications do these factors have for the future uptake of ICT in schools?</td>
</tr>
</tbody>
</table>

These questions are central to the organisation of the research and will be discussed in detail in Chapter 3 of the thesis.

### 1.4 Significance of the study

Much has been written about the attitudes and experiences of teachers as they attempt to come to terms with the challenges that ICT present (Cuban, 2001; Jamieson-Proctor et al., 2006; Macnish, Trinidad, & Fisher, 2003; Vannatta & Fordham, 2004).
However, there are relatively few studies that specifically focus on beginning teachers and even fewer that track these teachers over the initial years of their profession. This is surprising given that many of these teachers comprise the digital generation (Prensky, 2006), and that this cohort is potentially different from the rest of the teaching population in terms of their beliefs, knowledge, dispositions and skills in using ICT. This cohort of teachers represents the future of the profession and therefore is worthy of scrutiny.

The use of ICT in classrooms in ways that transform the process of learning is a complex matter. Voogt and Knezek (2008) suggest that whilst there is a vast amount of research into the use of ICT in primary and secondary settings, much of this is scattered and a synthesis of the research from an international perspective has not been achieved. There is a need for more evidence-based research that provides solid, defensible examples of ICT implementation (Condie & Munro, 2006; Lai, 2008; Sutherland et al., 2009). One of the crucial questions underpinning the development of new knowledge in relation to the use of ICT is “what works” in the variety and ever-changing settings in which ICT solutions are applied. This, coupled with the rapidity of technology-change suggests that identifying good practices will be a challenging and ongoing quest for future research. Robertson, Webb and Fluck (2007, p. 9) recognise this challenge:

Each situation is unique and there are no ready-made answers that can be applied universally. That is, in a complex endeavor such as incorporating the use of ICT into teaching and learning there is neither a unique, nor a specific strategy for achieving a particular outcome. What is valid in one situation may be irrelevant in another. Moment-by-moment judgments are required in order to achieve progress.

Perhaps acknowledging the importance of context, Kember (2008) proposes that valuable knowledge can be generated through tracking the actual journeys of teachers through the constraining and conflicting landscape that comprises their socio-cultural context. This thesis also proposes that studies into the use of ICT by teachers and
learners, particularly those with empirical and longitudinal orientations, have value and currency. The research seeks to contribute knowledge in methodological, applied and theoretical domains.

Methodologically, the study adopts a pragmatic, mixed methods approach (Johnson & Onwuegbuzie, 2004). Qualitative and quantitative data are brought together to produce a set of cases that aim to provide rich and contextualised insights into the way in which beginning teachers use ICT. In-depth studies that examine the use of ICT in context offer valuable insights into how and when to use ICT in teaching and learning (Auld et al., 2008; Jordon, 2008; Macnish & Trinidad, 2005). The thesis offers an interpretive dimension that integrates the findings of the research with the comprehensive and rapidly growing literature-base on ICT in education.

In the applied domain, the research seeks to provide practical insights into real school contexts by tracking the way in which 35 beginning teachers use different types of ICT in a range of environments. Practitioners may resonate with some of the experiences of the teachers involved in the study, and perhaps develop an impetus to further improve their own practices.

Finally, the study attempts to add-value to recently published theoretical and conceptual frameworks that seek to explain ICT use in education. These include conceptualisations of:

- The relationship between beliefs and practice (Buehl & Fives, 2009).
- The extent to which teachers’ pedagogical beliefs resonate with identified principles of meaningful learning (Jonassen et al., 1999).
- Pedagogical reasoning and teacher reflection (Mishra & Koehler, 2006; Webb & Cox, 2004).
- ICT adoption (Newhouse et al., 2005; Zhao & Cziko, 2001).
These frameworks, including their relevance for this study, are discussed in Chapter 2 of the thesis.

It is established, then, that the use of ICT in schools is problematic and characterised by a lack of energy and imagination despite significant policy and logistical support for the agenda. There is also a clear rationale and demonstrable need for research that offers insights into the use of ICT based on empirical evidence. Finally, the research methodology, an interpretive approach informed by the pragmatic paradigm, articulates a framework for gathering, analysing and interpreting data that will yield insights in practical and theoretical domains.

1.5 Organisation of the study

This thesis is comprised of eight chapters. This chapter has presented a background for the study and outlined its purpose and significance. Chapter 2 has two functions. Firstly, it provides a review of the literature on teachers’ beliefs, knowledge dispositions and skills in using ICT. Secondly, it brings together a theoretical framework that serves to situate the study in a way in which its findings can be scientifically considered and discussed. Chapter 3 provides an overview of the research methodology. An interpretive framework is adopted involving the collection of data from qualitative and quantitative sources. Chapters 4 to 6 present the data and identify some key themes that have emerged from the study. Chapter 7 discusses the implications of the findings, and finally Chapter 8 introduces possible avenues for further research and concludes the study.

Chapter 2 will now review the literature that has informed this study.


Erickson, F. (1986). Qualitative methods in research on teaching. In M. C. Wittrock (Ed.), Handbook of research on teaching (3 ed., pp. 119-161). New York:: Macmillan.


Chapter 2: Literature review

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CHAPTER 2

Literature Review

2.1 Chapter overview

This chapter presents a summary of the literature that informs the study. Its primary purpose is to situate the research within an existing body of knowledge, and to provide a context for subsequent chapters of the thesis.

The research is concerned with the way in which beginning teachers use ICT and the contextual factors that might influence this use over time. These contextual factors can be intrinsic and extrinsic to the teacher (Ertmer, 2005). Intrinsic factors can include teachers’ beliefs, knowledge and skills and their dispositions towards teaching and learning and ICT. Extrinsic factors, on the other hand, relate to the socio-cultural context in which teachers are situated including access to equipment, professional learning, school leadership and relationships with peers, students and parents.

Where possible, the literature review focuses on recent empirical studies that involve beginning teachers operating in educational contexts. However, there are limited research studies that fit these criteria, and therefore insights are also drawn from a wider scope of studies that fit into one or more of the literatures that are shown in Table 2.1. The review does not attempt to do justice to these literatures in terms of depth. However, it will endeavour to draw out some key themes that are felt to have particular relevance for the study.
Table 2.1:  
*Focus of the Literature Review*

<table>
<thead>
<tr>
<th>Literature</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intrinsic</strong></td>
<td>How teachers’ epistemological and pedagogical beliefs might impact on ICT use.</td>
</tr>
<tr>
<td>Teachers’ beliefs.</td>
<td>Relationships between teachers’ pedagogical, content and technological knowledge and skills.</td>
</tr>
<tr>
<td>Teachers’ knowledge and skills.</td>
<td>Teachers’ attitudes towards, and self-perceptions of, teaching, learning and ICT use.</td>
</tr>
<tr>
<td>Teacher dispositions.</td>
<td>The socio-cultural context for ICT in education. The impact of the wider socio-cultural setting on teaching and learning with ICT.</td>
</tr>
<tr>
<td><strong>Extrinsic</strong></td>
<td>The transformative potential of ICT. ICT as a vehicle for transformation of teaching and learning in different socio-cultural settings.</td>
</tr>
</tbody>
</table>

An overarching theme for the chapter is that there are complex forces that compel and constrain teachers, schools and education systems in their efforts to harness the potential of ICT. The chapter is interested in these forces and the conditions under which they operate, particularly at the levels of the teacher and the school. Goos (2003) sees the use of ICT by teachers as part of a learning journey that develops their identities as teachers, and manifests itself as changing participation in socio-cultural practices. One of the reasons why research into ICT use is so interesting (and so necessary) is that there is a multitude of ways in which teachers interpret ICT. Individual, localised and systemic change through the use of ICT in teaching and learning occurs at different rates and this sometimes promotes dysfunction and wastage of resources (Cuban, 2001; Elliot, 2004). Harnessing the transformative potential of ICT in schools would appear to involve (a) understanding the drivers for change at all levels and (b) establishing some alignment between the system, the school and the teacher.
Before discussing the literature as outlined in Table 2.1, it is useful to consider why ICT integration is so attractive to educators, and why it has assumed such importance in educational research.

### 2.2 Rationale for ICT integration

There is evidence in the educational technology literature that indicates a positive relationship between the appropriate use of ICT and student learning (M. Cox, 1997; M. Cox & Webb, 2004; Maor & Taylor, 1995; Webb, 2005). Notwithstanding questions of value for money (Cuban, 2001), if implemented well ICT can create environments where students are motivated to learn, exhibit minimal behavioural problems in the classroom, and generally engage more effectively in the learning process. This alone provides a compelling rationale to understand “what works” in ICT integration, and find ways to break down barriers that inhibit creative uses of ICT in the classroom.

There is, however, a darker side to the business of integrating ICT into the everyday lives of teachers. It can be argued that the agenda for the use of ICT in society generally, and education specifically, has been set by big business through the rhetoric of the knowledge economy. This rhetoric is ratified by governments and unfortunately does little to position the education sector in a way in which it can respond to the real goals of education (Brown, 2005). For example in the UK, Selwyn (2002) tracked the origins of the £1.8 billion investment in the National Grid for Learning (NGfL) to the economic rationalism of 1980s Thatcherism. He found that the legitimacy of ICT in education has been so strongly supported by governments of all political persuasions that it has become an unchallengeable orthodoxy that cannot be allowed to fail. Education, it is argued (Brown, 2005; Selwyn, 2002) has been skilfully positioned within the celebratory narratives of the information revolution and the
knowledge economy, providing a strong rationale for its uncritical adoption by school leaders, teachers, students and parents. However, contrary to the rhetoric of the information revolution, Postman (1992) observed nearly two decades ago that examples of impotent education have little relationship with inadequate information. More pertinent questions, according to Brown (2005), are: What is the ICT story being told? Who is telling it and why? What is missing (whose story is not being told)? These questions invoke a healthy level of scepticism in considering the expansive literature on the topic of ICT integration. They also help to better understand the research problem as posed in the previous chapter: why are so few teachers taking advantage of the significant opportunities that ICT present?

While contemporary students are purported to engage with digital media in staggering numbers outside of school, teachers are said to generally exhibit a lukewarm inclination to use ICT in their workplace (Prensky, 2006). This disparity between the use of ICT at school and other societal contexts is a measure of the lost potential of ICT to transform teaching and learning (Somekh, 2007). A recent report from BECTA (Cranmer, Potter, & Selwyn, 2008, p. 40) concluded that there was a need “to develop forms of classroom technology provision which fit better with the needs, values and experiences of young people.” These types of recommendations have implications across a range of contexts, and one of the common challenges is to draw upon the engaging elements of ICT whilst at the same time building educational relevance and value in the classroom.

Notwithstanding issues of competing interests and inequitable voices in the debate about ICT integration, it is clear that governments have invested massively in ICT (e.g., Gillard, 2008) and this, coupled with the ongoing potential of ICT to improve learning outcomes for students, provides a rationale for this research. The chapter will now discuss the literature on
teachers’ beliefs, knowledge, skills and dispositions, including how these constructs relate to each other, and play out in the variety of socio-cultural contexts in which teachers are situated.

2.3 Beliefs

This study defines beliefs as conjectural relating to premises or suppositions about something that is felt to be true (Calderhead, 1996). Individuals can have beliefs about almost any phenomena and these beliefs can emerge from personal experiences or cultural sources (Nespor, 1987).

According to Buehl and Alexander (2006) and Olafson and Schraw (2006), conceptualising the inter-relationships between epistemological beliefs (beliefs about knowledge), pedagogical beliefs (beliefs about teaching and learning), subject area beliefs and teachers’ practices is embryonic. This study is interested in exploring these inter-relationships, and the impact that they might have on the actions of teachers in the classroom. One of the recent advances in thinking about beliefs lies in the distinction between domain-genericity and domain-specificity.

2.3.1 Domain-general and domain-specific beliefs

Whilst there is some definitional debate over these terms (Hofer, 2006), the thrust of the distinction is that beliefs about the nature of knowledge (domain-generic) can be different from beliefs about the nature of knowledge as this relates to specific discipline areas and other phenomena like pedagogy and ICT (domain-specific). For example, a teacher could believe that knowledge is subjective, changeable and best acquired through active construction (i.e. adopt a relativist perspective at the domain-generic level), but equally hold
that knowledge about *mathematics* is factual, stable and best acquired from experts through transmission (a realist perspective at the domain-specific level). This scenario is graphically depicted in Figure 2.1.

**Figure 2.1.** Conceptualisation of competing beliefs within the socio-cultural context of the classroom.

In this scenario of teaching mathematics the teacher may conduct a lesson that is not congruent with her/his core epistemological and pedagogical beliefs and her/his beliefs about ICT. In the mind of the teacher, the context demands that, given the nature of the content, the resources available and student capabilities/motivation levels, a certain type of delivery of content is appropriate (e.g., transmissive).
Relationships between domain-general and various domain-specific beliefs are, therefore, multi-dimensional, multi-layered and interactive (Buehl & Alexander, 2006; Buehl & Fives, 2009). Further, these might change with every different classroom context. From a perspective of harnessing ICT to optimise learning opportunities, the ideal state is for all sets of beliefs to be (a) congruent and (b) situated within the teachers' socio-cultural context. However, the socio-cultural contexts in which the teachers operate can change very rapidly (e.g., switching from one activity to another or discerning that students are struggling with a concept). When the context changes, so too does the impact of teachers’ domain-general and domain-specific beliefs on the learning environment.

The task of unravelling the impact of beliefs on teaching is, therefore, extremely complex and messy (Buehl & Alexander, 2006; Pajeres, 1992). A number of researchers suspect that beliefs about the nature of knowledge have an impact on pedagogy, and that in turn pedagogical beliefs affect teachers’ practices (Demiraslan & Usluel, 2008; Fang, 1996; Higgins & Moseley, 2001; Moseley, Higgins, & Bramald, 1999; Tiene & Ingram, 2001). However, more empirical research is required to clarify the nature of the relationships between different types of beliefs and importantly between beliefs and practice. One recent study (Buehl & Fives, 2009) seeks to do just this by clarifying relationships between where knowledge comes from (i.e. its source) and teachers’ pedagogical beliefs. Where teachers’ believe knowledge comes from may have important implications for how they consider learning might take place and also how they develop themselves as teachers. The study, which included 53 pre-service and 57 practicing teachers, posed the question: Where does the knowledge of how to teach come from? Responses fell into the six categories shown in Table 2.2.
Table 2.2: Categories that Characterise the Source of Knowledge Developed by Buehl and Fives (2009)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Formal preparation</td>
<td>Recognises the external source of teaching knowledge (e.g., university or formal training courses).</td>
</tr>
<tr>
<td>2. Formal bodies of information</td>
<td>Recognises formal texts (e.g., books, journal articles) and other resources (e.g., the Web) as legitimate sources of knowledge about teaching.</td>
</tr>
<tr>
<td>3. Observational and vicarious experiences</td>
<td>Recognises that observing others’ teaching is an important source of knowledge in itself.</td>
</tr>
<tr>
<td>4. Interactive and collaborative experiences with others</td>
<td>Interaction, whether this is interpreted as co-construction through collaboration or simply learning from others can be seen as a source of teaching knowledge.</td>
</tr>
<tr>
<td>5. Enactive experiences</td>
<td>Experience in practicing teaching provides opportunities to construct knowledge through this process.</td>
</tr>
<tr>
<td>6. Self-reflection</td>
<td>Recognition that teachers hold inherent capabilities within themselves and are able to reflect on these capabilities and their actions as teachers.</td>
</tr>
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</table>

Categories 1 and 2 emphasise knowledge being obtained from external sources; categories 3 and 4 suggest that knowledge comes from social interactions; and categories 5 and 6 underline individual experience and reflection as being an important source of knowledge. The relative weight that teachers apply to these categories could provide important clues on how they see learning taking place. For example, teachers who believe that knowledge about teaching comes primarily from formal preparation (i.e. category 1 above) might build their pedagogical approach around a transmissive model of information provision. On the other hand, teachers who see the primary source of knowledge as being bound up with enactive experiences (category 5) might build their pedagogical approach around an active model of experiential learning. Simply becoming aware of one’s beliefs and reflecting about how these
beliefs can impact on the learning environment can lead to more adaptive and flexible
teaching (1986).

One of the reported challenges of research into teachers’ beliefs, though, is a lack of
specificity (Hofer, 2006). If teachers subscribe to beliefs that are multi-dimensional and
multi-layered (Buehl & Fives, 2009), then there are inherent difficulties in separating the
complex web of beliefs that teachers hold. The variability of any given context will also
demand that different weights are afforded to each set of beliefs depending on the context. In
these circumstances it is difficult to discern or predict which beliefs will most influence the
actions of the teacher, and difficult to understand why some beliefs are enacted whilst some
remain espoused. The relationship between teachers’ actions and their beliefs is complex
(Wild, 1996) and sometimes what teachers say their pedagogical approach is and the reality
of their practices are different. Unfortunately these issues are far from being adequately
resolved. Although some claim that beliefs influence judgments and decisions about teaching
and learning (Pajeres, 1992), drawing useful inferences is problematic because of the
messiness of the construct (Buehl & Alexander, 2006). A growing number of studies (e.g.
Ertmer, 2001; Judson, 2006; Lim & Chai, 2008; Palak & Walls, 2009) note that teachers’
beliefs and their practices are incongruent, and understanding exactly why they are
incongruent is a worthy research endeavour in itself.

2.3.2 Pedagogical beliefs and ICT

Much of the work that has contributed to an understanding of the interface between
pedagogical beliefs and ICT-integrated teaching practices has been done in the qualitative
research arena. The contextualised nature of teaching and learning suggests that teachers
make ongoing judgments about when (and when not) to enact their beliefs. This involves
ongoing negotiation of complex socio-cultural settings, particularly when ICT is a consideration.

A number of qualitative studies have specifically examined the relationship between teachers’ pedagogical beliefs and ICT. However, most have found the relationship is tenuous, citing a range of contextual factors such as curriculum constraints (Ertmer, 2001), pressures to complete the syllabi and prepare students for examination (Lim & Chai, 2008), teachers’ perceptions of their own expertise (Judson, 2006), lack of models of technology integration to facilitate their beliefs, class sizes, student ability (Palak & Walls, 2009), dependence on other people or resources, and distance from school culture (Zhao, Pugh, Sheldon, & Byers, 2002).

All of the above research cites professional learning as a potential avenue to better align pedagogical beliefs with ICT use. Certainly given the ever expanding array of ICT options available to teachers on the one hand (Freebody, Reimann, & Tiu, 2008), and the diversity of ICT infrastructure noted in many schools and classrooms (Demiraslan & Usluel, 2008) on the other, it would seem that linking ICT affordances to teachers’ pedagogical beliefs, described by Mishra and Koehler (2006) as technological-pedagogical knowledge, requires a high level of expertise.

In response to the complexity of helping to build technological-pedagogical knowledge, some research suggests an evolutionary rather than revolutionary approach to professional learning in ICT integration is required (e.g. Robertson, Webb, & Fluck, 2007; 2002). Focusing on ICT affordances and constraints within the context of teachers’ existing practices and curricula goals would seem to be a sensible idea.
Contemporary learning theory emphasises educational practices that encourage learners to construct their own understandings (Bennett, Harper, & Hedberg, 2002; Newhouse, 2002). However, learning methods are sometimes dichotomised with constructivist practices being cast as idyllic, assuring deep learning and “traditional” practices (Jonassen, Peck, & Wilson, 1999, p. 7) seen as simplistic, transmissive and supporting only surface learning. Brown (2008) suggests that there is a false dualism between behaviourism and constructivism and proposes that no single comprehensive theory of learning is likely to cover all dimensions of human cognition. This research avoids inappropriate dichotomies instead conceiving teachers as empowered professionals using a range of sometimes eclectic strategies, interpreting curriculum and their students’ needs and capabilities on an ongoing basis. As Uhlenbeck, Verloop and Beijard (2002, p. 244) point out:

The classroom is an uncertain place where it is difficult to anticipate how a particular activity will work out. During teaching, teachers resolve tensions among competing goals as they make moment-to-moment decisions about what to do in a particular situation.

Biggs and Moore (1993) discern that learning is sometimes declarative (e.g., dealing with facts and propositions), procedural (e.g., dealing with knowing how to perform cognitive tasks like problem solving), and conditional (e.g., knowing when and why a procedure is important). Each knowledge-type might require a different pedagogical approach and also a different ICT solution. For example, learning number facts (declarative) may involve using interactive websites for reinforcement whereas learning about climate change (conditional) may call for a problem-based webquest. Today’s teachers are empowered to make expert judgments that match their pedagogical beliefs with available affordances (ICT and non-ICT) within the context of the relevant curriculum. The extent to which they have the knowledge and skills to be able to do this effectively will now be addressed.
2.4 Knowledge and skills

It is accepted that there are distinctions between beliefs and knowledge. Drawing upon the work of Calderhead (1996) and Ertmer (2005), the study proposes that knowledge equates to understandings of a factual nature that can be scientifically supported. Beliefs, as discussed, are conjectural relating to premises or suppositions about something that is felt to be true (1996).

Rather than consider beliefs and knowledge as absolutes, it may be more useful to see these constructs as on a continuum that depends on the individual and the context in which he/she is set. For example, a teacher may have the technical knowledge required to set up and maintain a social application such as Facebook, but believe that Facebook is an inappropriate pedagogy. Conversely, another teacher may have no technical knowledge of Facebook, but may have strong beliefs about facilitating student learning through social communication. The ways in which beliefs and knowledge play out across pedagogical and technological domains (Mishra & Koehler, 2006) is important to this research. Teachers with a thorough knowledge of ICT combined with positive beliefs about its use in the classroom are likely to explore its transformative potential and attempt to push the boundaries of student learning.

2.4.1 Pedagogical knowledge and ICT

The dominant view of knowledge in Western society until recently is one that emphasised a truth out there in the natural world that, with a rational mind, can be understood (Boghossian, 2006). In the recent past, perhaps guided by notions of truth and rationality, the primary mechanism for passing on knowledge was by transmission from expert teacher to novice student (Bostock, 1997; White-Clark, DiCarlo, & Gilchriest, 2008).
This transmissive view of learning has been somewhat dismantled by a body of thought originating in cognitive theory that posits that individuals construct their own meaning based on their own current knowledge by engaging with the world around them (Piaget, 1963). Either consciously or sub-consciously from cradle to grave, people continually embark upon transformative processes of integrating new information and experiences into existing understandings, revising and re-interpreting existing knowledge in order to reconcile it with something new (Billett, 1996). The acquisition of knowledge can take place informally as we watch a television program, read a book or communicate with those around us, or formally through institutions whose very purpose is to educate. The way in which we gather and organise knowledge can be superficial, for example, comprising of the retention of isolated facts, or more deep and meaningful, for example, including analysis and evaluation of existing knowledge or creation of new knowledge (Anderson, Krathwohl, & Airasian, 2001).

A teacher who sees knowledge through a lens in which students build their own understandings might emphasise alternative ideas as opposed to facts; creative thinking as opposed to rote learning; and interpretation as opposed to searching for universal truths. Further, teachers who subscribe to the view that student conceptions of truth and reality are as equally viable as their own may build democratic and collaborative relationships promoting co-learning and co-production of knowledge. In these circumstances, the teacher will guide the process of learning, encouraging learners to engage with curriculum and embark upon individual journeys of discovery (White-Clark et al., 2008). This contemporary student-centred view of learning is compelling. However, there are some difficulties in applying these ideals to the real world of a classroom. Tiene and Ingram (2001) point out, there is something paradoxical about planning for the unstructured learning that is implied by constructivist
learning theory. The translation of a theory of learning in which individuals construct their own knowledge, into a theory of teaching practice is also challenging (Richardson, 2003).

Zimmerman (2002) notes that although research strongly supports the benefits of student autonomy in learning, there are few examples of students’ use of self-regulatory processes. For example, it is contended that students are rarely given choices regarding tasks to pursue and methods for carrying out assignments, and are seldom encouraged to set their own goals or self-evaluate their work. These qualities of lifelong learning, it is argued, are lacking in contemporary teaching practices. Webb (2005, p. 709) expresses similar sentiments in considering recent research into conceptual change amongst students in the science learning area, concluding that “there is no clear evidence of how constructivist theories of learning relate to actual learning and to teachers’ practice.” Kirschner, Sweller, and Clark (2006) compared constructivist approaches (which are equated with minimally guided instruction) with guided instruction, finding that the latter produced better recall of facts along with longer term transfer and more effective problem-solving skills. The authors concluded that constructivism can have a negative effect on learning particularly amongst novice learners.

Notwithstanding these cautionary sentiments, there is agreement in other literatures over a set of principles that, if adopted, have the potential to encourage meaningful learning (Driscoll, 2002; Jonassen, 2002; Jonassen et al., 1999; Maor & Taylor, 1995; Oliver & Omari, 1999). According to Jonassen et al. (1999), for example, meaning making occurs most effectively when active, cooperative, constructive, authentic and intentional learning is emphasised by the teacher. A description of these attributes is provided in Table 2.3.
Table 2.3: Jonassen, Peck and Wilson’s (1999, pp. 8-10) Attributes of Meaningful Learning

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
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<tbody>
<tr>
<td>Active</td>
<td>Manipulation of learning spaces (e.g., by building and testing scenarios using a spreadsheet) and observation of results of this input will stimulate greater understandings.</td>
</tr>
<tr>
<td>Cooperative</td>
<td>Learning is a natural social act, rather than an activity that is individually owned and then assessed. In interacting with others, knowledge is given greater meaning and depth.</td>
</tr>
<tr>
<td>Constructive</td>
<td>When experiences are integrated with prior knowledge and reflected upon, this process helps to build new mental models and create new meanings.</td>
</tr>
<tr>
<td>Authentic</td>
<td>Activities that are situated in a real world context will be better understood and transferred to other situations.</td>
</tr>
<tr>
<td>Intentional</td>
<td>Affording learners the opportunity to articulate their goals is essential for meaningful learning. If learning is intentional then it may promote greater learner ownership of the learning process and also lead to metacognition.</td>
</tr>
</tbody>
</table>

These categories form the basis of the method employed in this study that seeks to measure the extent to which teachers’ pedagogies resonate with principles of meaningful learning.

This will be further elaborated in Chapter 3.

Some studies (Becker, Ravitz, & Wong, 1999; Ravitz & Becker, 2000) claim to have identified a link between teaching practices that promote the construction of knowledge and increased ICT use. Other studies (Nicaise & Barnes, 1996; Vannatta & Beyerbach, 2000) suggest that ICT practices like Internet exploration and online communication can help to transform teachers’ beliefs toward a constructivist pedagogy. Yet more research demonstrates that using ICT in a constructivist-oriented pedagogy helps students to develop higher order thinking capabilities including critical thinking and inquiry oriented problem-solving.
(Jonassen, 2002; Maor & Taylor, 1995; Steketee, Herrington, & Oliver, 2001). Evidence on student attainment, through, seems to be inconclusive. In a recent BECTA-sponsored report (Condie & Munro, 2006, p. 4) it was suggested that:

At present the evidence on attainment is somewhat inconsistent, although it does appear that, in some contexts, with some pupils, in some disciplines, attainment has been enhanced. There is a need for more systematically gathered evidence although it is already apparent that, where ICT has been successfully embedded in the classroom experience, a positive impact on attainment is more likely.

Clearly there are circumstances where learning objectives lend themselves to the use of ICT. In these situations, if appropriate activities are developed according to principles of meaningful learning (e.g. as described by Jonassen et al., 1999), then it is likely that deep, meaningful knowledge construction might occur. As discussed, though, teaching is a profession in which a range of sometimes eclectic pedagogical approaches may be adopted in response to diverse matters such as student needs and developmental levels, ICT affordances available, and the nature of the subject matter.

2.4.2 Subject knowledge and ICT

There is agreement in the literature (Higgins & Moseley, 2001; Webb, 2005; Webb & Cox, 2004) that subject areas have a strong impact on teachers’ beliefs which in turn may impact on if, and how, ICT are ultimately used. Although this research does not focus on content knowledge as such, it is acknowledged that subject sub-cultures can impact upon the way in which ICT is used in the classroom. Higgins and Moseley (2001), in an empirical study involving 75 teachers in the UK, concluded that there were clear differences by teachers’ year group in their patterns of thinking and the way these patterns predicted student progress. Webb and Cox (2004, p. 242) also discerned that primary and secondary teachers have different experiences in teaching and this will influence their beliefs:
Secondary teachers usually teach mainly within their own subject specialism but primary teachers generally teach across a range of subjects and hence their beliefs will be influenced by their experiences of teaching in various subjects.

Early primary teachers also may justifiably adopt pedagogical approaches based upon considerations such as the social and emotional development of their students, communication skills, and language and literacy development. Developing these skills may be bound up with hands-on experiences, play, and talk, and it would appear that the computer (designed primarily for a business context) is not the appropriate tool for this purpose (O'Hara, 2008). Talking books and games-oriented software delivered via hardware that is easy to operate and manipulate (e.g., touch screen devices) may be more appropriate in these instances. A recent BECTA-commissioned report in the UK (Aubrey & Dahl, 2008, p. 3) identified 20 technologies that could be appropriate for the early years education, and the list did not include the personal computer:

Bee-Bot programmable floor robots, Roamers or Pixie Robots, digital audio players (DAPs), CD or cassette players, digital cameras, Digital Blue Computer Microscopes, mini DV camcorders and Digital Blue Movie Creators, DVD or video players, iPods, interactive whiteboards, laptops, mobile phones, photocopiers, scanners and televisions.

Interactive whiteboards in particular have been shown to increase levels of student motivation in early primary education, encouraging enhanced levels of student engagement in language development where children have increased their vocabulary in their explanations to others. As one teacher said of an early primary class (quoting from Somekh et al., 2004b, p. 7):

“They were sitting quietly through the whole lesson and they are only five. If I was using the [traditional] whiteboard it would not have held their attention so well.” These students could well have been seduced by the novelty of the interactive whiteboard. However, the impact of the possible novelty effect, together with the increasing availability of niche ICT, would
suggest that decisions around which ICT are appropriate for various developmental levels are becoming increasingly complex and challenging for teachers and their schools.

After a comprehensive review of the literature on the relationship between pedagogy and ICT, Webb and Cox (2004) concluded that teachers from different subject areas varied in the way they perceived the role of ICT in their teaching. In a later study of the science learning area, Webb (2005) was very specific indicating, for example, that computer simulations provided a new affordance for learning science, particularly when these were used to examine phenomena that were not easily observed or explored in the real world.

A number of recent studies in the area of mathematics suggest that learning via engaging with interactive websites (essentially a type of formative assessment) is becoming more prevalent and useful (Al-A'ali, 2008; Betne & Castonguay, 2008; Kodippili & Deepthika, 2008). In Australia, former mathematics teacher and founder of the Mathletics software, Shane Hill (2007) reports that Mathletics has been used effectively in a variety of ways in Australian and New Zealand schools including reinforcing mental computational skills through drill and practice, formative testing and for homework. The effectiveness of interactive websites for learning depends on the quality of feedback that students receive for the selections that they make. However, if this is done well, then a number of benefits may emerge. For example, Black and Williams (1998) noted that formative assessment assisted in students becoming more responsible for their own learning. This, the authors argued, had important implications for re-framing the roles of teachers and learners in the classroom.

Teachers from humanities-based subjects (e.g., English and History) were, according to John and Baggott La Velle (2004), Webb and Cox (2004) and Pittard and Bannister (2006) less enthusiastic about the potential of ICT in the classroom. The main application of ICT was
said to be the use of word processors and presentation software (Hyde, 2004). It is significant that these tools tend to promote individualised learning largely for the purpose of presenting and refining work. The demands upon computer resources for individualised learning have proven to be a significant barrier, particularly in primary schools where there are a limited number of computers available (Webb & Cox, 2004).

Teachers that integrate ICT well do so when they consider content-specific knowledge with pedagogical knowledge (Mishra & Koehler, 2006; Webb & Cox, 2004). The notion of synergising content and pedagogical knowledge has been taken up recently by Harris, Mishra and Koehler (2009) in the coordinated development of a taxonomy of activity types (with suggestions for compatible technologies) that lend themselves to specific content areas. Pedagogical and content knowledge, then, are critical in considering how ICT should be used in the classroom. However, technological knowledge, skills in selecting, configuring and applying ICT for the benefit of student learning, is also important.

2.4.3 Teachers skills in using ICT

It has been reported (Elliot, 2004) that teachers lack familiarity not so much with technology, but with educational ICT applications and good pedagogy. This view is supported by Demiraslan and Usluel (2008) who, after researching ICT in Turkey over a number of years, concluded that teachers mostly used ICT for administrative tasks. The authors (2008, p. 471) claim that it is “the skill and attitude of the teacher that determines the effectiveness of technology integration into the classroom.” Often technical knowledge is equated with skills in using specific software applications. For example, the Western Australian Department of Training conducted a questionnaire (WADT, 2006) to measure ICT competence amongst teachers in government schools in Western Australia. Using a random stratified sampling
technique, the questionnaire solicited 1,500 responses finding that 98% of teachers claimed to be able to use a word processor, 97% claimed to be able to use the Internet and 95% claimed to be able to use email. On the face of it, these results may appear encouraging for those seeking evidence to demonstrate value for money for ICT investment. However, the ability of a teacher to use a word processor does not necessarily mean that the teacher has the technical knowledge to be able to optimise this ICT for the benefit of student learning (e.g., developing hyper-linked worksheets, puzzles or templates for student work).

For Zhao, Pugh, Sheldon and Byers (2002, p. 483), research needs to focus on “the complexities and intricacies of how classroom teachers actually incorporate technology in their teaching.” In an in-depth study of 12 teachers, the authors found that teachers with a low level of dependency on others (including ICT support technicians) tended to be more successful.

The WADT questionnaire (2006) found that teachers with less teaching experience were most likely to be more adept in the use of ICT. In searching for a greater level of specificity on what the use of technology actually means, however, Russell, Bebell and O'Dwyer (2005) developed seven categories:

- Teachers’ use of technology for preparation.
- Teachers’ use of technology for delivering instruction.
- Teacher-directed student use of technology.
- Teacher-directed student use of technology to create products.
- Teachers’ use of technology for special education and accommodation.
- Teachers’ professional email use.
- Teachers’ use of technology for grading.
Russell, Bebell and O’Dwyer (2005) argue that the use of technology is not a single generic construct, and through an empirical study involving just over 2,500 teachers, found that first and second year teachers used technology mainly for preparation but delivered instruction less than teachers who had been in schools for more than 5 years. Although beginning teachers were confident and adept in the use of ICT, they seldom used it at the teaching and learning interface. It was suggested that significant barriers faced beginning teachers in terms of developing behaviour management approaches and curriculum knowledge. Innovative technology use, it seems, did not feature as a high priority for beginning teachers.

The Russell, Bebell and O’Dwyer (2005) study situates the use of ICT within a broader set of teacher priorities and provides greater specificity on types of ICT use. The authors reported that, across the board, teachers were not inclined to use technology to deliver instruction and facilitate the student use of ICT to create products. This lack of inclination may help to illuminate other research that has shown an apparent contradiction between the ICT skills of teachers and their propensity to use these ICT skills in the classroom. For example, the WADT evaluation (2006) found that although most teachers were skilled in the use of word processors, the Internet and email, 82% indicated that they are not regularly using ICT in the classroom (i.e. on a weekly to daily basis). The gap, it seems, is not in ICT skills, but in competing priorities and the pedagogical application of ICT skills. From the point of view of culture change, a critical question is the impact that dominant cultures might have on beginning teachers. A recent study of pre-service teachers’ ICT experiences revealed:

… pre-service teachers share observations that the use of ICT was not prevalent in the classrooms they visited. For some pre-service teachers, this provided sufficient opportunity to avoid using ICT, and thus start the cycle of the cultural view that ICT is neither required nor necessary in classrooms.

(Pegg, Reading, & Williams, 2007, p. 100)
In attempting to explain a similar culture of avoidance, Selwyn (1999) notes that many of the educational policies that have been put in place to promote ICT use have actually had the opposite effect. This may be because the focus of ICT support has generally been on how much rather than how ICT is used by teachers. Issues such as teacher-computer ratios, time spent on the computer and competency in the use of software, important as they are, have tended to overshadow more pertinent questions that might centre on the purposes to which ICT are put in the classroom (Judson, 2006; Mishra & Koehler, 2006).

A number of researchers report on variable responses to the digital environment with “pockets of excellence” operating within a broader context of institutionalised resistance (Elliot, 2004; MacKenzie, 1998; Pegg et al., 2007; Voogt, 2008; Zhao et al., 2002). One recent study, (Hammond et al., 2009), identified 40 pre-service teachers that exemplified very good use of ICT during classroom immersion. The reasons identified for these very good uses were a willingness to learn by doing and a propensity to see ICT as being of value. These dispositional factors are now discussed.

2.5 Teacher dispositions

Wasicsko (quoted in O'Neill, Singh, & O'Donoghue, 2004, p. 1170) defines dispositions as “attitudes, perceptions and/or beliefs that form the basis of behaviour.” This chapter has already dealt with teacher beliefs, and will therefore now focus attention on teacher attitudes towards, and perceptions of, ICT.

2.5.1 Teachers’ attitudes towards ICT integration

Attempts to integrate ICT in the classroom seem to have been in the first instance technology-driven, focusing on the provision of networked computers in the classroom on the assumption
that teachers would spontaneously use them. Teachers responded unenthusiastically (Cuban, 2001) and the focus shifted to technology training (Vannatta & Fordham, 2004). However, it has been shown that skills training alone has also had limited impact on increasing the use of ICT (Steketee, 2005).

The aforementioned WADT evaluation (WADT, 2006) measured attitudes and motivation amongst teachers in government schools in Western Australia. Five attitudinal statements relating to a teachers’ use of ICT (e.g., “ICT has the capacity to support learning” and “I like exploring technology and software”) were presented to respondents of the questionnaire. It was reported that responses to these statements was “extremely positive” (WADT, 2006, p. 30) indicating that Western Australian teachers had receptive attitudes and were highly motivated to using ICT in the classroom. According to the study, teachers most likely to have negative attitudes are those from secondary schools, working part time and over the age of 50.

In a study of 170 K-12 teachers in Ohio, USA, Vannatta and Fordham (2004) indicated an interest in non-technology-specific teacher attributes. The researchers conducted regression analysis on a Teacher Attributes Survey concluding that three variables best predicted technology use in classrooms. These are a combination of the amount of technology training that has been taken, openness to change and time spent in preparation beyond contracted hours per week. One of the significant aspects of this finding is in the acknowledgement that a combination of strategies is required to help bring about more sophisticated uses of ICT. The authors recommended that technology training include: personally experiencing ICT as a learning tool; observing demonstrations of effective ICT integration; and taking part in
practitioner reflection. In addition, the research urged administrators to provide the type of leadership that:

- values teaching as a learning endeavor; and
- encourages/models risk taking behaviour.

These findings are supported by Hew and Brush (2007) who suggest that school leaders should provide scope for teachers to make, and learn from, mistakes particularly if they are new to technology.

### 2.5.2 Teachers’ perceptions of ICT: Self-efficacy

Teachers’ self-efficacy - beliefs in their capacity to organise and execute actions required to produce attainments (Bandura, 1997) - can be an important factor in accelerating or de-railing ICT use. There is said to be a high correlation between levels of self-efficacy and computer use (Jones, 2002) and while it is evident that many contemporary teachers have positive attitudes towards the use of educational technologies, they do not necessarily believe in their ability to actually use these educational technologies in their teaching (Jamieson-Proctor, Burnett, Finger, & Watson, 2006; Ropp, 1999).

A number of studies attest to the importance of teacher self-efficacy in promoting the use of ICT in the classroom (Albion, 1999; Compeau, Higgins, & Huff, 1999). In conducting a longitudinal study over 6 years, Watson (2006), found that a mix of an intensive session coupled with online training had a long-term impact on the self-efficacy of 389 teachers in using the Internet in West Virginia. Another recent study (2006) found evidence that a lack of teachers’ confidence in using ICT was contributing to considerable resistance. Of particular concern was the finding that female teachers are significantly less confident than their male
counterparts in integrating ICT into their practice. The study was set in Queensland, Australia, and with the proportion of full-time female teachers in Queensland representing 70%, the authors (2006, p. 528) concluded that:

If the results are representative of the State education system in Queensland, then 70% of students are currently being taught by teachers who are less confident to use ICT than the other 30%, and 70% of students use ICT less than the other 30% as a result of the teacher’s lack of confidence.

Increasing teachers’ self-efficacy in ICT integration is challenging. However, in a study of 280 pre-service students involving three experimental groups and one control group, Wang, Ertmer and Newby (2004) were able to increase self-efficacy levels by encouraging students to set their own goals and supporting these by positive vicarious experiences that modelled effective ICT use.

So far, this literature review has found that, apart from some pockets of excellence, ICT integration has generally lacked enthusiasm and imagination and that reasons for this may be bound up with teachers’ beliefs about teaching and ICT and also their attitudes towards ICT and self-efficacy in using ICT. It has also found that the range of options available to teachers is extensive and growing. Therefore, if teachers wish to use ICT in ways that empower learners to construct their own understandings, then knowledge and capabilities are required that go beyond basic computer skills and competency in a narrow range of software applications. Teachers require well developed technological-pedagogical-content knowledge (Mishra & Koehler, 2006), underpinned by positive attitudes towards ICT and a belief in their ability to harness ICT for the benefit of student learning. A framework is now presented that shows how, when combined, technological-pedagogical-content knowledge can create suitable and sustained conditions for ICT integration.
2.6 A framework for understanding teachers’ actions: Pedagogical reasoning

The integration of contemporary ICT into classroom environments requires decision-making on a number of fronts. Appropriate hardware, software, ongoing maintenance and support and professional learning are all critical. However, this literature review suggests that it is in “teacher agency” (Fullan, 1993) that these ICT will live or die in the classroom. In the final analysis, learning solutions rely on the professional judgment of teachers (Robertson et al., 2007).

The environment in which teachers are being asked to use ICT is complex. Models that crystallise the important aspects of ICT in clear and simple language are useful in building a theoretical basis for ICT integration and its application. This research draws upon the work of Mishra and Koehler (2006), Harris, Mishra and Koehler (2009), and Webb and Cox (2004) to present a model that articulates what forms of knowledge are required by teachers for effective ICT integration, and how the quality improvement processes inherent in the teaching profession can change beliefs and practices.

Rather than considering the use of ICT within the scope of one learning theory, or from a singular pedagogical, subject-specific or technical perspective, Mishra and Koehler (2006) adopt a pragmatic approach believing that it is useful to synergise technological-pedagogical-content knowledge as the basis for theorising about the appropriate use of ICT for teaching and learning.

Figure 2.2 illustrates that when technological-pedagogical-content knowledge are brought together, potentially powerful learning environments are created that combine good teaching practices with thorough disciplinary knowledge and a deep understanding of how a range of
ICT can enhance the learning experience. The synergy of these constructs creates a space at the centre of the model described in Shulman’s (1987) terms as pedagogical reasoning.

**Figure 2.2. Knowledge required for effective ICT integration: adapted from Mishra and Koehler (2006, p. 6).**

The above framework may prove useful in bringing ICT into the consciousness of mainstream teachers, and also perhaps mainstream educational research. One of its weaknesses, though, is that it tends focuses on teaching as an individual rather than social activity. Omitting teacher professional networks and leadership qualities as important mechanisms of change ignores the scalability problem (Fishman, Marx, Blumenfeld, Krajcik, & Soloway, 2004) that has dogged educational technology since its inception. Law (2008),
for example, suggests that professional learning needs to go beyond knowledge to be an effective catalyst for change.

Webb and Cox (2004, p. 235) also focus on pedagogical reasoning as being at the core of ICT integration and present evidence to suggest that:

… new affordances provided by ICT-based learning environments require teachers to undertake more complex pedagogical reasoning than before in their planning and teaching that incorporates knowledge of specific affordances and how these relate to their subject-based teaching objectives as well as the knowledge that they have always needed to plan for their students’ learning.

A framework is now presented in which ICT integration is considered as part of an interface between beliefs and practices (Webb & Cox, 2004). An adapted version is shown as Figure 2.3.

As discussed, a range of socio-cultural factors can impact on teachers’ knowledge, attitudes and beliefs. However, the agency of teachers in the context of their professional role is also a significant force for change. Teachers’ beliefs form the basis of the pedagogical reasoning that underpins the design of the learning environment. The relative impact of ICT on this design depends on the development level of the students, the nature of the subject matter under consideration, and how this relates to the perceived affordances that ICT presents. The design of the learning environment might contain behaviourist and constructivist elements and be oriented towards individuals or groups.
Reflection upon “what works” can in turn affect attitudes and promote renewed pedagogical beliefs and/or innovations, and the cycle is set in train again. Pedagogical reasoning is thus a natural part of what it means to be a teacher. This is recognised by Newhouse, Trinidad and Clarkson (2002, p. 4) who suggest that “good teachers always aim to look for better ways of doing things and therefore their use of ICT should support this”.

The framework proposed, one that sets ICT within a pedagogical reasoning process and which is underpinned by a spirit of quality improvement, acknowledges the potential of teachers to harness ICT affordances. Tapping this potential, however, depends on a range of socio-cultural factors.
2.7 The socio-cultural context for ICT in education

This section of the thesis examines ICT use in the wider socio-cultural context through a
discussion of (a) developments in educational technology and (b) the implications of these
developments for contemporary teaching and learning.

2.7.1 Developments in educational technology

A decade ago the practice of ICT integration centred on the potential of the personal
computer, and the 3 million or so web sites that had been created up until that time (Zakon,
2006). Today, computers sit alongside a set of increasingly converging ICT including mobile
laptops, MP3 and MP4 players, digital TV and radio, mobile phones and touch screen devices
like tablet PCs and interactive whiteboards. As of the writing of this thesis, the Web contains
just over 109 million sites (Wikipedia, 2009). Internet users have ample opportunities to
dynamically and collaboratively create web sites (wikis) or maintain online journals (blogs),
and can communicate with each other using a variety of synchronous and asynchronous tools.
The convergence of computer, mobile telephone, Internet services and television is opening
up opportunities for learning that have not even been seriously considered yet.

It is perhaps easy to categorise developments in educational technology in terms of lists of
hardware and software that have potential for teaching and learning. However, ICT artefacts
come and go. More important is to identify the trends underpinning the rapidly changing ICT
environment in the schools sector.

Two themes have emerged in the literature. The first is about improving access for students
with a shift in the locus of control over ICT; the second is bound up with empowering
teachers with ICT tools that will help them do their job more effectively.
2.7.1.1 Improvement of access for students and its impact on the locus of control for ICT

There are educational advantages in affording students with the tools to become producers as well as consumers of knowledge (Reimann, 2006). This was recognised in Australia with the release of the Statements of Learning for ICT (MCEETYA, 2006) which encourages teachers to help students become creative producers, rather than just passive consumers, of knowledge. Recently the Australian Department of Education, Employment and Workplace Relations funded its Digital Education Revolution to the tune of $2.2 billion over 6 years to provide for new or upgraded ICT for secondary schools with students in years 9 to 12 ("Experience the Digital Education Revolution," 2009, para. 1). The overall aim is to achieve a 1:1 computer to student ratio for this cohort by the end of 2011.

The aim of personalisation of learning (Smith, Rudd, & Coughlan, 2008) was clearly important to many schools in Australia that had already been moving in the direction of 1:1 student to computer ratios mainly through the implementation of laptop programs. Whilst the expense of laptop computers has been synonymous with exclusivity in education, recently the costs of purchasing and maintaining laptops has reduced significantly to the extent that laptop programs are emerging in a range of contexts. For example, Negroponte (2008) reports on the implementation of “one wind-up laptop per child” programs in countries like Rwanda and Peru aiming to minimise reliance on power and networks such that children have 10 minutes of use for every 1 minute of cranking.

Research has shown increases in student motivation through creating more student-centered opportunities (Bellanger, 2002; Newhouse, 2008). A comprehensive study over 5 years by the Maine Education Policy Research Institute at the University of Southern Maine
(Peckham, 2008, p. 76) found that eighth grade educational assessment writing scores increased significantly between 2000 and 2005 through the introduction of a laptop program. After reviewing a 3 year 1:1 laptop program in a public middle school in Western Australia, Newhouse (2008) concluded that student control of the device was a key to the success of the program (some schools provide laptops on trolleys which are wheeled out on demand). When the student controls the device, it is likely that a high level of familiarity and personalisation will ensue, and this, it is argued, leads to greater and more effective use. The way in which ICT infrastructure is implemented is clearly critical to its success. Teacher agency in planning and implementation (McGrail, 2006) is said to be crucial in helping to identify and respond to challenges that may arise. The use of e-portfolios in conjunction with 1:1 programs can also contribute to the personalisation of learning. E-Portfolios have been shown to increase student ownership of the assessment process and generally assist in fostering more rigorous assessment practices (BECTA, 2007).

Research into 1:1 laptop programs in varied developmental and subject-specific contexts is in its early stages. However, it appears that providing learner-centred opportunities for students to construct their own knowledge can only have a positive effect on student motivation and ultimately learning.

Research into the educational benefits of mobile devices like mobile phones and portable MP3 (audio) and MP4 (video) devices is also embryonic. However, some commentators (e.g. Villano, 2007) believe that handhelds will become the norm in future classrooms because of their ability to inspire students to engage with resources at their own pace in e-book, movie, podcast and games formats. Villano (2007, para 19) suggests that even “conducting assessments on a handheld is easy…educators can keep track, with formative and summative
measures, of student performance on just about anything.” After a 6 month study, Churchill and Churchill (2008) identified four affordances for handheld devices including increased connectivity, capabilities in representing and analysing data and potential as a media capture device.

The use of the Web to display and communicate information (i.e. Web 2.0) provides an avenue for students to become active constructors of knowledge. Web 2.0 tools (e.g., blogs, wikis, instant messaging, YouTube and data mash-ups) provide students with immense opportunities to take their learning to a deeper level. However, drawing a line between informal social communication and learning can sometimes prove difficult. John and Baggot La Velle (2004) identified a raft of issues around computer mediated communication that led to a particularly lukewarm response to Web 2.0 from teachers. Cranmer, Potter and Selwyn (2008, p. 36) also point out:

In light of recent rhetoric over the changing nature of young people’s internet use, it was notable that creative and collaborative uses of so-called ‘Web 2.0’ applications were not prevalent either inside or outside school, with passive consumption rather than active production the dominant mode of engagement.

The above observation suggests that teachers have reservations about a wholesale shift in the locus of control of ICT from teacher to student. Certainly, restrictive policies surrounding the use of mobile phones and iPods in school environments would also indicate that this is the case.

2.7.1.2 Empowerment of teachers with appropriate tools to engage students

The eclectic nature of classroom learning can call for both teacher and student control of ICT. The use of ICT in the classroom can invoke both learning opportunities and risks. One of the
challenges for teachers is to get the balance right. For example, although word processors can be an excellent scaffold for learning, they can also be a distraction. Webb and Cox (2004) and Webb (2005) cite extensive use of ICT for polishing student work. The practice of using multiple fonts, backgrounds, borders and irrelevant graphics, described by Chandler (1990) as a celebration of form over meaning, is exacerbated by the increasing availability of graphics and polishing tools within software applications and on the Web.

The emergence of touch screen devices like the interactive whiteboard, typically geared towards group work and collaboration, is a significant recent development in education. A number of studies report on positive outcomes of the application of interactive whiteboards, particularly in the UK (Merrett & Edwards, 2005; Miller & Glover, 2002) where these devices appear to have been enthusiastically embraced. In a recent BECTA-sponsored report, (Smith et al., 2008, p. 5) it was reported that “interactive whiteboards are the dominant technology in schools.” Some studies into interactive whiteboards present explicit links between the ICT tool, motivation and thinking skills. For example, Merrett and Edwards (2005, p. 12) argue that:

There was evident improvement in mathematical thinking skills amongst students with the IWB [interactive whiteboard] and they were becoming more confident about discussing their findings. Their questions were more probing and displayed a deeper understanding of the mathematics they were learning.

After reviewing the school-wide implementation of interactive whiteboards in a UK secondary school, Glover and Miller (2001) concluded that interactive whiteboards:

- Increased efficiency enabling teachers to draw upon a wider range of resources.
- Extended learning through the provision of more engaging materials.
- Transformed learning through the creation of new learning styles associated with interacting with the board.
However, Glover and Miller (2001, p. 257) caution that teachers having least success with interactive whiteboards tended to be those that did not appreciate that interactivity requires “a new approach to pedagogy”. In a study of 13 teachers use of the interactive whiteboard in conjunction with multimedia specifically designed for Australia curriculum, Hedberg and Freebody (2007, p. 3) reported that most teachers “moved to higher levels of use.” Further, some of the teachers were said to be sophisticated users and had changed their pedagogical practice. This indicates that multimedia resources and/or the interactive whiteboard has a transformative potential. The published literature into interactive whiteboards certainly suggests that it increases student interest and motivation and enhances interactivity with learning materials, both among students and between the student and the teacher.

When integrated with projection devices, technologies like personal response systems (i.e. clickers or instantaneous voting devices) have also been shown to have an impact on teaching and learning, particularly in contexts of large class sizes. For example, in a self-reported study, (Ribbens, 2007, p. 62) discerned a significant improvement in performance and attendance as a result of integrating a personal response system into his teaching repertoire:

> Overall, my students averaged about 8% higher, and I believe they learned the material better. Attendance increased about 20%, and students seemed to enjoy the course experience more.

Another form of teacher empowerment can be found in the development of web-based software to help demonstrate concepts and stimulate activities. For example, the Australian and New Zealand governments have collaborated on the development of the Learning Federation digital learning objects repository which provides free access to materials for teachers. Research suggests a steady increase in both teacher and student use of these
resources (Freebody, 2005; Freebody et al., 2008). The use of the Web, however, can sometimes be antagonistic to notions of higher order thinking. The practice of students downloading and printing, or cutting and pasting masses of information without actually assimilating it into their understandings, described by John and Baggott La Velle (2004) as Encarta syndrome, is said to be endemic across subject areas.

Overall, the identified trends of (a) increasing student access and control over ICT and (b) empowering teachers with more sophisticated tools appears to be having a positive impact on ICT use. However, the take-up and use of digital resources has been patchy (Freebody & Muspratt, 2007) and the quality of ICT use for learning is generally low (Fishman et al., 2004). An even gloomier picture is painted by Prensky (2001) who argues that there is a communication impasse between students (digital natives) and teachers (digital immigrants) and that this has invoked a “crisis” in education. The veracity of this claim is now considered by looking at the implications of ICT on the socio-cultural context of the school.

### 2.7.2 Implications of developments in educational technology for schools

The crux of Prensky’s argument is that the students in schools “are no longer the people our educational system was designed to teach” (Prensky, 2001, p. 1), and that a radical re-thinking of the dynamics of teaching and learning and the curriculum is urgently required. The way forward, Prensky (2001) argues, is through a process of speaking the language of the digital native, which in part means using the medium of the Web to (a) convey interactive resources including games and (b) communicate with students. Recent research has questioned some of the assumptions that underpin Prensky’s conceptions of a relatively homogenous “digital native” student population (Bennett, Maton, & Kervin, 2008).
authors argue that more empirical evidence is required before embarking in a direction towards a games- and/or Web 2.0 oriented curriculum.

Although some may see the central thesis posed by Prensky (2001) and others (e.g. Jukes & Dosaj, 2004; Tapscott, 1999) as alarmist, there appears to be some truth in the notion of a mismatch in the way contemporary teachers and students conceptualise and use ICT. Many ICT (e.g., computers, software and iPods) were created for business or scientific objectives, and have developed a role in society that is independent of their use in schools. As such, teachers and students have developed beliefs about ICT that are not related to teaching and learning (Brown-L’Bahy, 2005). The mobile phone is a good example. This ICT has untapped potential in teaching and learning as a portable media player, communication tool and/or media creation device. However, many schools restrict or even prohibit its use because of the association of the mobile phone with disrupting traditional forms of communication and, lately, cyberbullying. There are clearly significant policy and classroom management issues requiring resolution before contemporary ICT like mobile phones and iPods can have a widespread effect in the classroom (Adams & Angeles, 2008).

The issue of embedded structural issues being antagonistic to ICT use was also investigated through recent research in two Singapore schools (Lim & Chai, 2008). The authors found that although 5 of the 6 teachers in the study purported to hold constructivist views of teaching, observations confirmed that lessons were generally inclined towards information acquisition and the regurgitation of facts. According to the teachers in the study, the reasons for this paradox could be found in four structural issues embedded in the Singaporean system which prevented them from pursuing their constructivist ideals in the classroom:
1. An examination-oriented society.
2. Block-timetabling.
3. An objective-based curriculum.
4. Potential for classroom management issues to arise when using ICT (average class sizes in the two schools in the study were 40 and 36).

Lim and Chai (2008, p. 825) concluded that the assessment system was the final frontier for ICT integration in Singapore.

Selwyn (1999) suggests that business-related origins of the computer has led to it being used in as a productive rather than a learning device in education. The computer and associated software is explicitly configured to make tasks easier. Maddux, LaMont Johnson and Willis (2001) also discern this in making a distinction between Type I and Type II uses of ICT. Type I affordances are those that make it easier or quicker to administer the teaching and learning environment. ICT are used as productivity tools for both the student and the teacher. Examples might include the teacher developing a worksheet and providing a Web resource for students to find answers, or provision of an interactive website for students to hone their knowledge and skills. Hughes, Thomas and Scharber (2006) provided a similar categorisation but split “Type I” uses of ICT into two categories: replacement, where ICT serves as a different means to achieve the same goal; and amplification where the learning goal is accomplished more efficiently and effectively without altering the goal.

Type II affordances allow students to develop an intellectual partnership with ICT. Jonassen (2002) sees the basis of this partnership as a shift from learning from, to learning with technology where ICT are used as cognitive tools extending student learning in productive
and creative ways. Examples include computer concept maps, databases, multimedia publishing tools and computer conferencing environments.

Both Type I and Type II uses of ICT have a role in the classroom. However, the potential for deeper levels of learning is perhaps greater when students are encouraged to enter into an intellectual partnership with ICT (Jonassen, 2002). This message is tacit in the aforementioned Statements of Learning for ICT (MCEETYA, 2006) which focus largely on Type II ICT affordances such as inquiry, communication and creativity. The previous observations made by Fishman, Marx, Blumenfeld, Krajcik, and Soloway (2004) on the quality of ICT use, however, would indicate that Type I applications are still very much prevalent in K-12 education.

After taking part in a comprehensive review of ICT integration in the UK (Harrison et al., 2002), Somekh (2004, p. 168) provides some interesting insights into the socio-cultural forces that have combined to inhibit ICT integration. She sees schools and teachers as being confined by mechanisms of mutual constraint:

> The formal authority of the head teacher (the principal) and policymakers to bring about radical change through the introduction of ICTs, is rendered powerless by the capacity of the informal networks of teachers to adapt such changes to traditional practices; while, at the same time, teachers are equally constrained by the predicament of working within an institution which, in Waller’s terms is ‘a despotism in a state of perilous equilibrium’ (Waller, 1932, p.10), and as a result are unable to use the potential power of their informal networks to engage in creativity, experimentation and risk taking.

Somekh (2004) calls for “the end of school as we know it”, questioning some of the fundamental assumptions that are taken for granted such as the division of knowledge into subjects, the compartmentalisation of a school day into short time periods and the notion that a school is a site of control.
In reflecting on teaching in an urban location characterised by low socio-economic conditions, Brown-L'Bahy (2005) adds some weight to the view that fundamental structural issues require attention for ICT to be better harnessed by teachers and learners. It is suggested that the school culture (including its structures and practices) have a profound impact on technology use of both teachers and students. According to the author, factors such as teacher-student ratios, discipline procedures, planning time allocated for teachers, and opportunities for students to become familiar with student-centred practices all contribute to the way in which ICT is integrated. These factors, it is argued, should be given more attention in managing the transition to increasing the use of ICT in classrooms.

2.8 The transformative potential of ICT

This chapter has so far covered an expansive set of literatures from teachers’ beliefs, dispositions and skills in relation to ICT, to the socio-cultural context for ICT use including current developments in educational technology and the implications of these developments for schools. The conclusions reached so far are largely consistent with those reached by Freebody, Reimann and Tiu (2008) who suggest that a range of factors can affect the adoption of ICT in schools, and that reasons for primarily localised examples of ICT innovation that were never scaled-up are:

… systemic, that is, they are embedded not only in individual attitudes and capacities, but in the interdependencies of different factors and different levels that make up the education system as a whole.

The pace of educational change is slow and the system is complex. This segment of the thesis attempts to discern why this is so.
One of the classic texts on the subject of innovation (Rogers, 2003, p. 11) defines diffusion as “the process by which (1) an innovation (2) is communicated through certain channels (3) over time (4) among members of a social system. To understand how an innovation like ICT is diffused throughout education systems, it is essential to consider ICT integration within the whole system. Paradoxically, though, the greatest insights into the educational application of ICT are through localised qualitative studies. Therefore, it would seem that the way forward in understanding how ICT are used across educational systems is for more well designed longitudinal studies that are not divorced from the socio-cultural context of the school (Hew & Brush, 2007).

The complexities of unravelling the primary concerns of different participants in the change process is a theme that has absorbed Fullan (1982) for 30 years. Working at various levels of education, Fullan has engaged with teachers (Fullan, 1993), school leaders (Fullan, 1997) and more recently with districts, states and even countries (Fullan, 2003). Fullan is an advocate of complexity theory arguing that a large scale sustainable reform agenda has been set for schools and that the changes inherent are so massive, that complex systems are required to help implement this agenda. Fullan (2003, p. 51) is critical of the contributions that have so far been made at district and state levels:

While district and states are theoretically important to this agenda, in empirical terms, they have done more harm than good…they have more often than not tipped us into chaos - multiple innovations colliding, policy churn as innovations come and go, piecemeal reform and an overall condition of overload and fragmentation.

One of Fullan’s (2001) central contentions that sustained change is everyone’s responsibility and people can contribute in a variety of socio-cultural arenas. This contention is supported by Somekh (2007) who argues that ICT integration is a complex innovation in progress that
involves the intersection of multiple participants at different levels of the education process. Teachers who are able to harness ICT for the benefit of their learners are change agents. They understand how to get things done. They are politically astute, possessing a sophisticated understanding of the socio-cultural space in which they operate (Zhao et al., 2002).

In attempting to gain insights from a teacher point of view, Fullan (1993, p. 12) posed the question *Why do people enter the teaching profession?* to a random sample of 220 student teachers. In responding, the most frequently mentioned theme was “to make a difference to the lives of students.” From this, the study concluded that, at least at the beginning of their careers, most teachers have a moral purpose.

Being a change agent involves making effective judgments about the alignment of innovations with one’s moral purpose as an educator (Fullan, 1993), but also with the organisational culture, current practices and available resources (Zhao et al., 2002). This line of argument is consistent with other studies (e.g. Lim, 2002, p. 411) calling for a more holistic approach to research into ICT integration:

…research studies in ICT need to shift their attention towards the whole configuration of events, activities, contents, and interpersonal process taking place in the context in which ICT is used.

So how is a teacher’s moral purpose given expression through harnessing ICT? It has been argued in this chapter that through the process of pedagogical reasoning teachers constantly search for new and better ways of enhancing student learning. Further, by engaging in reflective practice, attitudes and beliefs of teachers can change which in turn regenerates the process of pedagogical reasoning. However, because of the complexities inherent in school environments, and the competing priorities facing teachers and schools, there are forces that
can both promote and inhibit teachers from engaging in change. Groff and Mouza (2008) argue that it is important to identify these forces because they can empower teachers to respond to them when planning to use ICT.

As shown in Figure 2.4, teachers need to build bridges every time they attempt an innovation such as implementing ICT in a different way.

![Figure 2.4. Theoretical framework conceptualising the processes involved in harnessing ICT.](image)

This bridge metaphor forms the basis of the theoretical framework that informs the study. It is proposed that the beliefs that teachers hold about teaching, learning and ICT itself forms an important foundation stone for the way in which their various types of knowledge are given expression. For example, teachers with beliefs about learning that emphasise collaboration may choose to explore the transformative potential of ICT, building their knowledge-base and reflecting upon their own practices in the light of the communicative opportunities that ICT might present (e.g., Web 2.0). Teachers with this orientation may see students’ engagement with ICT as an intellectual partnership in which ICT is used as a cognitive or Mindtool (Jonassen, 2002) to extending students’ learning and creativity. Other teachers may hold
beliefs about learning that emphasise the importance of the teacher as an efficient means of distributing knowledge. In these circumstances it is likely that ICT is equated with productivity (Maddux et al., 2001), as an opportunity to compliment or amplify existing teaching approaches (2006), or simply as a reward for early finishers. Of course many teachers use both teacher- and learner-centred pedagogies in the classroom or adopt a shifting approach in response to their context (e.g., student capabilities, needs and preferences or the demands of specific content areas). To optimise the use of ICT in these circumstances requires a high level of pedagogical and technological knowledge in being able to harness the ICT options available for the benefit of student learning.

How teachers’ beliefs impact upon their pedagogical, content and technological knowledge, and ultimately their practices can only be understood in the context of their socio-cultural setting. For example, if a school adopts an approach to ICT integration based upon student access to a computer laboratory once per week, it is likely that a teacher’s beliefs about the student-centred use of ICT across the curriculum will not be enacted. Teachers, enthused about using ICT at the point of need (i.e. the classroom) may experience feelings of isolation and frustration without the support of their school. Hofer (2006, p. 90) proposes that teachers may feel some “cognitive dissonance” arising from endorsing worldviews that are incongruent with the practices adopted by the educational systems in which they are placed. The research literature on ICT integration cites many examples of small scale innovations that are ultimately unsustainable (Fishman et al., 2004). It is useful, therefore, where possible for teachers to build bridges between their own beliefs and practices and the school’s strategic vision. Similarly, it is useful for schools to build bridges with their constituents to achieve their strategic vision. Relationships between individual teachers, dominant cultures
and school leadership can sometimes be turbulent (Somekh, 2007), particularly in reform environments such as that which is characterised by the Digital Education Revolution in Australia. It is suggested that the culture of the school provides another important foundation stone for way in which its curriculum, pedagogical and technological support are expressed. In the same way teachers’ beliefs shape ICT practices at the level of the individual, a school’s culture sets the conditions for ICT practices at the level of the organisation.

Teachers’ pedagogical reasoning processes will determine the extent of innovation using ICT. Teachers are generally time-poor having a range of priorities including keeping up with changes in curriculum and assessment, preparation, administration, ensuring that parents are involved in their students’ education and development to name but a few. In these circumstances they need to decide whether a potentially disruptive change to their teaching (e.g., integrating ICT) is a priority that supports their goals and does not disrupt other high level goals.

In undertaking the process of building a bridge to innovate with ICT, teachers gain an appreciation of the “distance” between ICT innovations and (a) existing practice (b) available technological resources and (c) school culture (2002). Innovations that are most distant from these three dimensions are typically more dependent on others to succeed and therefore more likely to fail.

In examining one UK secondary school that was using ICT extensively, Tearle (2004) came to the conclusion that one of the critical success factors in achieving positive outcomes in relation to ICT integration was an ownership of the change process by both the individual and the school. She discerned a powerful sense of pride that pervaded the culture of the school in the study, and this created a social obligation that overshadowed personal views on ICT
integration. The bridge metaphor attempts to capture the symbiotic relationship between teachers and the environments in which they are set.

Given the complexity and evolving nature of ICT as an innovation as outlined in this chapter, it is suggested that the theoretical framework presented provides an avenue for discerning and describing changes to teachers’ practices within their socio-cultural context. This is likely to be useful in contributing to theoretical and practical knowledge about ICT integration.

Finally, to help teachers reflect on the extent to which they might use ICT in their classrooms, Newhouse, Trinidad and Clarkson (2005) propose five stages of progression. These are shown as Table 2.5.

The stages provide a useful framework which helps to gauge the extent to which teachers use ICT in practice. The term stages, however, implies that teachers, schools, and systems are on a path of ICT adoption that will ultimately lead to a fundamental transformation of teaching and learning. This has been questioned by Cartwright and Hammond (2007) who, after spending 2 years working with a primary school in the UK, concluded that time-poor teachers will always use tools like ICT on the basis of best fit. The authors argued that, from a teacher’s perspective, using ICT may require extra work to master and offers no guarantees of increasing effectiveness in the classroom. Therefore, it should not be assumed that all teachers have the inclination or need to use ICT in ways that are transformative.

Notwithstanding this critique, the stages identified by Newhouse, Trinidad and Clarkson (2005) provide a useful basis for self-assessment and could be equally applied to schools or whole systems as a way of gauging the extent of change in ICT use. The application of these stages to this research is further discussed in Chapter 3, Methodology.
Table 2.4: 
Progression of ICT Use Based Upon Newhouse, Trinidad & Clarkson, 2005, p. 159

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inaction</td>
<td>A general lack of action and/or interest.</td>
</tr>
<tr>
<td>Investigation</td>
<td>The teacher has developed an interest in using ICT with students and is beginning to act on this interest (e.g., uses PowerPoint for presenting information; develops and photocopies worksheets).</td>
</tr>
<tr>
<td>Application</td>
<td>The teacher is regularly using ICT with students and knows how to do so competently and confidently (e.g., encourages students to research the Web, play interactive games, uses an interactive whiteboard, and requires worksheets to be developed electronically by students).</td>
</tr>
<tr>
<td>Integration</td>
<td>The use of ICT becomes critical to the support of the learning environment and the opportunity for students to achieve learning outcomes through the learning experiences provided. For example, as a cognitive tool for problem solving and creativity, brainstorming, collecting and analysing data or as a communicative tool, like blogging, for building understanding.</td>
</tr>
<tr>
<td>Transformation</td>
<td>The teacher is able to take on leadership roles (formal or informal) in the use of ICT and be knowledgeably reflective on its integration by themselves and others. Experiments with new ways of using ICT to push boundaries of student learning. Empowers students to make choices on a range of ICT to use to respond to project-based and interdisciplinary approaches (e.g., development of complex webquests or class web or wiki pages using multiple media formats).</td>
</tr>
</tbody>
</table>

2.9 Conclusion

This chapter has critically appraised the literature on ICT integration by discussing the role of teachers’ beliefs, knowledge dispositions and skills in using ICT. It proposes a framework of pedagogical reasoning to understand teachers’ actions and this framework is cast in a broader conception of educational change which considers a range of socio-cultural factors. Table 2.6 shows how the ideas presented combine to respond to the requirements of the study’s research questions.
Table 2.5:  
*Mapping of Conceptual Ideas to the Study’s Research Questions*

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Frameworks</th>
<th>Reference in this chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are the characteristics of beginning teachers’ pedagogical beliefs?</td>
<td>Beliefs</td>
<td>Figure 2.1</td>
</tr>
<tr>
<td></td>
<td>(Buehl &amp; Fives, 2009)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meaningful learning</td>
<td>Table 2.3</td>
</tr>
<tr>
<td>2. What are the characteristics of beginning teachers’ knowledge, dispositions and skills in using ICT?</td>
<td>Pedagogical reasoning</td>
<td>Figures 2.2 and 2.3</td>
</tr>
<tr>
<td></td>
<td>(Mishra &amp; Koehler, 2006; Webb &amp; Cox, 2004)</td>
<td></td>
</tr>
<tr>
<td>3. What are the relationships among beginning teachers’ pedagogical beliefs, knowledge, skills and dispositions in using ICT?</td>
<td>Beliefs</td>
<td>Figure 2.1</td>
</tr>
<tr>
<td></td>
<td>(Buehl &amp; Fives, 2009)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meaningful learning</td>
<td>Table 2.3</td>
</tr>
<tr>
<td></td>
<td>(Jonassen et al., 1999)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pedagogical reasoning (Mishra &amp; Koehler, 2006; Webb &amp; Cox, 2004)</td>
<td>Figures 2.2 and 2.3</td>
</tr>
<tr>
<td>4. To what extent do beginning teachers’ pedagogical beliefs and their knowledge, skills and dispositions in using ICT influence the way in which they employ ICT in their classrooms?</td>
<td>Beliefs</td>
<td>Figure 2.1</td>
</tr>
<tr>
<td></td>
<td>(Buehl &amp; Fives, 2009)</td>
<td></td>
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<tr>
<td></td>
<td>Meaningful learning</td>
<td>Table 2.3</td>
</tr>
<tr>
<td></td>
<td>(Jonassen et al., 1999)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pedagogical reasoning (Mishra &amp; Koehler, 2006; Webb &amp; Cox, 2004)</td>
<td>Figures 2.2 and 2.3</td>
</tr>
<tr>
<td>5. What aspects of the socio-cultural environment impacts on beginning teachers’ pedagogical beliefs, and their knowledge, skills and dispositions in using ICT?</td>
<td>ICT adoption</td>
<td>Table 2.4</td>
</tr>
<tr>
<td></td>
<td>(Newhouse et al., 2005)</td>
<td></td>
</tr>
<tr>
<td>6. To what extent have beginning teachers’ pedagogical beliefs and their knowledge, skills and dispositions in using ICT changed during their time as teachers in the workplace? What factors have contributed to these changes?</td>
<td>All</td>
<td>Figure 2.4</td>
</tr>
<tr>
<td>7. What implications do these factors have for the future uptake of ICT in schools?</td>
<td>All</td>
<td>Figure 2.4</td>
</tr>
</tbody>
</table>

Chapter 2: Literature review
This research aims to contribute to generating a more sophisticated understanding of ICT integration in schools. It does not lay claim to providing solutions to the apparently slow and unrefined use of ICT that the literature suggests are evident across a range of contexts. However, by focusing on what teachers can do in their classrooms (i.e. by synergising technological-pedagogical-content knowledge in the pedagogical reasoning process and considering the complexity of the socio-cultural context in which they are set), teachers can be empowered by the opportunity of using ICT to make a difference to student learning.

The thesis will now present the methodology that underpins the research.
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Chapter 3: Methodology
CHAPTER 3
Methodology

3.1 Chapter overview

The development of the research methodology that underpins this thesis is based upon Shulman’s (1988) thinking that disciplined inquiry should first understand the problem, secondly decide which questions are worth asking and thirdly, select the appropriate method in response to these questions. The chapter firstly re-states the problem which was articulated in Chapter 1. Secondly, it poses the research questions that are framed to inform and confront the problem. Third, it describes how the study fits within the pragmatic research paradigm in which it is set. Fourthly, the chapter offers a description of the research design, approach and methods used to collect and analyse data. Finally, it considers the role of the researcher, the limitations of the research and the ethical conduct of the study.

3.2 The problem

As discussed in Chapter 1, the use of ICT in schools has been shown to be problematic (Cuban, 2001; Selwyn, 2002; Somekh, 2007), and characterised by a slow and unimaginative uptake amongst teachers despite significant policy and logistical support. A number of reasons have been posited to explain this, the most compelling of which seem to be bound up with teachers’ beliefs, knowledge, dispositions and skills in using ICT, and the impact of the socio-cultural settings in which they operate.

The lethargic reaction of many teachers to using digital technologies is at odds with broader societal trends that indicate that ICT are having an increasingly pervasive
impact on young peoples’ lives (Jukes & Dosaj, 2004; Prensky, 2006). This mismatch represents a lost opportunity to better engage students in education and ultimately enhance their learning (Somekh, 2007). The research posits that beginning teachers are a potentially fruitful cohort to investigate as they might provide a window into the future use of ICT in education.

3.3 Research questions

In response to this problem, seven core questions are framed to help develop new understandings in relation to beginning teachers’ pedagogical beliefs, knowledge, dispositions and skills in using ICT, along with the impact of the socio-cultural environment(s) in which they operate:

1. What are the characteristics of beginning teachers’ pedagogical beliefs?

2. What are the characteristics of beginning teachers’ knowledge, dispositions and skills in using ICT?

3. What are the relationships among beginning teachers’ pedagogical beliefs, knowledge, dispositions and skills in using ICT?

4. To what extent do beginning teachers’ pedagogical beliefs and their knowledge, dispositions and skills in using ICT influence the way in which they employ ICT in their classrooms?

5. What aspects of the socio-cultural environment impacts on beginning teachers’ pedagogical beliefs, and their knowledge, dispositions and skills in using ICT?
6. To what extent have beginning teachers’ pedagogical beliefs and their knowledge, dispositions and skills in using ICT changed during their time as teachers in the workplace? What factors have contributed to these changes?

7. What implications do these factors have for the future uptake of ICT in schools?

The rationale for posing these research questions is discussed below.

**3.3.1 Characteristics of beginning teachers’ pedagogical beliefs**

Research question 1 provides an avenue to describe the pedagogical identities of the beginning teachers that have taken part in the study. The literature review undertaken in Chapter 2 suggests that teachers’ pedagogical beliefs may be important in understanding how beginning teachers actually use ICT in their classrooms (Ertmer, 2005; Jamieson-Proctor, Burnett, Finger, & Watson, 2006; Vannatta & Fordham, 2004). It is, therefore, beneficial to describe beginning teachers’ pedagogical beliefs in relation to an established contemporary learning framework.

**3.3.2 Characteristics of beginning teachers’ knowledge, dispositions and skills**

Research question 2 provides an opportunity to build upon the work of Mishra and Koehler (2006) and Harris, Mishra and Koehler (2009) in describing beginning teachers’ technological and pedagogical knowledge and skills. It also considers the importance of beginning teachers’ dispositions in using ICT, specifically their attitudes (Vannatta & Fordham, 2004) and self-perceptions (Jamieson-Proctor et al., 2006).

**3.3.3 Relationships among beginning teachers’ pedagogical beliefs, knowledge, dispositions and skills in using ICT**

Responding to research question 3 helps to generate an understanding of the relationships among beginning teachers’ pedagogical beliefs, knowledge, dispositions
and skills in using ICT. A number of studies (Jonassen, 2002; Maor & Taylor, 1995; Steketee, Herrington, & Oliver, 2001) conclude that teachers who hold learner-centred beliefs about teaching are likely to use ICT effectively. By exploring the links among beginning teachers’ pedagogical beliefs, knowledge, dispositions and skills in using ICT, this research question may help to understand if, and why, learner-centred practices might be important to ICT integration.

3.3.4 How beginning teachers employ ICT in their classrooms

Research question 4 examines the realities of using ICT in classroom teaching. Addressing this question may shed light on the extent to which beginning teachers’ pedagogical beliefs, and their knowledge, dispositions and skills in using ICT, have influence on their practices. It may also lead to an understanding of why participants use ICT in the ways that they do, or indeed ignore ICT in their teaching.

3.3.5 Impact of the socio-cultural environment

Research question 5 provides an opportunity to examine how the socio-cultural setting impacts on beginning teachers’ pedagogical beliefs, and their knowledge, dispositions and skills in using ICT. A growing number of researchers (Goos, 2005; Hew & Brush, 2007) see the attributes of a teacher’s workplace as critical in shaping the identity of teachers. This question probes the socio-cultural context of beginning teachers, looking for ways in which it might influence their application or avoidance of ICT.

3.3.6 Changes to beginning teachers’ pedagogical beliefs, knowledge, dispositions and skills

Research question 6 focuses on the dynamics of change. There is considerable evidence in the literature that sustainable change requires action at the level of the system, school
and individual teacher (Fullan, 2003). This question seeks to help understand the forces of change at the level of the teacher and the school setting in which the teacher operates.

3.3.7 Implications of the research for the future use of ICT in schools

Research question 7 synthesises the impact of all of the constructs identified in research questions 1 to 6, and examines the implications that these constructs might have on future use of ICT in schools, particularly as this relates to supporting meaningful student learning through the use of ICT. It has been suggested in the literature that studies into ICT have tended to focus on how much, rather than how, ICT is used in the classroom (Judson, 2006). The research gathers evidence over time on how teachers use ICT within the constraints and/or affordances of the environment in which they operate.

3.4 Research approach

Like all social research, this study has a lens through which it interprets the subject under investigation. This lens influences the way in which research is conducted (Brown & Dowling, 1998) and it is, therefore, important to articulate it. What is seen when social phenomena are observed is, to some extent, shaped by one’s perception on the nature of knowledge itself. Further, the tools that are selected to measure and understand social phenomena are also bound up with these perceptions. For example, positivists (Blaxter, Hughes, & Tight, 1996; Burns, 2000; Peca, 2000) may use procedures like systematic testing of hypotheses and experimentation to arrive at what they might consider to be the truth. Drawing inferences from representative samples that can be applied to larger populations, generalising, leads to the development of theory which in turn can guide educational policy (Denzin, 1994).

The interpretive tradition, on the other hand, posits that reality is something that is entirely subjective, constructed by individuals through the process of interacting with
their social worlds (Erickson, 1986; Lincoln & Guba, 1985; Merriam, 1998).
Interpretive researchers embrace subjectivity and strive for their results to be measured
through a different frame of reference such as credibility and confirmability (1985).
Researchers from the interpretive tradition do not seek to distance themselves from the
object of their research, instead choosing to immerse themselves in the context of their
research describing and explaining it from within.

Some researchers (Creemers & Reezigt, 1999; Fraser, 1999; Henwood & Nicholson,
1995) have advocated combining qualitative/interpretive and quantitative/positivist
paradigms and the techniques that underpin these paradigms. Certainly combining these
approaches has been shown to be particularly useful in ICT research (Chester &
Gwynne, 1998; Maor & Fraser, 2005; Newhouse, 1997; Rourke & Anderson, 2002).

3.4.1 The pragmatic approach to inquiry

The debates between positivist and interpretive research have tended to emphasise
differences between qualitative and quantitative approaches with each side attempting to
expose and defeat one another’s assumptions (Alexander, 2006). Recent literature
(Alexander, 2006; Johnson & Onwuegbuzie, 2004) questions the pluralistic approach,
attempting instead to focus on the common ground between the qualitative and
quantitative research traditions. The pragmatic approach of bringing together the best of
both traditions to formulate compelling evidence in response to well designed research
questions is attractive. Phillips (2006), for example, draws an analogy between
scientific research and the legal profession in which judgments are made on the basis of
the persuasiveness of arguments which are in turn underpinned by corroborative
evidence.
In the legal analogy the strength of arguments depend upon both logical and ethical robustness. Likewise, educational research has both logical and ethical dimensions. The logical dimension being informed by a robust methodology, and the ethical by committing research to be in the service of peoples’ well being (Hostetler, 2005).

It is argued, then, that research situated within a pragmatic paradigm and that embraces qualitative and quantitative traditions is a preferable pathway to advance knowledge creation. This research accepts the pragmatic paradigm as being appropriate for the complexities of understanding ICT as an innovation in progress (Somekh, 2004), and for its ability to provide a potentially powerful mechanism for triangulating findings and assisting in interpretation.

### 3.4.2 Mixed methods research

Eisner (1979) contends that data collected through the combined use of qualitative and quantitative research provides greater breadth and depth than either technique could generate on its own. According to Johnson and Onwuegbuzie (2004, p. 17) mixed methods research is:

…inclusive, pluralistic and complementary, and it suggests that researchers take an eclectic approach to method selection and the thinking about and conduct of research. What is most fundamental is the research question – research methods should follow research questions in a way that offers the best chance to obtain useful answers.

This study strived for an appropriate mix of quantitative and qualitative data to help to describe, explain and interpret the use of ICT in a range of contexts in Western Australian schools. It set out to attain an empathetic understanding of teachers in their workplaces, and to achieve this, tracked a cohort of 35 beginning teachers over a 3 year timeframe. These 35 beginning teachers (the research participants) were all new to the teaching profession having graduated in the year before data collection commenced. All
but one completed their undergraduate education at one of the five universities in Western Australia.

The research uses a mix of methods comprising of a quantitative approach for gathering baseline data on beginning teachers’ pedagogical beliefs. This is done through a Pedagogical Beliefs Questionnaire which was administered in years 1 and 3 of the study. The research also embraces a qualitative interpretive approach through interviewing and observation to help discern how these beliefs relate to participants’ knowledge, dispositions and skills within their socio-cultural context.

The research participants operated in unique physical and socio-cultural settings, dealt with different challenges, and had a range of experiences with ICT over the 3 year period in which the study took place. The school settings of most participants changed during the period of the study (e.g. some participants changed school and some schools changed leadership). This contributed to the uniqueness of each participant’s experiences.

A sub-set of 14 of the cohort of 35 participants contributed fully in all data collection processes. This created a number of unique cases yielding rich data through: completion of the Pedagogical Beliefs Questionnaire at two points of the research; participating in all interviews between years 1 and 3 of the research; and agreeing to be observed in their classroom or a school laboratory on at least two occasions between years 1 and 3 of the research.
3.5 Research design

3.5.1 Research model

This research adopts a longitudinal design whereby data are collected over 3 years and re-visited at various stages of the research. This enables insights to be drawn on the extent to which participants might change their beliefs and actions over time.

The research model is illustrated as Figure 3.1.
3.5.2 Phases of the research

To enhance the clarity and manageability of the research, the study was broken down into four discrete phases, the first three of which were directly related to the data gathering instruments used. The fourth phase was analytical and involved consideration of the data gathered from the first three phases. The four phases are:

1. Pedagogical beliefs (questionnaire).

2. Pedagogical knowledge, dispositions and skills as these relate to ICT (interview).

3. Use of ICT in the workplace (observation).

4. Changes to participants’ pedagogical beliefs and their knowledge, dispositions, and skills in using ICT (all data collection methods).

Phases 1 to 3 were conducted sequentially and informed each other from year to year. Phase 4 has an overarching character that examined if, how and why change occurred over time. Constant scanning of the literature into the use of ICT in K-12 education underpinned the research. The four phases of the research acted as a road map for the study. These are now discussed in detail.

3.5.2.1 Phase 1: Pedagogical beliefs

The literature suggests that there may be a relationship between teachers’ beliefs about pedagogy and the way in which they use or do not use ICT (Ertmer, 2005; Fang, 1996; Wang, Ertmer, & Newby, 2004). As a starting point, the research sought to collect data that captured the essence of beginning teachers’ beliefs, and relate these beliefs to a recognised contemporary framework of meaningful learning. The Pedagogical Beliefs
Questionnaire was the primary mechanism employed to gauge participants’ pedagogical beliefs. This is provided as Appendix A.

The Australian Statements of Learning for ICT (MCEETYA, 2006), set out in Chapter 1, suggest that students should be offered opportunities to inquire, communicate, create and operate ICT as well as consider the ethics and issues in ICT use. These elements suggest a level of student control over ICT, and it therefore follows that beginning teachers that acknowledge and embrace student-centred pedagogies are more likely to be able to respond to the Statements of Learning for ICT. Jonassen et al. (1999) subscribe to the view that the primary goal of education is to provide opportunities for students to engage in meaning making. Meaning making occurs when learners engage in authentic, active, constructive, cooperative and intentional learning (Jonassen et al., 1999).

The purpose of the questionnaire was to provide a measure of participants’ pedagogical beliefs which was then used as a basis for determining the extent to which beliefs change over time. The questionnaire was administered at the inception (Year 1) and conclusion (Year 3) of the study. Data from the questionnaire were used to create teacher pedagogical identity profiles. These profiles were developed according to Jonassen, Peck and Wilson’s (1999) five attributes of meaningful learning; for the purpose of brevity, described as “identified attributes of meaningful learning” for the remainder of the thesis. Participants were then interviewed to gain an appreciation of their pedagogical knowledge, dispositions, and skills in using ICT.

3.5.2.2 Phase 2: Pedagogical knowledge, dispositions, and skills as these relate to ICT

Phase 2 was about obtaining a sense of participants’:
- Understanding of how and when to implement ICT within the context of their stated pedagogical beliefs (pedagogical knowledge).

- Attitudes and self-perceptions towards using ICT (dispositions).

- Perceptions of their own technological knowledge and skills (skills).

Interviewing has been shown to strengthen qualitative research particularly in its “ability to evoke extensive and naturally expressed information” (Stenhouse, 1982, p. 3). The purpose of the interview process was twofold. Firstly interviewing sought to clarify responses to the questionnaire. Secondly, it attempted to understand participants’ pedagogical knowledge, skills, and dispositions towards ICT in the context of their stated pedagogical beliefs.

Semi-structured interviews occurred annually over 3 years of the study. Interview questions used over these 3 years are provided as Appendix B.

3.5.2.3 Phase 3: ICT use in the workplace

To provide an authentic depiction of the way in which beginning teachers used ICT in their teaching, a proportion of participants in the sample were observed in their naturalistic classroom settings. The observation protocol used over the 3 year period is provided as Appendix C.

Where possible, principals at observation sites were also interviewed to obtain a school’s strategic perspective on ICT implementation. Interview questions posed to principals are attached as Appendix D.

In the first year, interviews and observations were undertaken separately with observations scheduled for later in the school year. In subsequent years, interviews and
observations were conducted at the same time with the interview typically following the observation.

Data pertaining to the school’s infrastructure and the equipment/software available to the teacher were also collected at the time of observation, as were artifacts (e.g. lesson plans, worksheets, hand-outs and electronic materials) to further understand the teaching and learning setting.

3.5.2.4 Phase 4: Changes in pedagogical beliefs, knowledge, dispositions and skills in using ICT

The process of undertaking phases 1 to 3 provided a basis from which to discern changes in the use of ICT and how this impacted on teaching practice. Email and telephone contact were maintained with participants during the research and this resulted in varying levels of interaction with participants. These discussions (physical and online) also provided insights into the changing character of participants as they established themselves in their school environments. There were no dependency relationships between the researcher and the beginning teachers who took part in the study.

3.6 Data collection

3.6.1 Data collection techniques

Phases 1 to 3 required specific data collection techniques that were conducted at pre-determined times during the research. Data collection techniques and their relationship to the study’s research questions are shown in Table 3.1.
Table 3.1:  
Data Collection Techniques

<table>
<thead>
<tr>
<th>Phase</th>
<th>Data collection technique</th>
<th>Research question</th>
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<tbody>
<tr>
<td>1</td>
<td>Questionnaire for beginning teachers</td>
<td>1, 6, 7</td>
</tr>
<tr>
<td>2</td>
<td>Semi-structured interviews with beginning teachers</td>
<td>2, 3, 6, 7</td>
</tr>
<tr>
<td>3</td>
<td>Observation of beginning teachers</td>
<td>4, 6, 7</td>
</tr>
<tr>
<td></td>
<td>Principal interviews</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Inventory of ICT available at the workplaces of beginning teachers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Collection of artifacts from the workplaces of beginning teachers</td>
<td>5</td>
</tr>
</tbody>
</table>

These data collection techniques are now discussed in detail.

3.6.2 Questionnaire for beginning teachers

3.6.2.1 Development of the Pedagogical Beliefs Questionnaire

At the inception of the study a 40 item questionnaire, originally based upon Frid (2000) and later Goos and Bennison (2002; 2007) was developed for the purpose of capturing data in relation to beginning teachers’ pedagogical beliefs. The original design of the questionnaire was aimed at a novice mathematics teacher audience and the statements, which were said to underpin current research on mathematics teaching and learning (Goos & Bennison, 2002), required some refinement to facilitate use in a more generalised context.

The initial version of the questionnaire for this study also contained 40 statements in which participants were invited to indicate their level of agreement through a five point Likert type scale (Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree). Statements were designed to both support and contradict student-centred learning. For example, agreement with the statement *Effective teachers provide students with*
solutions to problems might indicate a teacher-driven pedagogy whilst agreement with the statement Effective teachers regularly devote time to allow students to find their own methods to solving problems suggests a more student-centred approach. The initial version of the questionnaire contained 22 statements which supported student-centred learning and 18 which resonated more with a teacher-driven pedagogy. These 40 statements comprised the quantitative component of the questionnaire.

Seven further items were added to the questionnaire based on the work of Fives and Buehl (2005). These include:

- Five open ended questions designed to encourage responses about teaching philosophy and knowledge about how to teach.
- One question that asked respondents to choose one or more statements from a list of seven statements that best represent their beliefs about teaching.
- One question that asked respondents to rank their top five teaching goals from a list of 13.

One open ended item designed to collect data about respondents’ attitudes towards ICT was also added. These 8 items formed the qualitative component of the questionnaire. The initial version of the questionnaire, therefore, contained 40 items designed to collect quantitative data, and 8 items that were aimed at gathering qualitative responses.

3.6.2.2 Piloting of the Pedagogical Beliefs Questionnaire

The 40 quantitative items of the questionnaire, essentially statements about pedagogical orientation, were mapped against the identified attributes of meaningful learning: learning is active, cooperative, constructive, authentic and intentional. Three academics
with expertise in learning theory independently cross-checked the alignment of items to these identified attributes of meaningful learning, and with minor amendment this resulted in the development of 5 subscales for the questionnaire.

The questionnaire was piloted with a convenience sample of 40 final year Bachelor of Education students who were attending a de-briefing session at a university in Western Australia. Six of the 40 students acted as a focus group to provide feedback on the structure of the questionnaire and the language used. A summary of this feedback is provided as Appendix E.

One of the key purposes of the pilot was to check the dimensionality of the instrument. Factor analysis was conducted on the 40 items. It was found that five items did not sufficiently load (loadings were less than 0.4). These items were then deleted from the questionnaire. The remaining 35 items mapped against the identified attributes of meaningful learning are shown in Table 3.2.

**Table 3.2: Scales of the Questionnaire**

<table>
<thead>
<tr>
<th>Scale (learning is…)</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>1-5</td>
</tr>
<tr>
<td>Cooperative</td>
<td>6-11</td>
</tr>
<tr>
<td>Constructive</td>
<td>12-23</td>
</tr>
<tr>
<td>Authentic</td>
<td>24-31</td>
</tr>
<tr>
<td>Intentional</td>
<td>32-35</td>
</tr>
</tbody>
</table>

The final version of the questionnaire contained 35 items designed to collect quantitative data, 19 of which were positively associated with the above attributes, and 16 which ran contrary.
The pilot also enabled testing for the reliability of the instrument. Responses to the questionnaire resulted in a Cronbach Alpha of 0.755 which indicated that overall the questionnaire had an acceptable level of reliability.

Four procedures contributed to the extent to which the questionnaire measured all facets of the construct of pedagogical beliefs (i.e. content validity). Firstly, the questionnaire was grounded in a previous questionnaire that has been used extensively to consider pedagogical beliefs in the area of mathematics (Frid, 2000; Goos & Bennison, 2002, 2007). Secondly, all items of the questionnaire were independently mapped against the identified attributes of meaningful learning with minimal levels of disagreement. Thirdly, factor analysis was conducted on the piloted version of the questionnaire to eliminate items that did not adequately load with at least one other factor. Finally, 7 of the 8 qualitative items that were included in the questionnaire also targeted the construct of beliefs (Fives & Buehl, 2005). These data could be used in conjunction with quantitative responses to attain a comprehensive understanding of the construct of pedagogical beliefs.

The final version of the Pedagogical Beliefs Questionnaire, therefore, contained 43 items (35 designed to collect quantitative data, 6 open-ended items, 1 item asking respondents to choose statements from a list that best represented their views about teaching, and 1 item requesting respondents to rank teaching goals).

### 3.6.3 Interviewing

An interview instrument used in the aforementioned study into beliefs about mathematics was obtained from Goos (2005). However, as with the Pedagogical Beliefs Questionnaire, this needed to be refined for use (a) over the 3 years of the study and (b) to cater for a more diverse audience.
A semi-structured and conversational interview approach was adopted and provided a level of flexibility to the researcher to follow up questions and probe issues where required (Cohen & Manion, 1994). Open-ended questions were preferred to allow participants to consider and elaborate their responses.

Where possible, interviews were conducted with school principals at the conclusion of observations. The purpose of these interviews was to generate a perspective of the school’s strategic approach to ICT implementation including the technologies that were seen as most attractive to the school, the way these technologies were supported and the principal’s perspective on whether beginning teachers had a particular role to play in generating interest at the school in using ICT. The interview questions posed to principals were also based upon those developed by Goos (2005).

### 3.6.4 Observation

The purpose of the observation process was to:

- Obtain a deeper understanding of teachers’ pedagogical identities and use of ICT; and
- Examine the correspondence between teachers’ views on their pedagogical approaches and use of ICT, and what was apparent to an observer.

An observation protocol called Focus on Integrated Technology: Classroom Observation Measurement (FIT:COM) was adopted from a similar study undertaken by Judson (2006). FIT:COM contains segments for qualitative description of ICT use, but also a 25 item instrument categorised under 5 subscales: Design of technology integration, Class dynamics, Meaning and purpose, Content and knowledge and Technology as tools. Each subscale contained 5 statements and participants were given a score on each item on a 5 point scale from 0=never occurred to 4=frequently occurred.
The total possible score for each subscale is, therefore, 20 (5 questions at the maximum score of 4) and for the instrument, 100 (25 questions at the maximum score of 4).

FIT:COM was used to collect data on ways in which participants used ICT to help facilitate learning, the barriers and affordances for teachers’ use of ICT in the classroom, and the reactions of students.

Observations were pre-arranged and undertaken overtly with teachers and students having an awareness that the research was being conducted. Results from the observations were recorded on the protocol instrument.

3.6.5 Documented ICT environments and collection of artifacts

Details of the ICT available to participants were documented at each observation session. This provided a context for gauging the extent to which teachers optimised the use of the infrastructure that were available to them. Of particular interest were affordances and constraints that confronted teachers in their classrooms.

Artifacts (e.g. lesson plans, hand-outs, multimedia products, electronic materials and URLs) were also collected at the time of observation to help provide a rich understanding of the lesson observed.

3.6.6 Research sample

The research sought to gain an appreciation of beginning teachers’ beliefs, knowledge, dispositions and skills in using ICT across a spectrum of year levels, education sectors (public and private), and locations (metropolitan and rural/remote). It did not seek to narrow the participant base to those that either had a particular disposition towards using ICT and/or were located in technology-rich schools. For this reason, the research cast a broad net in seeking participation. To take part in the research, beginning teachers
were asked to respond to the Pedagogical Beliefs Questionnaire and sign a Statement of Informed Consent.

The following four strategies were adopted to attract participation in the research:

In February of Year 1 of the study, a list of new graduates (n=935) was obtained from the Professional Learning Institute (PLI) of the Western Australian Department of Education and Training. These graduates were contacted by email by the PLI and introduced to the research. Interested new graduates were then asked to contact the PLI to request a Pedagogical Beliefs Questionnaire which would indicate their intention to become involved in the research. Six participants, all from rural/remote areas of Western Australia, responded through this process. The onus to participate was on the new graduates themselves and given other priorities that they may have had in the first 3 months of their teaching careers, it is not surprising that only a few new graduates volunteered to participate.

To augment (1) above and generate interest in the study, the researcher attended three professional learning sessions that were provided by the PLI to beginning teachers (n=92) in March and April of Year 1 of the study. A brief explanation of the aims and objectives of the research was provided at these sessions. The Pedagogical Beliefs Questionnaire was distributed to all 92 participants at the professional learning sessions and potential participants were asked to complete and return the questionnaire by mail in a stamped-addressed envelope together with the consent form required for participation in the research. Fifteen participants responded through this process representing a response rate of 16%.
An email to participants involved in the pilot study (n=40) was sent along with an electronic version of the Pedagogical Beliefs Questionnaire. Ten participants responded through this process representing a response rate of 25%.

The researcher worked for two universities as a practicum supervisor and during school visits, between April and June of Year 1 of the study, made personal contact with four new graduates all of whom chose to become involved in the study. In all, 35 beginning teachers chose to take part in the study.

### 3.6.7 Data gathering

#### 3.6.7.1 Data collection timeline

The research was conducted over 3 years. During this time, participants engaged with the researcher in a number of ways including through completion of a questionnaire at the commencement and conclusion of the research and annual interviews/observation sessions. Analysis and synthesis of the data in relation to the literature was ongoing throughout the study. Contact was maintained with participants by email and in four cases the researcher actively inputted into participants ideas for ICT use, one of which resulted in being part of a participant’s action learning project. The data collection timeline is shown in Table 3.3.

Of the 35 beginning teachers that completed the questionnaire in Year 1, 28 were interviewed and 8 observed in Year 1. This cohort of 28 then formed the basis of 16 interviews and observations in Year 2. The Year 2 cohort of 16 formed the basis of 14 interviews and 6 observations in Year 3 of the study. To help gain some sense of the extent to which participants’ pedagogical beliefs might have changed over time, all 35 original participants were asked to complete the questionnaire again in Year 3. During the study two participants left the teaching profession, and with 20 completing
the questionnaire for the second time, this represents a response rate of 61% in Year 3 of the study.

Table 3.3: Data Collection Timeline

<table>
<thead>
<tr>
<th>Instrumentation</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire</td>
<td>Mar-Apr (n=35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant interview</td>
<td>Apr-Aug (n=28)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal interview</td>
<td>Apr-Aug (n=6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observation</td>
<td>Aug-Oct (n=8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant interview</td>
<td>Apr-Jul (n=16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal interview</td>
<td>Apr-Jul (n=4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observation</td>
<td>Apr-Jul (n=16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Questionnaire</td>
<td></td>
<td>Mar (n=20)</td>
<td></td>
</tr>
<tr>
<td>Participant interview</td>
<td>Feb-Mar (n=14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal interview</td>
<td>April (n=1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observation</td>
<td>Mar-Apr (n=6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is acknowledged that beginning teachers are under significant pressure at an early stage of their careers having to contend with a range of priorities including understanding the curriculum, establishing a presence at their new place of employment, and developing an effective approach to classroom management. Considering these circumstances, it is proposed that the combination of overall numbers of responses for questionnaire, interview and observation, over 3 years, are adequate for a mixed methods study.

3.6.7.2 Implementation of the Pedagogical Beliefs Questionnaire

Fifty five questionnaires were completed during the study (35 in Year 1 and 20 in Year 3). The quantitative aspects of the questionnaire were inputted into a spreadsheet.
and then imported into SPSS version 15 for analysis. Qualitative components were inputted into QSR NVivo version 1 for analysis.

Of the 35 respondents to the Pedagogical Beliefs Questionnaire in Year 1 of the study, 25 (71%) were located in public education state schools and 10 (29%) in private schools. This is broadly representative of the split between the number of teachers in public sector state schools and those employed in private schools at the time the questionnaire was administered in Year 1 of the study, 66% and 33% respectively ("Western Australian Department of Education and Training human resources statistics," 2009). Twenty six or 74% of respondents were female which again is representative of the proportion of females to males in the overall teaching population in Western Australia - 71% female in 2007 ("Annual Report," 2008).

The number of respondents from metropolitan and rural/remote areas and primary and secondary sectors are provided in Table 3.4.

<table>
<thead>
<tr>
<th></th>
<th>Primary</th>
<th>Secondary</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td>Year 3</td>
<td>Year 1</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>18</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Rural/remote</td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>15</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

*Note:* One participant was teaching in the UK in Year 3 of the study and is therefore not included in the above data.

At the time the questionnaire was administered in Year 1 of the study, 24% of public sector teachers were located in rural and remote areas in Western Australia ("Western
Australian Department of Education and Training human resources statistics," 2009). In
this study the proportion of participants from rural/remote schools was 29% in Year 1.
Similarly, primary and early childhood education teachers comprised 56% of teachers in
Western Australia with secondary teachers comprising 44%. The proportion of primary
and early childhood education teachers in this study was 71% in Year 1. Therefore,
primary and early childhood teachers were slightly over-represented in this research.

3.6.7.3 Implementation of interviews

Semi-structured interviews were conducted in each of the 3 years of the study.
Interviews were video- or audio-taped and then transcribed into textual format. A month
prior to the second and third interviews, a CD of the previous interview was provided to
participants to generate discussion on teachers’ perceptions on if or how they might
have changed their beliefs and dispositions over the previous 12 months.

Interviews were typically of between 30 to 40 minutes in length in Year 1, 20 to
30 minutes in length in Year 2 and 10-15 minutes in length in Year 3. Table 3.5
provides details of the number of participants that were interviewed over the 3 year
period by education sector.

<table>
<thead>
<tr>
<th></th>
<th>Primary</th>
<th>Secondary</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>19</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>Year 2</td>
<td>11</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Year 3</td>
<td>11</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total interviews</strong></td>
<td><strong>41</strong></td>
<td><strong>17</strong></td>
<td><strong>58</strong></td>
</tr>
</tbody>
</table>
At the conclusion of interviews in Year 2 and Year 3 of the study, participants were asked to rate themselves on the ICT integration schema developed by Newhouse, Trinidad and Clarkson (2005). The schema used is provided as Appendix F.

Over the period of the research, 11 interviews were conducted with school principals (9 primary and 2 secondary). These varied in length, but none was shorter than 10 minutes or lasted longer that 45 minutes. All principal interviews were recorded and then transcribed using a word processor and imported into QSR NVivo for analysis.

3.6.7.4 Implementation of observation protocol

Thirty observations were conducted over the period of the research. These were pre-arranged and took place in scheduled lessons. The researcher did not participate in any of the lessons. The number of observations conducted each year by education sector is provided as Table 3.6.

Table 3.6: Observations Conducted Over the Term of the Research by Education Sector

<table>
<thead>
<tr>
<th>Year</th>
<th>Primary</th>
<th>Secondary</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Year 2</td>
<td>11</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Year 3</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Total observations</td>
<td>23</td>
<td>7</td>
<td>30</td>
</tr>
</tbody>
</table>

Observations took place in either a classroom or a computer laboratory or sometimes both. Typically, observations ran between 40 minutes and an hour. Two observations were independently co-observed by a colleague in the third year of the study. Overall FIT:COM scores for these co-observations are provided in Table 3.7.
Table 3.7:  
Co-observation of Participants 29 and 34 Conducted in Year 3 of the Study

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Colleague</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 29</td>
<td>48/100</td>
<td>47/100</td>
</tr>
<tr>
<td>Participant 34</td>
<td>77/100</td>
<td>79/100</td>
</tr>
</tbody>
</table>

The process of conducting two independent observations of the same lessons helped to strengthen the overall quality of the data gathered through the observation protocol.

### 3.7 Data analysis

#### 3.7.1 Quantitative data

Quantitative data was inputted into a spreadsheet and then imported into SPSS for analysis. Cronbach’s Alpha was used to calculate the reliability of both iterations of the questionnaire which was 0.724 in Year 1 and 0.717 in Year 3.

As discussed, the final questionnaire contained 16 items that were phrased negatively in terms of the identified attributes of meaningful learning. Responses for these items were inverted and mean scores were calculated for individual items and by each of the five subscales. A weighted average was calculated to provide an overall index of participants’ resonance with the identified attributes of meaningful learning. The maximum possible mean score for the questionnaire was 5.0 and to achieve this, a participant would need to have strongly agreed with the 19 items that complied with the identified attributes of meaningful learning and strongly disagreed with the 16 items that challenged these attributes.

Profiles were prepared for all participants who completed the questionnaire in both Year 1 and Year 3 and participants were placed in three bands (high, medium or low).
which indicated the degree to which their pedagogical beliefs resonated with those described by Jonassen, Peck and Wilson (1999). The profiles were also used to inform the interviewing process.

Cross-tabulation of the data on variables of gender, location, level (primary, secondary) and sector (public, private) was also undertaken for both iterations of the questionnaire. Finally, comparative analyses were conducted by individual and scale to discern possible changes in responses between Year 1 and Year 3.

3.7.2 Qualitative data

The researcher conducted, video or audio-taped, and transcribed all interviews and all data from completed questionnaires. Transcriptions of the interviews (and the qualitative aspects of the completed questionnaires) were done using a word processor and then entered into QSR NVivo software. As data were entered and coded in QSR NVivo at the conclusion of each period of data collection, categories were created to help describe teachers’ pedagogical beliefs, and their knowledge, dispositions and skills in using ICT. This provided a natural mechanism for further coding to be considered within the context of current categories. Coding was conducted entirely by the researcher using guidelines developed by Bogden and Biklen (1992). All data in transcripts were coded by allocating chunks of data to one of 38 nodes that emerged during the 3 years of the study.

During processes of data collection, data entry and data manipulation (creation of categories and then themes), the researcher employed a constant comparative method of data analysis (Lincoln & Guba, 1985) which meant that reports for all nodes were created, printed and scrutinised after each data collection period. In this way, the ongoing development of themes was informed by qualitative data already considered.
This process also ensured that data collected at the commencement of the study fed back into interview questioning, improving the overall quality of the data collected.

### 3.7.3 Integrity of data analysis

The subjectivity of interpretive research is acknowledged. However, acknowledgement of subjectivity does not infer that interpretive research is unscientific. Newman (2003, p. 76), for example, suggests that “systematic analysis of socially meaningful action” should be at the heart of interpretive research. Denzin (1994) points out that although research is fundamentally about the researcher, in order for research to be credible it has to go beyond the researcher and the researcher’s position. The following steps were taken to enhance the credibility of the research.

#### 3.7.3.1 Auditability

To ensure the dependability of the data collected, the research has an audit trail ensuring that data underpinning description and interpretation are easily traced back to their source. All statements made in interviewing and transcribed from questionnaire responses have a unique code that ensures that the identity, location and date of the data is traceable.

#### 3.7.3.2 Member checking

Member checking, the process by which participants in research verify data and interpretations (Lincoln & Guba, 1985), was undertaken in two ways. Firstly, prior to interviews, a video or audio CD of the previous interview was provided to participants as a record of the conversations that took place. Interviewing began with clearing up any ambiguities in conversations that took place as a precursor to discussing how participants might have changed their beliefs and practices. Secondly, the
conversational style of interviewing was one that referred to other data (e.g. questionnaires, observations and previous interviews) as a way of deepening understanding of the participant within their socio-cultural context. This represents a natural and informal way of verifying interpretations.

3.7.3.3 Peer de-briefing

Lincoln and Guba (1985, p. 308) describe peer debriefing as:

> The process of exposing oneself to a disinterested peer in a manner paralleling an analytic session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer’s mind.

Peer debriefing was used in two ways in the research. The first, an informal approach, was in the context of discussion with the researcher’s supervisors who provided ongoing feedback before, during, and after data collection. The second application of peer debriefing was at a specifically arranged analytic session with a disinterested peer. After an initial analysis of the qualitative data and development of a concept map, a session was held to facilitate articulation of the themes identified in the concept map and further exploration of the themes including their credibility.

Peer de-briefing was used, particularly, during phase 4 of the research to help interpret the findings that emanated from the data collected. This also served to help clarify thinking, add other perspectives, and identify potential bias.

3.7.3.4 Triangulation

Triangulation of data is a useful mechanism to help strengthen qualitative research (Stake, 1994). Four mechanisms were used to promote triangulation. Firstly, in the research design the use of multiple methods to provide corroborating evidence was in itself a powerful form of triangulation (Mathison, 1988). This was explicitly planned
for, and implemented in this study through the use of questionnaire, interview (participant and principal), observation and collection of artifacts. Secondly, the longitudinal nature of the study strengthened the overall quality of the data and subsequent interpretations, as evidence was gathered and checked over time. Thirdly, the way in which the qualitative data-base was designed and structured in QSR NVivo (i.e. theme-based as opposed to instrument- or time-based) promoted the practice of triangulation. Data was extracted solely on the basis of its value in either confirming or disconfirming interpretations. Finally, ongoing literature reviews over the period of the research contributed to the quality of interpretation of findings. These mechanisms ensured that opportunities for triangulation were identified and taken, thus contributing to the overall credibility of the research.

3.7.3.5 Acknowledgement of bias

The issue of confronting bias in qualitative research is crucial in establishing credibility (Brown, 1996). Where possible, the researcher’s biases are acknowledged through a rich and thick description (Merriam, 1998) of the research, including how participants were selected, the research methodology, and frameworks for analysing data and interpreting findings. Review and potential bias was discussed in the process of peer de-briefing. The researcher also actively searched for confirming and disconfirming evidence in the data using the search capabilities in QSR NVivo.

3.8 Limitations of the research

The overall number of participants involved in the study was low in relation to the beginning teacher population in Western Australia. The variations in the socio-cultural contexts which participants were situated has advantages in terms of providing a rich data set. However, the emergence of themes is sometimes underpinned by a relatively
small number of cases, and therefore interpretations of findings to other contexts should be undertaken with caution.

Researcher bias is also accepted as a potential limitation of the study. Hammersly and Atkinson (1983) point out that researcher decisions made during the design and implementation of the study can effect findings. The study was conducted by one researcher in one educational jurisdiction. Although this has benefits in terms of the consistency of data preparation and analysis, it is acknowledged that it has the potential to limit interpretation across other contexts. To minimise this limitation, the research adopted a mixed methods approach combining qualitative and quantitative approaches. This mixed methods approach allowed for a wider range of data to be collected and overcame some of the weaknesses that can eventuate in the use of a single method (Cohen & Manion, 1994).

The research has attempted to keep up to date with changes in ICT through constant literature scanning. However, the rate at which existing ICT are improved and new ICT become available may limit the usefulness of some of the findings particularly in the longer term.

3.9 Role of the researcher

The researcher attempted to build relationships with research participants over the 3 years of the study in order to gain a level of trust and informality. This involved sharing knowledge, and certainly in cases where participants were interviewed, the researcher offered a contribution to the knowledge-base of participants as far as ICT integration was concerned. The researcher, therefore, to some extent took on an interventionist role contributing in varying degrees to the way in which participants conceived and implemented ICT.
The researcher ensured that all participants were aware of the independence and impartiality of the research at the commencement of each interview and observation session. Assurances were made in respect to confidentiality of participants’ responses to interview questions.

3.10 Ethical considerations

In the collection of data, using techniques like observation and interviewing, it is likely that some information may be deemed sensitive to the participants. The issues involved in establishing and maintaining rapport with teachers in a learning setting are essentially ethical ones. Hollingsworth and Socket (1994) believe that good research relationships are collaborative, requiring mutual engagement with the research process on the part of the researcher and participants.

The conduct of the research study adheres to the Australian Association for Research in Education Code of Ethics (AARE, 2005) and also followed the guidelines issued by the Murdoch University Human Research Ethics Committee.

Before visiting the workplace of participants in the research, a written request for approval was made directly to the school principal. The study, as a pre-requisite, required a Statement of Informed Consent by all participants. This statement protects participants against the release of information that may cause personal harm. Anonymity of participants was assured as part of the Statement of Informed Consent.

The research comprised beginning teachers from all over Western Australia in order to obtain a fair, balanced and accurate assessment of ICT use. The researcher sought reasonable access to documents, data and people. Data has been securely stored, both in
electronic and hard-copy formats in the university supervisor’s office, and will be available for a period of 5 years.

Strict confidentiality and anonymity were preserved throughout the research. No information was concealed and deception through participant exposure to false information or circumstances was avoided by the researcher.

3.11 Summary

This chapter has described the pragmatic and mixed methods research paradigm that underpins the study. Consistent with the interpretivist approach, the research seeks to contribute new knowledge through scientific empirical inquiry judged through criteria of credibility. The extent to which findings are generalisable to other contexts is for others to decide.

The chapter has offered a description of the longitudinal research design, and the qualitative and quantitative methods used to collect and analyse data. It has also considered the role of the researcher, the limitations of the research and the ethical conduct of the study. The next chapter deals with the findings that have emerged from the research.


Chapter 4: Beliefs, knowledge, dispositions and skills

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Chapter 4: Beliefs, knowledge, dispositions and skills
4.1 Introduction

The next three chapters of the thesis present the findings of the research. The framework for understanding ICT integration, based upon the work of Webb and Cox (2004) and Webb (2005), and articulated in Chapter 2 (p.44) of the thesis is adopted to help provide clarity.

Teaching is a complex activity that draws upon technological, pedagogical and content knowledge (Mishra & Koehler, 2006), and is grounded in beliefs and dispositions about teaching and about use of innovations like ICT (Ertmer, 2005; Goos, 2005; Vannatta & Fordham, 2004). Teachers engage in pedagogical reasoning processes in planning lessons, weighing up their understandings of the affordances and risks associated with their chosen teaching strategy (Shulman, 1987; Webb, 2005). Where teachers adopt ICT in the classroom, they make judgments about gains and losses that occur in their particular setting and appraise whether the energy expended in using ICT is worth the effort. In a spirit of continuous improvement, the reflective practitioner would then consider how their beliefs, knowledge, dispositions and skills might have changed.

This natural process of reflective practice forms a basis for presenting the findings in the following three chapters. Firstly, the research seeks to understand participants’ beliefs, knowledge, dispositions and skill levels. This may provide a window into participants’ pedagogical reasoning processes, particularly their approach to
integrating ICT. Secondly, the research seeks to appreciate the socio-cultural settings in which participants are situated, and the impacts which these settings might have on participants’ use of ICT. Finally, the research is interested in change, the evolution of participants’ practices and their underpinning beliefs, knowledge, dispositions and skill levels within the context of their socio-cultural setting(s). This organising schema is illustrated as Figure 4.1 (see p.100).

The chapter provides baseline data to describe participants’ beliefs, knowledge, dispositions and skills at the inception of the study and discusses the relationships among participants’ pedagogical beliefs, knowledge, dispositions and skills in using ICT. Chapter 5 examines how participants used ICT in their socio-cultural setting and investigates the nature of the relationships between the socio-cultural environment and participants’ stated beliefs, knowledge, dispositions and skills. Chapter 6 draws upon the entire data set to explore the changes that might have occurred in this area during the first 3 years of participants’ teaching.

### 4.2 Beliefs and knowledge

This study distinguishes between teachers’ pedagogical beliefs and knowledge and teachers’ beliefs and knowledge in relation to using ICT. It is suspected that both have an impact on the use of ICT in the classroom.

#### 4.2.1 Pedagogical beliefs and knowledge

To gather insights into participants’ pedagogical beliefs and knowledge, a Pedagogical Beliefs Questionnaire was administered to participants at the inception (Year 1) and conclusion (Year 3) of the data collection phase of the research. Findings from the Year 3 iteration of this questionnaire will be dealt with in Chapter 6 of the thesis.
Chapter 4: Beliefs, knowledge, dispositions and skills

**Rationale:**
Provision of baseline data on participants' beliefs, knowledge, dispositions and skills.

**Relationship to research questions:**
1. What are the characteristics of beginning teachers' pedagogical beliefs?
2. What are the characteristics of beginning teachers' knowledge, dispositions and skills in using ICT?
3. What is the relationship between beginning teachers' pedagogical beliefs and their knowledge, dispositions and skills in using ICT?

Chapter 5: Use of ICT in socio-cultural setting

**Rationale:**
Description and explanation of how participants' beliefs, knowledge, dispositions and skills translated into actions with respect to the use of ICT in the classroom.

**Relationship to research questions:**
4. To what extent do beginning teachers' pedagogical beliefs and their knowledge, dispositions and skills in using ICT influence the way in which they employ ICT in their classrooms?
5. What aspects of the socio-cultural environment impacts on beginning teachers' pedagogical beliefs, and their knowledge, dispositions and skills in using ICT?

Chapter 6: Reflection on ICT use

**Rationale:**
Consideration of the changes that have taken place during the research.

**Relationship to research questions:**
6. To what extent have beginning teachers' pedagogical beliefs and their knowledge, dispositions and skills in using ICT changed during their time as teachers in the workplace? What factors have contributed to these changes?

**Figure 4.1.** Organising schema for presenting the findings of the research.
The Pedagogical Beliefs Questionnaire was formed from similar instruments developed by Goos and Bennison (2002; 2007) and Fives and Buehl (2005). The instrument includes 43 items that delve into the intricacies of learning, exploring a range of concepts including the extent of teacher and student control of the learning process, the role of creative work and problem-solving, and the balance between student independence and communication.

4.2.1.1 Quantitative aspects of the questionnaire

The overall purpose of the questionnaire is to measure pedagogical beliefs and each of the 35 items designed to collect quantitative data was assigned to one of Jonassen, Peck and Wilson’s (1999) five attributes of meaningful learning (active, authentic, constructive, cooperative and intentional learning). All items were assigned to an identified attribute of meaningful learning whether they supported or undermined the attribute. These attributes thus formed the subscales of the instrument.

Participants were asked to indicate their level of agreement with these 35 items on a Likert-type scale that comprised five response categories ranging from strongly agree to strongly disagree. To analyse the results, participants were afforded a score for each item: 1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree. The questionnaire included 19 items that supported the identified attributes of meaningful learning and 16 statements that contradicted these attributes. Scores for the latter were then inverted. The result of this process was an overall index of the extent to which participants’ pedagogical beliefs resonated with the identified attributes of meaningful learning.
Overall mean scores were calculated for each respondent. The maximum possible score is 5.0 and to register this, a participant would have strongly agreed with the 19 items that comply with the identified attributes of meaningful learning and have strongly disagreed with the 16 items that challenge these attributes. Conversely, the minimum possible score is 1.0 and to register this, a participant would have strongly disagreed with the positively oriented items and strongly agreed with the negatively oriented items. The median value for the questionnaire is, therefore, 3.0.

The overall mean score for the 35 respondents at the inception of the research in Year 1 was 3.6 with a standard deviation of 0.21. The highest score was 4.2 and the lowest score was 3.0 indicating that participants began their careers holding beliefs about learning that resonated, to a fairly substantial degree, with the identified attributes of meaningful learning. The overall spread of responses to the questionnaire is provided as Figure 4.2. The numbers on the graph relate to the unique identifier of each participant.

Although the overall spread of results suggests that participants generally held views that were consistent with the identified attributes of meaningful learning, further scrutiny revealed that some of these attributes were more strongly supported than others. The mean scores for each of the five subscales are presented in Table 4.1.
Figure 4.2. Spread of responses (n=35) to the questionnaire administered at the inception of the study (Year 1).
Table 4.1:  
Mean Scores for Questionnaire Administered in Year 1 (n=35) Presented by Subscale

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>3.0</td>
<td>0.26</td>
</tr>
<tr>
<td>Cooperative</td>
<td>4.1</td>
<td>0.43</td>
</tr>
<tr>
<td>Constructive</td>
<td>3.5</td>
<td>0.33</td>
</tr>
<tr>
<td>Authentic</td>
<td>3.8</td>
<td>0.36</td>
</tr>
<tr>
<td>Intentional</td>
<td>3.6</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Developing classroom environments that are cooperative and authentic were held to be particularly important to participants whereas active learning did not seem to rate as highly. Figure 4.3 shows the mean scores for the five items of the questionnaire on the Active learning subscale.

Figure 4.3. Participants’ degree of resonance (n=35) with the Active dimension of learning (Year 1 Pedagogical Beliefs Questionnaire).
The Active learning subscale contained two items that supported the identified attributes of meaningful learning (1 and 3) and three that did not (2, 4 and 5). Three of the 5 items on this scale registered mean scores that were less than the median value for the questionnaire:

- **Item 2, Learning mostly involves accessing and understanding factual information.** This statement does not support active learning and yet only 10 respondents disagreed and 1 respondent strongly disagreed (mean=2.9).

- **Item 3, Students’ mistakes are usually caused by a lack of practice.** This statement supports active learning, the implication being that practice (e.g. actively solving problems) can help to minimise errors in understanding. Only 8 respondents agreed and 1 strongly agreed (mean=2.6).

- **Item 4, Being able to memorise facts and procedures is important for learning.** This statement implies that committing facts and procedures to memory, by implication without critique or deeper cognition, is important. This does not support active engagement in the learning process and yet only 11 respondents disagreed and no one strongly disagreed (mean=2.9).

Responses to these items had an effect of reducing the overall mean of the Active learning scale. Other items in the scale did not attract particularly strong ratings (item 1 mean=3.1; item 5 mean=3.7).

Figure 4.4 shows the results for the six items of the questionnaire on the Cooperative learning subscale.
The Cooperative subscale was the most positively oriented towards the identified attributes of meaningful learning, recording an overall mean of 4.1. The subscale contained four items that recorded mean scores of 4.0 or above. Item 10 (Effective teaching involves class discussion in which students share ideas and negotiate meaning) recorded a particularly high mean of 4.5.

Figure 4.5 shows the results for the 12 items of the questionnaire on the Constructive learning subscale.

The Constructive subscale contained 7 items that supported the identified attributes of meaningful learning and 5 that did not. Four of the 12 items on the Constructive learning scale registered mean scores that were less than the median value for the questionnaire. All of these were negatively oriented towards the identified attributes of meaningful learning.
12. Learning mostly involves creative thinking
13. There are often several different ways to interpret something
14. Effective teachers show students the proper procedures to answer questions
15. Students should be encouraged to build their own ideas, even if their attempts contain much trial and error
16. Effective teachers provide students with solutions to problems
17. Students' errors often reflect their current understandings of ideas or procedures
18. Learning is about getting to the truth
19. Learning is enhanced if students are encouraged to use their own interpretations of ideas and their own procedures
20. Learning periods of uncertainty, conflict, confusion or surprise when students are learning
21. Effective teachers value periods of uncertainty, conflict, confusion or surprise when students are learning
22. Students learn best if they are shown clear, precise procedures for doing things
23. The role of the teacher is to provide students with activities that encourage them to wonder about and explore their subject

Figure 4.5. Participants’ degree of resonance (n=35) with the Constructive dimension of learning (Year 1 Pedagogical Beliefs Questionnaire).
Items 14, 15 and 17 and 22 (Effective teachers show students the proper procedures to answer questions; Students learn by being shown the correct ways to interpret symbols and situations; Effective teachers provide students with solutions to problems; and students learn best if they are shown clear, precise procedures for doing thing) have some commonalities. These items insinuate that there are a set of proper and correct ways of solving problems and arriving at solutions, and that teachers hold this knowledge. These views run counter to the identified attributes of meaningful learning. For items 14 and 15, only 5 respondents disagreed and no one strongly disagreed (item 14 mean=2.3, item 15 mean=2.4). For item 17, 10 respondents disagreed and 1 strongly disagreed (mean=2.9). For item 22, 8 respondents disagreed and 1 strongly disagreed (mean=2.7).

Item 23 of the Constructive subscale (The role of the teacher is to provide students with activities that encourage them to wonder about and explore their subject) recorded a particularly high mean of 4.6. All respondents either agreed or strongly agreed with this statement.

Figure 4.6 shows the results for the 8 items of the questionnaire on the Authentic learning subscale. This subscale tended to support the identified attributes of meaningful learning recording and overall mean rating of 3.8. Two of the 8 items recorded means of 4.0 or above: item 27 (Effective teachers show students lots of different ways to look at the same question) and item 30 (The use of physical objects and real life examples to introduce ideas is an essential component of learning). Item 27 recorded a mean score of 4.5 (19 respondents agreed and 16 strongly agreed) while item 30 registered a mean score of 4.6 (15 agreed and 20 strongly agreed).
24. Problems presented should be solved in one consistent way.
25. Solving a problem usually involves finding a truth, rule or formula that applies.
26. Effective teachers regularly devote time to allow students to find their own methods for solving problems.
27. Effective teachers show students lots of different ways to look at the same question.
28. Effective teachers teach only what is important for assessment.
30. The use of physical objects and real life examples to introduce ideas is an essential component of learning.
31. Engaging with lots of problems is the best way for students to learn.

**Figure 4.6.** Participants’ degree of resonance (n=35) with the Authentic dimension of learning (Year 1 Pedagogical Beliefs Questionnaire).
One item in the Authentic learning subscale, which was antagonistic to the identified attributes of meaningful learning, recorded a mean score of less than the overall median of 3.0. Item 29 (*Effective lessons progress step-by-step in a planned sequence towards the lesson objectives*) implies a structured, teacher-centred conception of learning; only 5 respondents disagreed with this proposition (mean=2.5). It is possible that participants may have perceived this item as indicating the importance of organisational skills rather than adopting teacher-centred practices.

Figure 4.7 shows the results for the four items of the questionnaire on the Intentional learning subscale.

This subscale contained 1 item that ran counter, and 3 that supported the identified attributes of meaningful learning. The 3 positively oriented statements all recorded mean scores of above 4.0. Item 33 (*Regular assessment against curriculum outcomes is an effective way to monitor student progress*) which is negatively oriented implies that curriculum outcomes rather than students’ own goals should be set at the centre of the learning design, and therefore could be considered contrary to the ideal of
encouraging student ownership of the learning process. However, regular assessment is clearly an important part of the learning process which may have been why this item recorded a mean of 2.0 which was the lowest mean score in the questionnaire. Only one respondent disagreed.

It is interesting to note that, of the 9 items that recorded mean scores of less than the overall median of 3.0, 8 were antagonistic to the identified attributes of meaningful learning. Two were concerned with the value of factual information over conjectural knowledge, 5 dealt with the teacher applying procedures and structure to the learning environment as opposed to encouraging learner-centred problem solving, and 1 was about a focus on assessing student progress towards curriculum outcomes (rather than progress towards learner goals).

Overall, the results for the quantitative component of the questionnaire would seem to indicate that participants in the research held views that were supportive of the identified attributes of meaningful learning. If participants were true to their stated ideals, they might be expected to exhibit active, cooperative, constructive, authentic and intentional approaches to their teaching. Their use of ICT could also be expected to reflect an emphasis on these identified attributes of meaningful learning. However, this was not the case in the first year of participants’ teaching. Possible reasons for this are discussed later in this chapter under 4.5 Relationships among pedagogical beliefs, knowledge, dispositions and skills in using ICT.

4.2.1.2 Qualitative aspects of the questionnaire

To augment the quantitative data collected, the questionnaire also posed five open-ended questions derived from an instrument developed by Fives and Buehl (2005). These questions were designed to add richness to the study, providing respondents
with opportunities to articulate their philosophies of teaching and the underpinning knowledge that they believed was necessary for effective teaching.

In reporting findings from qualitative data, three numbers are displayed after quotations. The first relates to the numerical identity of each of the 35 participants; the second denotes a unique paragraph identity for the quotation in the qualitative data base; the third (in square brackets) relates to one of the 38 nodes or coding categories that were used to analyse the data.

With regard to underpinning knowledge, the question (39) *What knowledge is necessary for effective teaching?* was posed. Most participants communicated more than one type of knowledge in responding. For example:

Pedagogical content knowledge (knowledge about your subject and knowledge about how to effectively teach your subject). (12, 221, [30])

This indicates that Participant 12 felt that both content knowledge and pedagogical knowledge were necessary ingredients for effective teaching.

A total of 68 specific types of knowledge were offered in response to the question, and these knowledge-types were organised into 8 categories as shown in Figure 4.8. Three responses were not deemed to constitute knowledge and therefore were deleted from the analysis. These were motivation (2 responses) and self-confidence (1 response).
The data indicates that participants’ beliefs about the knowledge required for effective teaching centred mainly on four categories: pedagogical knowledge (34% of responses), content knowledge (31% of responses) and knowledge of students’ needs (16% of responses). As might be expected with beginning teachers, behaviour management also featured with 10% of responses indicating that this was important. It is significant that no participant mentioned technological knowledge.

Two open-ended questions also invited respondents to articulate their teaching philosophy: (36) To you, what is teaching and (40) Describe the important components of your philosophy of teaching. Of the 35 respondents, 34 provided an answer to question (36) and 31 responded to question (40).

Table 4.2 shows some typical responses in relation to the identified attributes of meaningful learning. It is interesting that many of the responses reflect the language and content of current undergraduate education programs in Australia.

Figure 4.8. Participants’ responses to question 39 of the Pedagogical Beliefs Questionnaire: What knowledge is necessary for effective teaching?
### Table 4.2: Participants’ Philosophies of Teaching as Articulated in the Questionnaire (Year 1) in Relation to Jonassen, Peck and Wilson’s (1999) Attributes of Meaningful Learning

<table>
<thead>
<tr>
<th>Attribute: Learning is…</th>
<th>Typical responses when asked: (36) To you, what is teaching? and (40) Describe the important components of your philosophy of teaching?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>Providing opportunities for children to explore the world and make meaning of it. (2, 317, [31])</td>
</tr>
<tr>
<td></td>
<td>Teaching is facilitating learning activities that engage and motivate students to explore, understand and learn about themselves and the world, as well as important content and concepts. This ultimately helps the students gain knowledge that will empower them to participate actively in the world around them. (23, 332, [31]). All students should be given the opportunity to extend their learning and capabilities, by being provided with challenges and encouragement.</td>
</tr>
<tr>
<td>Constructive</td>
<td>I believe in finding out what the students already know on a topic, exploring that topic with them then extending that knowledge into other areas. (5, 388, [31])</td>
</tr>
<tr>
<td></td>
<td>Providing activities that scaffold learning for children and build on the knowledge they already have. (27, 233, [31])</td>
</tr>
<tr>
<td></td>
<td>Challenge students in their zone of proximal development so they remain engaged. Give them the opportunity to become independent learners and encourage a love of learning so that they remain lifelong learners. (34, 447, [31])</td>
</tr>
<tr>
<td>Cooperative</td>
<td>Children learn in collaborative situations where they can share ideas and learn from each other. (27, 245, [31])</td>
</tr>
<tr>
<td></td>
<td>Learning is best done collaboratively as that way they can learn from each other. They will get more ideas if they are working with others. (28, 16, [31])</td>
</tr>
<tr>
<td>Authentic</td>
<td>Teaching is helping students learn about the world around them how to survive in society and be successful. (17, 152, [31])</td>
</tr>
<tr>
<td></td>
<td>Introduce topics with tangible and interesting stimulus. (26, 242, [31])</td>
</tr>
<tr>
<td>Intentional</td>
<td>Students should be involved in the teaching process. (28, 15, [31])</td>
</tr>
<tr>
<td></td>
<td>…plan for students’ needs and interests. (8, 450, [31])</td>
</tr>
</tbody>
</table>

The Pedagogical Beliefs Questionnaire introduced 13 teacher goals that had been identified as important by Fives and Buehl (2005):

- Equality among students
- Student creativity
- Instruction based on students’ interests
- Student independence
- Critical thinking in students
- Lifelong learning
- Generalised skills and abilities
- The process of learning

Respondents were asked to rank their top five goals in order of importance. To analyse these results, a respondent’s highest ranking goal was afforded a score of 5; their second choice a score of 4; their third choice attracted a score of 3; fourth choice scored 2 and fifth choice, 1. The results are presented as Figure 4.9.

![Pie chart showing the distribution of teacher goals]

**Figure 4.9. Participants’ views of the most important teacher goals (Year 1 Pedagogical Beliefs Questionnaire, n=35).**

These results indicate that participants valued lifelong learning (23.9%), student independence (13%), the process of learning (12.4%) and critical thinking (11.8%) in
students above all other listed teaching goals. These teacher goals would suggest that respondents to the questionnaire were open to empowering their students to take control of their learning, setting their own goals, and engaging in independent problem-solving.

These forms of student-centred learning corroborate results from the quantitative aspects of the questionnaire which broadly complied with the identified attributes of meaningful learning.

The literature suggests that teachers who adopt practices that emphasise student-centred construction of knowledge are likely to use ICT more often (Becker, Ravitz, & Wong, 1999; Ravitz & Becker, 2000). The results gathered in the first year of the present study indicated that participants claimed to hold beliefs and possess knowledge that might underpin these practices.

4.2.1.3 Consistency across variables of sector, gender, location and employer

The results of the Pedagogical Beliefs Questionnaire are now scrutinised to determine whether there are consistencies across the following variables:

- Employment by sector (primary and secondary).
- Gender.
- Location of school (metropolitan or rural/remote).
- Employment in private or public sector schools.

Responses to the Pedagogical Beliefs Questionnaire in Year 1 included participants from the primary (n=25) and secondary (n=10) sectors. An examination of the overall mean scores of participants by sector reveals that participants employed in the
primary sector tended to hold views that were slightly more akin to the identified attributes of meaningful learning.

Figure 4.10 illustrates that secondary participants comprised 9 of the lowest 14 scores. The letter P on the graph denotes employment in a primary school whilst the letter S shows employment in a secondary school. Secondary participants’ specialist areas are also shown on the graph.

The learning area of technology and enterprise deals with knowledge and skills development associated with ICT. It is interesting that the two participants in this learning area were among the four participants least inclined to embrace the identified attributes of meaningful learning.

Table 4.3 shows a comparison of participants from the primary and secondary sectors on each of the subscales.
Figure 4.10. Spread of responses to the Year 1 Pedagogical Beliefs Questionnaire by sector.
Table 4.3: 
Mean Scores for Year 1 Pedagogical Beliefs Questionnaire Presented by Subscale (Primary and Secondary)

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Primary (n=25)</th>
<th>Secondary (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>3.1</td>
<td>2.8</td>
</tr>
<tr>
<td>Cooperative</td>
<td>4.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Constructive</td>
<td>3.6</td>
<td>3.2</td>
</tr>
<tr>
<td>Authentic</td>
<td>3.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Intentional</td>
<td>3.6</td>
<td>3.6</td>
</tr>
</tbody>
</table>

The Intentional subscale was the only one in which primary and secondary participants registered parity. Participants in secondary settings displayed a lukewarm attitude to Active learning, and were not as enthusiastic as their primary counterparts on the Cooperative, Constructive and Authentic subscales. The items of the questionnaire that registered greatest disparity between the responses of participants from the primary and secondary sectors are displayed in Figure 4.11.
All of the three items are antagonistic to the identified attributes of meaningful learning. Participants from the secondary sector appear to have agreed more decidedly with the items that challenged these attributes. Valuing independent (as opposed to collaborative) learning recorded a difference in mean between primary and secondary of 0.90 (item 6); providing firm direction in problem solving recorded differences in mean between primary and secondary of 0.88 (item 24) and 0.82 (item 25).

No differences in means were discerned in the Pedagogical Beliefs Questionnaire in Year 1 on variables of employment in the private or public sector, or location in metropolitan or regional areas. On the variable of gender, the overall mean for the questionnaire for female participants was 3.6 (n=26) compared to male participants at 3.5 (n=9). A slight difference in mean was noted on the Cooperative subscale (female=4.1, male=3.7). The three secondary male teachers registered a mean on this subscale of 3.4 whilst the six primary male teachers registered a mean of 3.9.
Although the number of male respondents to the questionnaire was low, and subsequent inferences should be treated with caution, it may be that male secondary teachers are less likely to value cooperative learning.

In the main, participants in the study claim to hold beliefs and possess knowledge that are in tune with contemporary, student-centred theories of learning. However, it would seem that there are differences between primary and secondary participants.

4.2.1.4 Relationship between epistemological and pedagogical beliefs

As discussed in Chapter 2, research has shown that teachers may hold multiple beliefs that are both domain-general and domain-specific (Buehl & Fives, 2009). The relationship between domain-general and domain-specific beliefs is of particular interest to this study.

As described in Chapter 2, Buehl and Fives (2009) recently examined teachers’ beliefs about the source of knowledge, concluding that the knowledge comes from the six categories: formal preparation (e.g. university), formal bodies of information (e.g. books and the Web), observational and vicarious experiences (e.g. observing others), interactive and collaborative experiences with others (e.g. communicating with peers), enactive experiences (e.g. teaching) and self-reflection (e.g. action learning).

The Pedagogical Beliefs Questionnaire posed an open-ended question that was aimed at understanding participants’ beliefs about the source of knowledge: (37) *Where does knowledge of how to teach come from?* It is important to note that teachers might assign the source of their knowledge to more than one of the categories identified by Buehl and Fives. The following response to the questionnaire exemplifies this:
Knowledge of how to teach comes from a range of sources, which include formal training (university), speaking to and watching other teachers, mentors, colleagues, practical experience and intuition. (23, 335, [30])

In analysing these data, the number of comments assigned to each category was aggregated for each participant (if applicable) before being further aggregated for the entire data set. Individual participants, therefore, may have contributed to just one or multiple categories. The results are provided as Table 4.4.

Table 4.4: Year 1 Responses to Question (37) of the Pedagogical Beliefs Questionnaire: Where Does Knowledge of How to Teach Come From? Sorted by Categories Developed by Buehl and Fives (2009) (n=35)

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of responses</th>
<th>Proportion of total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External source</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Formal preparation</td>
<td>24</td>
<td>27%</td>
</tr>
<tr>
<td>2 Formal bodies of information</td>
<td>9</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Socially constructed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Observational and vicarious experiences</td>
<td>6</td>
<td>7%</td>
</tr>
<tr>
<td>4a Collaborative experiences in learning with others</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>4b Interactive experiences in learning from others</td>
<td>12</td>
<td>14%</td>
</tr>
<tr>
<td><strong>Individually constructed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Enactive experiences</td>
<td>26</td>
<td>29%</td>
</tr>
<tr>
<td>6 Self-reflection</td>
<td>9</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total number of responses</strong></td>
<td>89</td>
<td>100%</td>
</tr>
</tbody>
</table>

Broadly, 37% of comments suggest that knowledge can be ascribed from external sources, 24% say that it is socially constructed and 39% indicate that it is individually constructed. Buell and Fives (2009) suggest that teachers’ beliefs in where knowledge
comes from is potentially important to teaching practices. For example, the authors argue that stronger beliefs in authority as a source of knowledge has been linked with lower levels of student motivation. Given that 37% of responses to this question suggest that knowledge comes from external sources, there appears to be an uncomfortable fit between participants’ epistemological beliefs as derived from this question and their pedagogical beliefs as responded in the quantitative components of the questionnaire. In particular, the prevalence of knowledge as being perceived as coming from formal preparation (27%) would seem to be antagonistic to notions that individuals construct knowledge either socially and/or through their own actions and experiences. How the participants learnt themselves was different to how they conceived that learning should take place.

4.2.2 Beliefs and knowledge in relation to ICT integration

Participants’ beliefs and knowledge in relation to ICT were explored at the inception of the research during interviewing in the first year (28 interviewed), followed up in the second year (16 interviewed) and again in the third year (14 interviewed). This section will discuss teachers’ beliefs about ICT at the inception of the study.

Two core questions regarding beliefs about ICT were posed to participants in Year 1: Do you believe that ICT makes a difference to the way teachers teach? And, do you believe that ICT makes a difference to the way students learn?

4.2.2.1 Beliefs and knowledge about ICT and teaching

In answering the first question participants tended to focus on the capacity of ICT to make teaching easier (15 participants specifically mentioned the word “easier” in their responses). This is consistent with literature that has found that most teachers
use ICT to make the administration of the teaching and learning environment easier or quicker (Fishman, Marx, Blumenfeld, Krajcik, & Soloway, 2004; Maddux, LaMont Johnson, & Willis, 2001). The availability of web resources, in particular, was attractive to participants:

I think it makes teaching a lot easier. You have a lot of resources through the Internet at your disposal. (20, 39, [20])

You can get resources more easily. You can structure your lessons. (33, 7, [20])

It makes teaching a lot easier to access resources and you need to create a lot less stuff because there's such a wealth of stuff available for you and it is easier not to reinvent the wheel. (35, 7, [20])

These responses suggest that participants, at the inception of the study, held a worldview of ICT that largely equated accessing web resources through computers. Although participants claim to have had beliefs that equated to student-centred learning, most did not see the guided student use of ICT as a vehicle to achieve this. Kirschner et. al. (2006) criticise student-centred approaches to using ICT in the classroom. It may be that participants exhibited an intuitive understanding of the challenges of using ICT to put their constructivist beliefs into practice. Certainly, if governments wish to promote the student-centred use of ICT, then it would seem that professional learning in this area is critical.

It is interesting that a key technology that emerged during this study (the interactive whiteboard) was mentioned by only 2 participants in considering whether ICT made a difference to the way they taught, and yet for at least 11 participants interviewed this technology was to fundamentally change their teaching approach. The interactive whiteboard is a relatively recent ICT in Australia and increases in student motivation may be due to a novelty effect. Further, some warn of the propensity of interactive whiteboards to support a presentation mode of teaching (Knight, Pennant, & Piggott,
2004; McCormick, 1992). However, observations conducted in the current study confirmed a sustained use of whiteboards in interactive and communicative ways in addition to a widespread practice of demonstration prior to student activity.

4.2.2.2 Beliefs and knowledge about ICT and learning

When asked whether participants believed that ICT made a difference to the way students learn, responses tended to centre on two themes: student motivation and learning styles.

At interview in Year 1 there was a widespread view amongst participants that ICT generated heightened levels of excitement in the classroom:

I know that by taking them to the library they were just so much more excited to be on a computer and doing what they enjoy doing rather than sitting there and reading a book or writing. Yes their attitude changed 100 per cent. (12, 144 [13])

I can see how excited they get by using technology. I think they are not interested in using books. They are more motivated to learn and be focused by using technology. (20, 154 [13])

Participants linked this generic sense of excitement to increased levels of motivation and sustained task-oriented engagement:

Yesterday when I accessed the laptops and the children got on and researched their animals they were so much more excited about that. They were so engaged that they could actually go on the Internet and look up their animal, see pictures of them and get information. (4, 212 [13])

The engagement of the students is a big thing here. I have four boys and if you mention computers they are automatically awake. You mention writing something and they are all dramatically snoring. (5, 54 [13])

These sentiments are consistent with literature which reports that ICT has a great potential to engage and motivate the emerging digital generation (Ainley, Enger, & Searle, 2008; Dede, 2008; Sutherland, Robertson, & John, 2009).
According to participants who had access to an interactive whiteboard, this technology was responsible for a sharp and immediate increase in student motivation, even if implemented in a teacher-centred manner:

I was saying before you only have to put the whiteboard on and immediately they're paying attention. So there is some motivation in that. (35, 102, [13])

I can say that when we got the Smartboard they thought it was magic. They were just engaged the whole time. As soon as I use it and they interact with it, they are so much more switched on. And they actually want to do it and they're focused more. (34, 206 [13])

Other studies have also noted that the interactive whiteboard has been particularly effective in engaging students in learning (Merrett & Edwards, 2005; Miller & Glover, 2002).

Although there was general acceptance of the motivational qualities of ICT, participants in Year 1 of the study were a little cautious about making the link between increased levels of motivation/task-oriented engagement and deeper levels of learning. There was a sense that, if not implemented well, ICT had the potential to actually detract from learning:

They may be able to get the information faster but I still find with the technology it doesn't necessarily go deep. You get all this information, but do you really understand it? (33, 152, [14])

They definitely learn faster, but not necessarily deeper. Some students will go for a quick copy and paste and nothing is retained so you need to give them an avenue to learn deeper. (35, 142, [14])

It’s like anything else. Unless you channel it and scaffold it, you will get a lower quality outcome no matter what tools you’re using. But if you’re nudging them in the right direction then they are going to get more out of it. (5, 62, [14])

These comments suggest that participants felt that teachers had an important role in facilitating learning with ICT, to help ensure that learning outcomes are achieved. However, it is telling that no participant mentioned working with students on
complex projects (e.g. webquests) or promoting activities that involved high levels of student ownership (e.g. e-portfolios).

Notwithstanding this, participants did feel a keen responsibility to ensure that they used ICT to tap into affordances that may support visual, auditory and kinaesthetic learning styles:

It is something that is visual, that will get their adrenalin moving a lot more quickly than sitting back and watching me do something. I also find that it helps the students who want to be more hands on and practical. (17, 25, [13])

I guess the computer is just another way of presenting it. Kids who learn better when they have a visual input - that helps them. You can also have audio and things like that so that helps for kids to learn in that way. You can open up more avenues as to where the kids can go. (23, 179, [14])

The data suggest, then, that participants held strong beliefs about the capacity of ICT to motivate and engage students. Participants also felt that ICT had potential in being able to help mediate material that taps into a range of learning styles. There was a sense, however, that the teacher had a crucial role in managing ICT environments and scaffolding learning, and that if this was not done effectively learning could be peripheral and off-task. The extent to which these fears became a reality is discussed in Chapter 5, Findings: Socio-cultural settings for ICT use.

### 4.3 Dispositions

This component of the research focuses on teachers’ attitudes and perceptions as they relate to pedagogy and ICT use. Pedagogical beliefs have been identified and discussed as a specific construct, and therefore teacher dispositions will be examined in terms of participants’ attitudes and perceptions about ICT use. Perceptions about ICT use include perceptions about participants’ own use of ICT and perceptions about the ICT environment in which they operate.
4.3.1 Attitudes towards ICT

According to Simpson, Koballa, Oliver, and Crawley (1994), attitudes are specific feelings that indicate whether a person likes or dislikes something. Attitudes are readily changeable and research has shown that beliefs, premises or suppositions about something that are felt to be true (Calderhead, 1996), determine a person's attitude (Bodur, Brinberg, & Coupey, 2000).

Data on participants’ attitudes towards ICT were collected at the inception of the study through the Pedagogical Beliefs Questionnaire. The open-ended question, item 41, *How would you describe your attitude toward information and communications technologies (ICT) in teaching and learning?* was posed and 32 of the 35 respondents offered an answer. Of these, 31 participants exhibited a positive and enthusiastic attitude toward ICT:

- Love it! Would like to use more, but need more training. (2, 332, [30])
- Positive and enthusiastic. Love to incorporate and use them. Have a good grasp of hardware, just need to wade through and build a resource base. (26, 245, [30])

It is clear that some participants indicated that they need to know more about how to best integrate ICT. Some felt that they needed more training and others indicated that they could learn through experience by developing their own resource-base.

Some of the attitudes expressed in answering the question merged into what Calderhead (1996) might describe as beliefs. However, it is useful to consider some of these statements as they provide an important context as to why participants exhibited such positive attitudes. ICT was described variously as both a “useful tool” (1, 38 [30]) and “the way of the future” (4, 427 [30]) indicating that participants (a)
felt that ICT could assist them in their work and (b) saw it as part of a broader societal
trend that they needed to take account of:

I believe ICT has an important place in the classroom, especially in this
technological age. It should not be used as only a type of teaching method in the
classroom, but rather a tool to aid the further discovery of relevant information
as well as exploring other information. (25, 19 [30])

I feel I have a positive attitude towards ICT in teaching and learning, as
wherever possible I try to incorporate these technologies in my classroom. ICT
now must be utilised in the classroom as it is not only a necessary skill to learn,
but the children are constantly exposed to multimedia and as a consequence
respond and are more engaged when these technologies are used in the
classroom. (20, 421, [30])

Participants, therefore, demonstrated an almost unanimously positive attitude towards
applying ICT to teaching and learning. In a survey of primary and secondary teachers
conducted in the UK in 2006, Kitchen, Finch and Sinclair (2007) found that most
teachers felt that ICT could have a positive impact on student motivation and
attainment. It would seem that the positive attitude towards ICT that participants in
this study reported is also shared by teachers generally. For example, Sutherland,
Robertson and John (2009, p. 5) conclude that: “in theory, at least, the climate among
teachers appears to be favourable to incorporating ICT in teaching and learning.”

It is likely that the attitudes expressed by participants in this study are grounded in
beliefs that ICT is both useful to teachers and learners and that it is inextricably
linked to how we function in today’s digital society. However, the data collected at
interview and through the Pedagogical Beliefs Questionnaire suggest that although
participants claimed to be competent in the use of a basic suite of ICT tools, they felt
inadequate in their preparedness to harness ICT in the classroom to optimise learning.
This theme is now explored further by examining how participants felt about their
ability to use ICT in the environments in which they were situated.
4.3.2 Participants’ self perceptions

During interviewing in Year 1 of the study, questions aimed at gaining an understanding of participants’ self-perception of their competence in using ICT for learning, were posed. Participants were asked how competent they were at mastering ICT itself, adopting appropriate teaching approaches using ICT and stretching the limits of innovative teaching using ICT. A four point Likert-type scale was used to collate the data. Categories offered to participants included 3=very competent, 2=reasonably competent, 1=a little competent and 0=not at all competent. All 28 of those interviewed in Year 1 responded to the questions. A mean score was calculated for each of these three categories and results are presented as Figure 4.12.

\[\text{Figure 4.12. Participant levels of competence on three aspects of harnessing ICT (n=28).}\]

The optimum mean for these items is 3.0, so clearly participants felt reasonably competent in mastering ICT and using ICT appropriately in the classroom. The area in which participants felt less competent was in stretching the limits of innovative teaching using ICT. This was confirmed in subsequent comments during interviews.
which revealed that participants were looking for opportunities to expand their ongoing understanding of the possibilities of ICT integration:

It comes down to a little bit of a lack of imagination I think. The things that I could be doing but I don’t know so I’d like to learn a little bit more about what is possible and how to utilise that in the classroom. (5, 223, [29])

I would like to find more about what is out there. There is so much and you just want to get the best and you are not really sure of what you are getting and what you’re teaching them is right because what we are teaching them today could be reinvented tomorrow. Keeping up with all the new technologies. (8, 223, [29])

To see where I can use things more in the classroom. What is available? What is appropriate for my kids? What is out there and how can I access it? (2, 136, [29])

Sentiments about “keeping up with new technologies” and “wanting to learn more about what is possible” indicate that participants believe that they already have competence in which to build from. Further, these comments suggest a desire, enthusiasm and confidence to be able to extend their knowledge. This strongly correlates with data from the questionnaire on attitudes towards ICT.

Research has shown that teachers’ vicarious experiences can have an impact upon beliefs and practices (Ertmer, 2005). Participants were asked about their vicarious experiences in the first round of interviewing through the question “What is the best use of ICT you have ever seen?” The results are shown as Figure 4.13.

The results indicate that participants’ knowledge of the innovative use of ICT was limited. The three major response categories – the interactive whiteboard, web simulations/interactions and teacher use of PowerPoint – accounted for 78% of the best applications of ICT the participants had ever seen. The absence of tools to facilitate creative student production of knowledge was limited to three examples of the use of Photostory, MovieMaker and Robolab (now Lego Mindstorms), but reference to complex problem-solving (e.g. webquests) or collaborative tools (e.g.
wikis) were absent from the study. With limited vicarious experiences, it is not surprising that participants felt that their knowledge-base was lacking in creative uses for ICT stretching the limits of innovative teaching.

![Pie chart showing participant experiences of ICT]

Figure 4.13. Participants’ vicarious experiences of ICT (n=28).

4.3.3 Participants’ perceptions about their environment

In the first round of interviewing, participants were quizzed on the affordances of their school environment and also asked whether there were any constraints or restrictions that influenced whether, when, and how they used ICT. Participants’ responses fell into two categories: perceptions of contemporary students, and perceptions of the physical environment at the school.

4.3.3.1 Perceptions of contemporary students

Participants communicated a range of perceptions about their students. The most frequently expressed insights are shown in Table 4.5 with some example quotations.
Table 4.5: 
*Participants’ Perceptions of the Impact of ICT on Their Students*

<table>
<thead>
<tr>
<th>Insight</th>
<th>Example quotation</th>
</tr>
</thead>
</table>
| Varied ability levels in the use of ICT | The levels really vary. I’ve got some kids who know more than I do on computers and other kids who don’t even know how to turn a computer. (10, 94, [10])  
I would say that of my class of 22, about 7 or 8 would know how to turn a computer on, how to search the Internet, how to shut it down. I don’t think there is as many as I would have expected. (4, 73, [10])  
All students should be given the opportunity to extend their learning and capabilities, by being provided with challenges and encouragement. |
| Propensity of ICT to be distracting | I am concerned with the distractions that it brings. It takes away from the teaching. It might be a good thing for some of the kids, but for other kids they don’t like it. They like to be told “this is what you need to do.” (13, 55, [10])  
If you’ve got them on the computers they could so easily be doing something off task. (9, 135, [10]) |
| Tendency of students to offload cognitive tasks such as spelling and grammar | I have to get them to remember to go through their work first and check it before they start to type because they slump in a spelling otherwise. So I say “check your spelling first rather than rely on the computer to check your spelling.” (5, 172, [10])  
A lot of them think that the spell checker will fix it for them. (12, 15, [10]) |
| Inappropriate use of the Web | What I’m finding is they are taking information, and they are putting that information on to a bit of paper but there is no thought process in between. That is doing nothing. You are achieving nothing. It is information to information, and there is nothing in between. (33, 215, [10])  
There is an assumption that everything on the Internet is correct and kids need to understand that this is not the case. (2, 87, [10]) |
| Loss of other non-ICT skills and abilities | One of the negative impacts of ICT is that if they are using it too much then they’ll miss out on play. And these are things that kids should do at a certain age or else they will become dependent on it. (18, 115, [10])  
I think one negative effect is their writing skills. They are now abbreviating words and changing words. So I think they are losing some English skills. (20, 158, [10])  
The face-to-face, one-on-one interaction is going in the meantime. If there is one thing that you need to know in life is how to talk to people. You need to be able to read and write as well to be able to get anywhere, but you also need to be able to talk to people. (21, 170, [10]) |
The sentiments reveal that participants are not evangelistic about ICT integration and recognise that there are a range of issues associated with the effective use of ICT in the classroom. This is consistent with literature that suggests that beginning teachers are more cognisant of the negative impacts of ICT than their more experienced counterparts (Russell, Bebell, & O'Dwyer, 2005).

### 4.3.3.2 Perceptions of the physical environment at the school

The question of whether there were constraints or restrictions that influenced participants use of ICT, also promoted responses about the physical environment at the school. Responses centred on issues of availability and reliability of ICT infrastructure.

Of the 28 interviewed in the first year, 11 specifically mentioned availability of ICT as a problem, and 7 suggested that there were deficiencies in the reliability of ICT infrastructure. Of these 18, 17 worked in public sector schools and 1 was employed at an independent school.

In terms of availability, the perceived lack of access to computers was a major issue for participants:

> For me it's the funding and the lack of computers. These are the main issues. I think that as far as this school is concerned Art in IT is not a priority. IT and some of the other subjects will come first. (3, 228, [10])

> All schools don’t have the same ICT. As you can see here I only have a couple of computers. We don’t have a projector here. We don’t have an interactive whiteboard. All these kinds of things I would really like to use in my classroom. (8, 9, [10])

> At the school that I am in, there are a couple of computers and a couple of games. I guess they are equipped but not well equipped. (18, 81, [10])

All of the schools in which participants were interviewed had a central facility (typically one or more computer laboratories) where participants could plan for, and
book, student access. However, there were problems identified in booking these facilities. There was a perceived pecking order with IT classes seeming to be at the top of the list. This impacted on participants’ enthusiasm:

The teachers who teach IT have already booked those rooms. They have a priority. And then you have got the English teachers who have booked it for their classes, so they have the second priority. So it basically comes down to hierarchy and we are somewhere at the bottom. I would have to give them at least 2 or 3 weeks’ notice. (3, 244, [10])

I am not able to get into the computer lab. They are mainly teaching IT skills. (20, 49, [10])

It is perhaps easy to dismiss these comments as isolated examples of disenfranchised teachers. However, a recent study (Phelps & Maddison, 2008) of visual arts teachers in New South Wales, Australia, also points towards teachers in marginal learning areas like visual arts and languages feeling frustrated by the perceived inequities in the way in which ICT resources were distributed throughout the school.

The lack of ICT infrastructure in many classrooms (i.e. at the point of need) was thought to compromise the potential learning that could take place:

You have to book it so there is no incidental learning with it. You pre-plan everything. If something did come up in a class and you just want to research it and do it on a Smartboard then this is not necessarily going to happen. (19, 103, [10])

It was difficult to determine whether perceived issues of reliability were hardware, software or network related. However, from a teacher perspective, the underlying cause was irrelevant. If the infrastructure was perceived as not being reliable, then this constituted a barrier:

The only constraint would be when they are not working and are not up and running. We have just had new upgrades in the school. It has taken a very, very long time to get everything working properly. So that’s been a setback as to why I have not used them. They are not always reliable. You can be using one and it would switch off just like that. (4, 121, [10])
Computers are not always a reliable thing to use. Sometimes you can’t access a site. Sometimes the computers just don’t work. (19, 95, [10])

On the face of it ICT infrastructure could be seen as the single most significant barrier to ICT integration for many of the participants in the study. However, this barrier may be masking a deeper issue of the priorities of the school leadership. During interviews in Year 1, participants were asked whether their peers shared their perceptions and beliefs about ICT. One of the impressions that emerged from this question was that participants generally perceived themselves as a minority with regard to their propensity to use ICT, and that age was an issue in determining whether a teacher used or rejected ICT:

I think I am different. I think there is an age issue because since they have not grown up with computers they’re not as familiar or as comfortable with computers as I am. Sometimes they don’t even think of using the computer and this is something that they could do so quite easily. Whereas I think computers are much easier and if I can use them I do. (9, 97, [16])

I think the new younger teachers are fine, but I do know that older teachers who did not grow with technology find it hard to integrate that into their teaching. I grew up with computers and I don’t have a problem with it. (18, 17, [16])

A lot of them have very little knowledge. The older teachers have no idea to tell you the truth. (29, 100, [16])

During the study, 11 interviews with principals or deputy principals were conducted (6 in Year 1, 4 in Year 2 and 1 in Year 3). Comments from principals/deputy principals in Year 1 confirm that beginning teachers were seen to have a critical role in assisting schools to respond to the challenges of ICT:

I think the leadership role comes in the way that they embrace it, and the way that they promote it amongst the school as a fantastic way for learning and teaching. That is what I think their role is. Because a lot of them are open to change and have that enthusiasm. They probably have that familiarity with it as well. (2P, 50, [34])
This principal exhibited views that were representative of most school leaders interviewed during the research acknowledging the skills and appetite of beginning teachers for using ICT. The following comment from a principal reveals how he manufactured what he saw as a win-win situation where novice and experienced teachers could work together and both learn from the experience.

[The participant] has a partner teacher in Year 4 who is very hesitant with the use of ICT. So [the participant] was strategically placed in order to brush shoulders and show and demonstrate and all of the rest of it. And it has worked. Because we are a double stream school we have the opportunity to pair up those who are highly competent and those who may not be so or reluctant to, and that can make the journey much easier. So there is a positive outcome: a new graduate, highly competent in ICT, working with a teacher and moving them on. (23P, 138, [34])

Results, then, show that participants in the study exhibited positive attitudes towards ICT integration and self-perceptions that appraised themselves as having the ability to use ICT. Participants were attracted to using ICT in their classrooms, but an absence of infrastructure provided by schools, particularly public schools, and a lukewarm interest exhibited by their peers was interpreted by participants as evidence that a cautious approach to ICT integration was appropriate at an early stage of their career.

### 4.4 Skills

Mishra and Koehler (2006) argue that contemporary teachers should strive to combine their content, pedagogical and technological knowledge in interpreting subject matter, finding different ways to represent it and make it accessible. This study is interested in how technological knowledge manifests itself in the classroom. For the purposes of this study, participants’ skills are gauged by how ICT is integrated rather than how adept they might be at operating particular software
applications. This is consistent with recent research that views ICT integration as an advanced form of technological knowledge (Buehl & Fives, 2009).

It has been established that participants felt competent in mastering ICT and using ICT appropriately in the classroom. In the first year of interviewing, participants were asked how they actually used ICT in the classroom. Twenty seven participants answered this question and 8 were observed in the classroom 3 to 4 months after the interview as a way of triangulation to determine whether these self-perceptions were accurate. Responses for the 8 participants that were observed along with a summary of the way in which ICT was used in each of these lessons are provided as Table 4.6.

The results of the observations conducted in the first year show that participants exhibited proficient ICT skills in using interactive whiteboards and rotating groups of students through computers in the classroom. The focus of ICT use was typically on using web-based interactive games and using software as creative tools (in this case Adobe Premier and Microsoft PowerPoint).

Participants 2, 23, 24, 30 and 32 used ICT in the way that they described at interview: web-based interactive games and/or inquiry. Participant 22 also used ICT in the way in which was described at interview: to develop student skills in media studies. Participant 4 suggested that a focus on IT skills was appropriate for a Year 2 cohort. This focus partly emerged in the lesson observed (some students were enhancing their ability to use Microsoft Word). However, the use of a web-based interactive game was also observed. Participant 34 suggested that her main use of ICT was the interactive whiteboard in a classroom context. The lesson observed was in a computer laboratory.
### Table 4.6: 
**Responses to the Question “How Do You Use ICT?” by the 7 Observed Participants in the First Year of the Study**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Level</th>
<th>Response to the interview question “How do you use ICT?”</th>
<th>Lesson observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Pre-primary</td>
<td>I use it mainly for organisational purposes. I have things like my plans on the computer. Using it so that my kids can access it. Things like Internet sites. (2, 7, [20])</td>
<td>Lesson conducted using an interactive whiteboard. Class split into two groups, one of which used the interactive whiteboard and the other worked through a literacy activity. The interactive whiteboard was used to mediate a web-based interactive game (Mucky Monsters).</td>
</tr>
<tr>
<td>4</td>
<td>Year 2</td>
<td>Basic typing skills, how to log on, how to connect to the Internet, how to use search engines, and Word documents and things like that. I think once they learn how to do that then they can learn how to do other things. (4, 11, [1])</td>
<td>The teacher rotated students through three stations using 10 computers. Activities included a web-based interaction Rainforest Maths (6 machines), typing stories using Word (4 machines) and an audio listening station.</td>
</tr>
<tr>
<td>22</td>
<td>Year 8</td>
<td>To teach media studies and photography (22, 19, [10])</td>
<td>Participant gave a presentation on the use of Adobe Premier and then students formed groups of three to edit a video that they had previously made.</td>
</tr>
<tr>
<td>23</td>
<td>Year 4</td>
<td>There are brilliant sites out there that kids can practice on, just for skills. Some of the sites that I use on the Internet with interactive whiteboards are like that. It gives you the instant feedback. I think that is good for kids but I think it is good for reinforcing concepts. (23, 77, [24])</td>
<td>Participant used the interactive whiteboard to engage the class in a web-based activity using Rainforest Maths.</td>
</tr>
<tr>
<td>Participant</td>
<td>Level</td>
<td>Response to the interview question “How do you use ICT?”</td>
<td>Lesson observed</td>
</tr>
<tr>
<td>-------------</td>
<td>-------</td>
<td>--------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>24</td>
<td>Year 2</td>
<td>The computers we have in the classroom, we use them for games and stuff at the moment, and we also have structured computer time when we go to the computer lesson. Obviously we only have two so that’s difficult for a full class activity. (24, 27, [24])</td>
<td>Participant rotated class through 3 stations one of which involved 2 computers that were used to play educational games (either Reader Rabbit or KidsPix).</td>
</tr>
<tr>
<td>30</td>
<td>Year 4</td>
<td>I use ICT mostly at the moment as a research tool. Researching the Internet and then students putting things into PowerPoint and displaying them. (30, 81, [25])</td>
<td>Participant rotated class through 3 stations one of which involved 2 computers that were used to enhance literacy skills via an interactive website (Giggle Poetry).</td>
</tr>
<tr>
<td>32</td>
<td>Year 9</td>
<td>I would primarily use ICT for extension work at this stage for Japanese. I think with the computers using the Internet it allows the kids of a certain level to do an extension that will go over something that they have already learned. Then it gives me a chance to work more one-on-one with the kids that require a little remediation. (32, 41, [24])</td>
<td>Participant used interactive whiteboard to show a video and engage the class with a web-based instructional Japanese language game.</td>
</tr>
<tr>
<td>34</td>
<td>Year 4</td>
<td>I have access to the Internet and the Smartboard software and I can access that at any time in my classes so if something was to come up and we didn't know something I can quickly go to the net and my students can see me do that. (34, 11, [18])</td>
<td>Participant facilitated the class in a computer laboratory helping students working individually to develop a PowerPoint presentation.</td>
</tr>
</tbody>
</table>
The uses to which ICT were put into practice were therefore in tune with participants’ own perceptions of how they used ICT. The findings corroborate other data collected at interview suggesting that although participants perceived that they were competent in using ICT at a technical level, there were gaps in their knowledge-base on how to best harness it in the classroom.

Apart from the interactive whiteboard, the tools that teachers used in observations were not created to solve pedagogical problems (Zhao, 2003). In Mishra and Koehler’s (2006, p. 9) terms, the tools that participants were asked to work with required the teachers to “engage with the affordances and constraints of particular technologies in order to creatively repurpose these technologies to meet specific pedagogical goals of specific content areas.” This requires deep pedagogical-content-technological knowledge and it is probably unrealistic to expect beginning teachers to possess this level of knowledge at such an early stage of their career. However, it is significant that none of the 35 participants that completed the Pedagogical Beliefs Questionnaire in Year 1 even mentioned technological knowledge as being important in answering the question *What knowledge is necessary for effective teaching?* This compares with 34% of comments that considered pedagogical knowledge as important and 31% of comments that considered knowledge of content to be important. It seems that in Mishra and Koehler’s (2006) tripartite model, technological knowledge is not even considered by participants to be in the same realm as content knowledge and pedagogical knowledge. This theme will be further discussed in Chapter 7.

In summary, data gathered on ICT integration skills through observations indicates that participants were generally competent in using a basic skill set which revolved
around the use of the Web and/or presentation/word processing software. Apart from Participant 22, a media studies teacher seeking to develop students’ skills in video editing, participants did not promote the creative student use of ICT and therefore did not extend their own knowledge and skills to become more adept at integrating ICT into the curriculum.

Observations substantiated the self-perceptions that participants made of their own use of ICT. The literature confirms that many beginning teachers are seldom exposed to good practice student-centred examples of ICT integration (Ertmer, 1999; Russell et al., 2005). Although beginning teachers may be skilled users of ICT, it does not necessarily follow that they will know how to best integrate ICT for the benefits of student learning.

4.5 Relationships among pedagogical beliefs, knowledge, dispositions and skills in using ICT

The Pedagogical Beliefs Questionnaire suggested that participants held views that broadly resonated with the identified attributes of meaningful learning. It also pointed towards participants having a focus on the cooperative and authentic identified attributes of learning. The scores, for the 8 participants that were observed, on each of the subscales of the Pedagogical Beliefs Questionnaire are provided in Table 4.7. The mean scores for the 8 participants that were observed closely resembles those which were calculated for the entire sample (n=35).

The questionnaire suggests that participants claim to hold beliefs about teaching and learning that promote collaboration and authentic problem-solving in their classrooms. It may be expected, therefore, that participants might harness ICT in support of these beliefs. These attributes were not described in participants’
comments on how they used ICT in the classroom nor were they observed in the classroom. This suggests that participants’ use of ICT is out of step with their stated pedagogical beliefs.

Table 4.7: 
Scores on Each of the Subscales of the Pedagogical Beliefs Questionnaire for Observed Participants in the First Year of the Study

<table>
<thead>
<tr>
<th>Participants</th>
<th>Active</th>
<th>Cooperative</th>
<th>Constructive</th>
<th>Authentic</th>
<th>Intentional</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3.2</td>
<td>4.3</td>
<td>3.4</td>
<td>3.8</td>
<td>3.5</td>
</tr>
<tr>
<td>4</td>
<td>3.0</td>
<td>4.3</td>
<td>3.3</td>
<td>3.6</td>
<td>3.5</td>
</tr>
<tr>
<td>22</td>
<td>2.6</td>
<td>3.7</td>
<td>2.8</td>
<td>2.8</td>
<td>3.8</td>
</tr>
<tr>
<td>23</td>
<td>3.6</td>
<td>4.0</td>
<td>3.4</td>
<td>3.9</td>
<td>4.0</td>
</tr>
<tr>
<td>24</td>
<td>2.8</td>
<td>4.5</td>
<td>3.8</td>
<td>3.8</td>
<td>3.5</td>
</tr>
<tr>
<td>30</td>
<td>3.0</td>
<td>4.2</td>
<td>3.8</td>
<td>4.0</td>
<td>3.3</td>
</tr>
<tr>
<td>32</td>
<td>3.0</td>
<td>4.0</td>
<td>3.3</td>
<td>4.1</td>
<td>4.3</td>
</tr>
<tr>
<td>34</td>
<td>3.2</td>
<td>4.8</td>
<td>3.3</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Mean</td>
<td>3.1</td>
<td>4.2</td>
<td>3.4</td>
<td>3.8</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Interviews in Year 1 of the study revealed that participants’ knowledge about ICT integration were very much aligned with being able to readily access web resources to enhance their teaching. As has been seen, although participants had fairly sophisticated beliefs about student-centred learning, most did not see the guided student use of ICT as a vehicle to achieve this. Participants focused on learner engagement and opportunities to tap into a range of learning styles as primary attributes of ICT. It is not surprising, therefore, that participants mainly used the interactive web-based affordances of ICT as this was in tune with their knowledge and worldview of what ICT was for. It is interesting that the use of spreadsheets, graphing applications and data loggers was non-existent in the study. Tools that generate present and analyse numerical data may be under-utilised particularly in primary schools.
The Learning Federation provides, for educational jurisdictions in Australia and New Zealand, a comprehensive suite of K-12 learning materials that are designed to encourage students to engage in higher order thinking and problem-solving. In the first year of interviewing, all 28 participants were asked if they had used these learning materials in their classrooms. No one had. Sixteen participants had never heard of the Learning Federation, 10 participants had heard of the initiative but never seen any of the materials. Only 2 had seen the materials although never used them in the classroom.

During interviewing in Year 1 of the study, participants were also asked about their use of communicative ICT tools. Twelve equated communicative ICT tools to email and supported using this with their students as a mechanism to either submit work (9 participants) or set up pen pal arrangements with other schools (3 participants). Six participants were surprised, but interested in the notion of using ICT communicative tools for learning. Four participants would not consider this as an option due to a perception that it would be too distracting for their students. Two participants from a remote school had seen ICT being used to facilitate communication in distance education, but had never used it themselves. The remaining 4 participants talked about podcasting, chat, blogging and the discussion room in a Learning Management System, but had never used any of these tools.

The line of inquiry about Learning Federation materials and communicative uses of ICT reveals a knowledge gap in the student use of ICT for activities other than web-based interactions, and a limited suite of software applications for student presentation of work.
4.6 Conclusions

Participants articulated pedagogical beliefs that resonated with the identified attributes of meaningful learning. Attributes that rated particularly highly on the Pedagogical Beliefs Questionnaire at the inception of the study were cooperative and authentic learning. However, observations confirmed that many participants, although claiming to hold learner-centred ideals, showed little evidence of adopting these practices in their classrooms. This is consistent with findings from other research (Judson, 2006; Maor & Fraser, 2005; Russell et al., 2005).

Participants’ beliefs and knowledge about ICT and teaching and learning emphasised the capacity of ICT to make teaching easier, particularly through the affordances offered by the Web. However, participants did acknowledge that ICT enhanced possibilities for learner engagement and provided opportunities to tap into contemporary students’ learning styles.

Participants exhibited positive attitudes toward ICT and indicated high levels of competence and confidence in their ability to develop their understanding of the possibilities of ICT. However, actual use of ICT for teaching and learning was found to be relatively superficial and mainly teacher-driven. Given that participants’ claimed to hold learner-centred ideals, it is interesting that these ideals did not translate into concrete action in the student use of ICT. For example, the cooperative attribute of meaningful learning scored the highest in the Pedagogical Beliefs Questionnaire, but communicative ICT options were rarely considered or used in practice.

Finally, participants generally felt that they had superior technological knowledge and more positive attitudes and beliefs from those held by their more experienced
colleagues. As they progressed into Year 2 of their careers, many perceived themselves as different from their peers particularly in relation to what, how and when to integrate ICT. The next chapter will focus on the socio-cultural settings in which participants were situated whilst confronting these questions.


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Chapter 5 - Findings: Socio-cultural settings for ICT use
CHAPTER 5
Findings:
Socio-Cultural Settings for ICT use

5.1 Introduction

This chapter considers the socio-cultural setting(s) in which participants were set including the relationships between these settings and participants' pedagogical beliefs, knowledge, dispositions and skills. The socio-cultural setting is taken to comprise the participants’ immediate school environment which manifests itself through a range of stakeholders including students, teachers, school leaders and the wider social setting encompassing parent and broader community attitudes and values toward education and ICT.

As discussed in the previous chapter, contemporary teachers engage in pedagogical reasoning processes (Mishra & Koehler, 2006; Webb & Cox, 2004) in planning their lessons, weighing up understandings of the affordances and risks associated with their chosen teaching strategies. The emergence of ICT as an option adds a layer of complexity to pedagogical reasoning because it brings in a technological dimension. Teachers are now in a position where they need to make judgments about the potential of ICT in their classrooms, sometimes with little guidance and limited knowledge.

Webb and Cox (2004, p. 238) use the term ICT affordances in a broad sense to mean “what ICT offers” to both teachers and to learners. The pedagogical reasoning process, as it relates to ICT integration, is concerned with how teachers gauge what ICT offers and also what they see as the risks of using ICT. This necessarily embraces all of the
stakeholders as described previously. Therefore, this chapter will examine the affordances and risks associated with ICT through a consideration of its impact on each of the identified stakeholders: students and teachers, school leaders, and the wider social setting.

Data from interviews with teacher participants conducted during the 3 years of the study (n=58) along with interviews with principals or deputy principals (n=11) and observations of participants from all 3 years of the study (n=30) are used to explore ICT from the perspectives of each of the above stakeholders.

5.2 Affordances and risks of using ICT in the classroom

Teachers gauge the affordances and risks of using ICT through the lens of their beliefs about what constitutes ICT integration and their experience of using or viewing ICT in the classroom (Ertmer, 2005). This section of the thesis will first unpack teachers’ perceptions of the affordances and risks of using ICT before considering the extent to which these perceptions reflected the reality of their practice.

5.2.1 Perceived affordances of using ICT

During interviewing and observations in Year 1 of the study, it was established that participants held a particular worldview of ICT that emphasised its potential to (a) make teaching easier by facilitating access to web resources; (b) motivate and engage students; and (c) provide options to respond to individual student learning preferences.

5.2.1.1 ICT for inquiry, communication and creativity

The Statements of Learning for ICT suggest that opportunities should be provided for students between Years 3 and 9 to operate ICT, use ICT for inquiry, communication and creativity, and also to consider ethical issues associated with ICT (MCEETYA, 2006).
Given that all of the participants in this study were teaching in Australian schools, it is considered a legitimate line of inquiry to determine the extent to which participants used ICT in accordance with the Statements of Learning for ICT (MCEETYA, 2006). During interviewing in Years 2 and 3 of the study, participants were asked to rate themselves on a scale of 0-10 on the extent to which they facilitated the student use of three aspects of the Statements of Learning for ICT: inquiry, communication and creative work.

There were 16 participants interviewed in the second year of the study and 14 in the third year of the study. Mean scores for the ratings participants gave themselves on the three aspects of the Statements of Learning for ICT are provided for both years in Figure 5.1.

![Mean scores for participants' self-assessment on the extent to which they facilitated the student use of ICT for inquiry, communication and creativity (Year 2 n=16; Year 3 n=14).](image)

**Figure 5.1.** Mean scores for participants' self-assessment on the extent to which they facilitated the student use of ICT for inquiry, communication and creativity (Year 2 n=16; Year 3 n=14).

The use of ICT for inquiry, which was interpreted by participants primarily as using the Web as a search tool, scored consistently over the 2 years (mean scores of 5.2 in Year 2 and 5.1 in Year 3). The use of ICT in communicative ways scored the lowest with mean scores of 2.6 in Year 2 and 3.6 in Year 3. The creative use of ICT registered quite a sharp increase between Year 2 (mean= 3.7) and Year 3 (mean=5.4) indicating that some
participants perceived that they had expanded their repertoire of applications that promoted creative work.

During interviews in Year 1 and Year 2, participants were probed for examples of creative and communicative uses of ICT. Fourteen participants suggested that they used PowerPoint in setting creative work for students. For example:

> We did heaps of PowerPoint last year. Kids loved the PowerPoint, and they were quite familiar and experienced with it. And capable, it was a very independent thing. (20, 238, [10])

> We made PowerPoint presentations which were on display. And I thought that was a great use of ICT. (8, 374, [10])

Four participants cited the use of semantic networking tools (in all cases using Inspiration software), but no participant cited spreadsheets, databases or microworlds (Jonassen, 2002) as useful cognitive tools.

There were 4 participants interviewed that were employed in early primary education settings. This cohort had not explored the creative uses of ICT due to a perception that their students had insufficient literacy and/or computer skills:

> I know with my kids at the moment creative work would be a bit of an issue. It would be great if the Year 2 and 3 in a few years’ time could be able to do that. Mine they are not computer savvy enough. (10, 84, [10])

> I think you could probably do some of that stuff later on in the year, but at the moment I have the kids that can’t write. They won’t know where the letters are. (24, 66, [10])

No examples of communicative applications of ICT were provided by participants, although some mentioned a desire to set up e-pal email networks with other schools.

It should be noted that mean scores on all three facets of the Statements of Learning for ICT were quite low. One of the reasons for this may be that the way in which participants tended to facilitate the student use of ICT were more akin to what Maddux,
LaMont Johnson and Willis’ (2001) refer to as Type I applications of ICT (i.e. those that make it easier or quicker to administer the teaching and learning environment). The previous chapter established that participants held a worldview of ICT that emphasised the use of the Web to motivate students and tap into a greater range of learning styles. A manifestation of this worldview is to use ICT to reinforce concepts.

5.2.1.2 ICT for reinforcement

Almost all of the comments received during interviews from participants located in the primary school sector indicated that the most useful ICT affordance was to reinforce learning. For most participants this was an amplification (Hughes, Thomas, & Scharber, 2006) of their teaching rather than a replacement:

For me it is reinforcement. I do not use it to evaluate them. I look at how they went very briefly, but it is more to reinforce what we are doing in class. (34, 378, [24])

The capacity to provide instant feedback was seen as a particularly useful aspect of ICT that perhaps reduced some of the burden of formative assessment from the teacher:

There are brilliant sites out there that kids can practice on, just skills. Some of the sites I saw on the Internet for interactive whiteboards were like that. It gives you the instant feedback. I think that is good for kids. I think it is good for reinforcing concepts. (23, 77, [24])

We’re doing Maths games in the lab and the kids love the automatic responses they get back. (21, 106, [24])

This focus on consolidating rather than exploring suggests that participants in the primary sector saw limited opportunities for students to enter into an intellectual partnership by using the inquiry, communicative and creative dimensions of ICT. Rather, the major affordance of ICT was as a drill and practice tool. Two secondary mathematics participants had a similar view:
You give them a concept and then they can do repetitious work to get it in their heads. It switches the exercises they do on paper to doing it on a computer. (15, 73, [24])

Rather than me do it, the computer can do it. (13, 43, [24])

In the previously alluded to study of two Turkish schools (see Chapter 2), Demiraslan and Usluel (2008, p. 462) reported that teachers tended to use ICT for reinforcement purposes in an attempt to “ensure the permanence of what was learned.” In the current study, many participants were hampered by a lack of computers in the classroom, and teachers adopted strategies like playing games (viewed as a reward by teachers and students alike) and visiting interesting websites. ICT thus remained as a peripheral classroom activity rather than the main focus of the lesson.

Most participants interviewed from the secondary sector emphasised inquiry, particularly through the Web, as being the most important affordance:

Using it for research is absolutely excellent. It is so much easier to type in a search phrase and get what you want than have to trawl through hundreds of thousands of books not even knowing if the information that you’re going to find is relevant. (9, 47, [25])

I definitely use it as a research tool. The current information, the up-to-date different perspectives - it is huge. It does save a lot of time in comparison to the traditional way of going to the library to get a book. You can access online journals. We have got access to all the newspapers every day electronically. There is so much. (33, 64, [25])

The use of the Web as an inquiry tool for students seemed to gather greater traction as students progressed through late primary and into secondary environments. By comparison, in earlier years reinforcement was seen as the major student application. However, whether for inquiry or reinforcement of knowledge the Web in particular, and ICT more generally, was universally found to be a great motivator.
5.2.1.3 The motivational qualities of ICT

Participants were unanimous in their view that there were benefits arising from the use of ICT in increasing motivation in the classroom:

It is motivation for them to get to finish an activity, and know that they are going to be able to go and learn something in a different way. Instead of using counters they can learn using a computer. (4, 299, [12])

I think it is a motivational thing because this is the third year of using the ICT and my kids are still doing the right thing so they get to use it. So it is still a motivational tool for them. (23, 405, [13])

The extent to which participants viewed motivation as being directly related to the introduction of an ICT is exemplified by the enthusiasm of a secondary teacher in commenting on the immanent arrival of a mobile interactive whiteboard:

When I get the Mimio [mobile interactive whiteboard] there will be a massive increase in student motivation. (9, 435, [13])

Acknowledging the capacity of ICT to motivate students, a number of participants used it as a reward mechanism for completing a task and/or behaving appropriately:

It definitely has motivational qualities, particularly with the bribery at the end of the lesson - that certainly helps. (3, 130, [26])

I asked my kids "What would you like as a reward" and every single one of them said they wanted to go on the computer. If you have a motivational tool, you can use it in terms of classroom management. (4, 456, [13])

I know I can use it for a motivational thing. So as a behaviour thing at the end of each month I can give them 20 minutes free time on the computer. I was just talking to a teacher yesterday about doing that in my class. He said he was doing it in his class and it worked well. (16, 36, [26])

With an increase in motivation participants saw heightened levels of engagement and from this some concluded that inevitably more learning was taking place:

I would say that I use the eBoard [interactive whiteboard] for example, to further the children's learning and so from the data that I gather and the improvements that I see from the children, that tells me that they are learning from it. Whether they are actually taking in every single thing when they are sitting there, I am not sure. But
based on the assessment afterwards, that tells me that they have gained knowledge or have learnt. (21, 470, [13])

In the third round of interviewing, participants were asked if they felt that there was a link between student motivation and the learning that was taking place. Most responses felt that this was the case. Two examples are provided here. The first from a teacher in early primary education:

[Interviewer] Can you see a direct link between students being motivated and the learning that takes place?

[Participant] Yes definitely. They don't even know the mat sessions that we do, that is where they do most of their learning. All are talking and interacting with each other, using the whiteboard, viewing things from around the world, by the time they had gone to the table they have learnt much more than what they were going to learn in the actual activity. My kids are really good, they keep talking about what they were doing on the mat, and it is like awesome to keep them motivated. (2, 390, [13])

Here the interactive whiteboard was used in a teacher-directed way. However, according to the participant, accessing authentic and relevant websites promoted discussion in the class leading to a positive learning environment that continued throughout the lesson.

ICT is used by the participant as a springboard to promote verbal communication in the classroom.

A second example is from a participant working in a primary school located in an area of low socio-economic status:

[Interviewer] Can you see a direct link between students being motivated and the learning that takes place?

[Participant] Of course. If you are completely unmotivated, then you are not going to learn. If you do not want to learn or do not want to be there, then you are not going to learn. I think that is the case with anybody. When you use ICT it's definitely rowdy which I think is a good thing. They are excited, they want to share things with one another and show each other and there is more of a community aspect to it especially if sometimes there are two people per computer which is what you have. They are working together and it's rowdy and it's loud which I like. I don't have a problem with that because it's rowdy and they are on task. If they misbehave then they are taken away from the computer and they don't like that at all. (30, 513, [13])
In this example, the participant discusses the use of ICT in a computer laboratory. Again the communicative dimension of learning comes through strongly with the participant referring to the classroom as a “rowdy” place. Both examples suggest that using ICT promotes discussion outside of the ICT environment.

Other participants also saw that using ICT in the classroom enhanced communication and teamwork between students. Ten of the 16 interviewed in Year 2 of the study reported improvements in communication in their classrooms. Other comments suggest that ICT is responsible for incidental learning outcomes such as improvements in teamwork:

I have found they [students] work better in teams. They really encourage each other, and one might know something that the other might not and they would tell them what to do, talk them through that. So it has allowed them to work better in pairs. (8, 370, [13])

It has strengthened the relationships in class, and sometimes you don't even realise that it is going to do things like that. (21, 370, [13])

The study has found evidence of ICT underpinning strong student motivation and participants have linked this to increased opportunities for learning and also incidental outcomes such as better communication and teamwork. This suggests that there is a solid alignment between ICT use and the ways in which contemporary students learn.

5.2.1.4 ICT and learning styles

The benefits of using ICT in response to perceived visual, auditory and tactile learning styles was a powerful theme that was consistent throughout the study, particularly from participants working in primary schools:

When you are going on the Internet, and going on to things like Brainpop you can model everything first and you don't have to give them an A3 handout. There are a lot more visuals, and for boys, they are visual learners. Just being able to explain a concept in a different way like the tactile is on the Smartboard. If you think that you don't know how to explain a concept, and you try to explain it and the kids still don't
get it I can then go on to Brainpop, search for another site and find a whole load of resources that may cater for another child. (34, 493, [13])

I think that some kids, quite a lot of kids, are very visual learners and they like that visual input, and they like to touch things and manipulate. (23, 405, [13])

The fact that they can see, and they can make the computers do what they want and they are getting the color and the movement. Once they are engaged you can get them to do just about anything. (5, 58, [13])

The participants here all felt that ICT helped them to expand their repertoire in being able to approach concepts from different directions in order to respond to the needs of their students. Although responding to visual learning styles was seen as an important aspect of using ICT, other learning styles (e.g. auditory and tactile) were not seen as mutually exclusive to ICT. As previously discussed, ICT could also be used to respond to students who favoured verbal learning styles:

So if we are doing a chance and data lesson, I will put one problem on the board [interactive whiteboard]. And the whole class will work through it. It is good for these kids because they are very much visual and practical. And so they could sit and talk about it all and work through it together. (5, 410, [35])

There was unanimity in the perception that all learning areas could benefit from using ICT indicating that participants held views that ICT could be used across the curriculum:

You could look at integrating it into anything. I think technology can be used almost anywhere. (30, 153, [2])

There are opportunities in every subject. (3, 110, [2])

Participants, then, saw ICT as a mechanism that helped them to tailor their teaching. However, participants cited few examples of the provision of opportunities for students to be producers of knowledge in a range of ICT formats that were in tune with their learning styles. Although data collected through the Pedagogical Beliefs Questionnaire indicated that participants held beliefs that were in tune with student-centred learning, at interview participants did not mention any practices that promoted student choice on
what work to produce work or how to produce it, nor were any examples of this noted during observation. Apart from benefits to classroom discussions, it may have been more apt to describe the use of ICT as expanding the range of teaching styles in the hope that this would align with students’ learning styles.

### 5.2.1.5 Summary: perceived affordances of ICT use in teaching and learning

In summary, it would seem that Maddux, LaMont Johnson and Willis’s (2001) Type I uses of ICT prevailed for the participants in this study. Although participants saw that their students were motivated by ICT, the main affordances offered to students were web-based interactions aimed at reinforcing learning and to a lesser extent supporting inquiry or exploratory work. Examples of communication and creative work using ICT were rare and the creative student use of ICT usually involved a fairly limited range of activities generally involving presentation or word processing tools.

Recent research suggests that beginning teachers use ICT extensively for preparation (Russell, Bebell, & O'Dwyer, 2005). The findings of this study support this contention. However, this research has also found many examples of teacher-directed use of ICT in the classroom mainly through the use of an interactive whiteboard or multimedia projector. In addition, interviews and observations confirmed that the use of interactive whiteboards in particular acted as a platform for deeper student engagement through discussion or non-ICT based activities.

Possible reasons for the scarcity of creative and communicative uses of ICT are now discussed by shifting the focus to the perceived risks of using ICT.
5.2.2 Perceived risks of using ICT

Although there was relative consistency in participants’ views on the affordances of ICT, there was some variability of views in relation to the risks that ICT integration might pose. This could have stemmed from the differential impact that ICT potentially has on students of different ages, and the range of capabilities that Generation Z students now exhibit. For example, cyber-bullying was not mentioned as a potential threat in early primary settings, but emerged as an issue for late-primary and secondary students; similarly plagiarism only emerged as an issue at a point where students began to produce independent work using ICT.

During interviewing and observation six major risk factors that potentially could subvert the teaching and learning environment were identified:

- ICT infrastructure issues.
- Locus of control for ICT.
- Time and professional learning in the application of ICT.
- Student dependency on ICT.
- Perceptions of variable student skill levels in using ICT.
- A mismatch between ICT and established ways of assessing students.

5.2.2.1 ICT infrastructure issues

The lack of student access to ICT at the point of need (i.e. the classroom) was a major concern to participants.

The main thing is lack of computers at the school. I think we have got 400 students at the school, and around 50 computers. It doesn't make sense to me. (3, 292, [23])

I will get there one day. But I think not having enough resources in the classroom, to make it achievable. There is no point in having all of this knowledge, if I cannot use it in the classroom. (23, 324, [23])
I am not able to bring it [ICT] into a daily routine. I would love to be there and I would be there if I had the tools, but I haven't got the tools. (30, 447, [23])

Of the 28 participants interviewed in Year 1, only 6 had four or more computers in their classroom, and even these participants attempted to design activities that generally involved rotating small groups through computer stations. Twenty two participants had less than four computers in their classrooms and some operated with class sizes of 25 or more. These participants found rotating students through computer stations to be disruptive and unworkable, sometimes concluding that there was little use for the computers in their classroom. Participants were almost unanimous in calling for a higher computer to student ratio:

It can be quite disruptive getting one lot out and one lot in to the computers, rotating students. Some people work faster than others, some people don’t want to get off and that sort of thing. (15, 143, [26])

For a rotation one between three would be good, so in a class of 24 that would mean eight computers. (29, 278, [26])

Probably a third would be good so 10 in my class. Then you could have a significant amount of kids working away and do a good rotation, but when you have only the three it is very limiting. (26, 21, [26])

The limited number of computers in participants’ classrooms in relation to class sizes, then, constituted a major disincentive for ICT use. Another risk was the fact that there was, for many, a crisis in confidence that ICT would actually work:

The network, between here and the rest of the school, keeps on breaking. (9, 219, [9])

Sometimes the ICT just does not work. We can’t connect the students all at the same time or else the network drops out. (10, 106, [9])

Although participants tried to be helpful when it came to technical problems, most did not see it as their role, nor did they have the skills to resolve more complex technical issues.
The support is not there, although they try to do their best. Our IT teacher will try to do her best, even though she is not a technician. Our Principal will help out where he can, but we do not have a techie on board to be there all the time. We just try and help each other. Sometimes, if it is more technical things then it is way over my head. (23, 251, [9])

Lack of ICT infrastructure remained a constant problem for many participants, particularly those from the public education sector. Other studies (Phelps & Maddison, 2008) have also noted a diversity of ICT infrastructure, sometimes across what might seem comparable schools. The importance of providing pedagogical leadership in the provision of ICT infrastructure is an important theme that emerged from the current research.

5.2.2.2  Locus of control for ICT

Somekh (2004) argues that ICT integration involves shifting the locus of control from teacher to student, and that this is challenging for schools and teachers because it is the antithesis of the way in which schools are designed – as instruments of control. This theme found expression in participants’ responses to questions surrounding the management of student behaviour on the Internet:

The biggest problem is, if you have got a big class of say, 30. Just maintaining control of what they are accessing. If they are on the Internet, you don't have control of more than three or four kids. (5, 345, [10])

I would be worried about what they were doing on the computer. You would just need to keep control of it. (27, 126, [9])

These comments suggest that participants were reluctant to hand over the locus of control over ICT to their students. The issue of control over the learning environment was often discussed in terms of teachers believing that students would be disruptive, frivolous and prone to wasting time. The potential for these behaviours to arise certainly came into focus when discussing the communicative affordances of ICT. Web 2.0 ICT affordances empower students to be producers of knowledge and also be active in
sharing and communicating on the Web. However, participants’ use of Web 2.0 technologies was almost non-existent in the study. Table 5.1 provides excerpts of dialogue with Participant 5 which show how the consideration of Web 2.0 tools meandered over the 3 years without really getting off the ground.

Table 5.1: 
Dialogue with Participant 5 Over the 3 Years of the Study on the Topic of Using the Communicative Potential of ICT

<table>
<thead>
<tr>
<th>Year</th>
<th>Interviewer</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>You mentioned Think.com earlier. How is this used?</td>
<td>At the moment it is more for use in their spare time so they come in at lunch time and get on there. We can do projects with other students in other schools but we haven’t progressed that yet. (5, 84, [6])</td>
</tr>
<tr>
<td></td>
<td>So have you used any other web-based communication tools in your teaching?</td>
<td>Not yet, but I think in their world it will be important because it will give them the basis of how to communicate on the Internet. And they need to know that it is not safe. They need to have their own safety in mind when they say or do anything on the Internet. (5, 90, [6])</td>
</tr>
<tr>
<td></td>
<td>What about rapid publishing and the potential of students to become producers of knowledge?</td>
<td>They are learning a lot about other people’s cultures just on a personal basis so at the moment it is personal and it is their own time. We haven’t progressed down that path but we intend to. (5, 92, [6])</td>
</tr>
<tr>
<td>2</td>
<td>Have you used any web-based communication tools in your teaching in the last 12 months?</td>
<td>No, we have not done any. We did go on Think.com last year. I took them off that because of the time thing. It took me a long time every afternoon. And in the end, I made it a once a week thing just so I could go through and see what was on the site and to check everything. It was a big time waster for me so I took it off. I could leave it there and let them do it, but you do not know what they are getting up to if you don't check it all the time. And you can't guide them if you don't have a look at what they are doing. I am looking forward to getting to blogs. (5, 301, [6])</td>
</tr>
<tr>
<td>3</td>
<td>Have you used any web-based communication tools in your teaching in the last 12 months?</td>
<td>That would be a zero. They do not use anything like that here. (5, 447, [6])</td>
</tr>
<tr>
<td></td>
<td>How about in your last school?</td>
<td>No, we weren't allowed to do email with them, and blogs, we didn't progress. (5, 454, [6])</td>
</tr>
</tbody>
</table>
The participant was open to using the communicative affordances of the Web, particularly at the inception of the study. However, issues of safety, time and school policy were offered as reasons for not pursuing this. It is interesting that the social networking tool mentioned (Think.com) was used for a while, but this was dropped because of the pressures that it put on the participant in terms of monitoring the communication that was taking place on the site. Students were clearly using it. In fact, it was the amount of use that impacted on workload that led to its demise in the classroom. It may have been that the use of this particular tool involved shifting the locus of control from participant to student. However, the participant was not prepared to do this without structures in place to minimise what she perceived as extra workload for her, and disruption or time wasting on the part of her students.

There were some concerns expressed by participants in relation to the extent to which the students should be handed the locus of control in using ICT. For example, 5 of the 10 secondary participants believed that their students lacked the maturity to use ICT without close supervision. Distractions were seen as a major problem:

The problem that I have in the library is that they have gone on to MSN and use it frivolously. I think that is more convenient nowadays, and I guess a lot of kids have broadband at home and it is easier to communicate than travel or by picking up the phone. It distracts them a little bit. (12, 87, [9])

I don't think there should be so much focus on form, and I think that is one of the limitations of things like Word. It is so easy to start making things look pretty, and that is not the point. (30, 482, [9])

I guess sometimes the kids get a little distracted with some use of ICT. They take a long time to edit and stuff and sometimes I have to come in after school. (22, 281, [9])

Of the 30 lessons observed, 21 involved the use of web-based interactive resources. Whilst 21 of these resources were essentially teacher-driven using a centralised projection device, 7 afforded the student the locus of control. However, students in four of these observations (4O1, 4O2, 24O1, 30O2) engaged with the resources in a manner
that would not indicate thoughtfulness and reflection about the decisions made with the interactive materials. Three observed lessons involved Microsoft products (PowerPoint and Word). In these lessons students were seen to be heavily focused on presentation rather than content (e.g. 34O1, 34O2). Data from observations, therefore, corroborates participants’ comments made during interviews that ICT has the potential to distract and disrupt learning. This also found expression in two responses made at interview to the question *How would you feel about implementing a 1:1 laptop program in your class?*

I would say keep those laptops out of my classroom. A lot of the students that I teach, they might be able to use a computer but they would not be using it properly that’s for sure. Definitely not the kids that I’ve got. (13, 135, [21])

I wouldn't like it if I was in a school where all of my kids have a laptop. I don't know how I would deal with that. (34, 301, [21])

These comments support the contention that many participants in this study were reluctant to hand over the locus of control to students. ICT alters social relationships in the classroom and many teachers find it difficult to strike the right balance between student freedom and teacher control (Sutherland, Robertson, & John, 2009). Participants were unsure of how to manage classrooms in which students had autonomy over ICT. Inadequate infrastructure, coupled with disruptions and distractions brought about by ICT created conditions in which student-centred learning with ICT was just too hard. It may be that professional learning on how to manage student-centred ICT environments (e.g. helping students to set their own goals, manage their own time and keep on task) could be a useful component of a school’s ICT professional learning strategy.

### 5.2.2.3 Student dependency on ICT

The tendency of students to become dependent on ICT, particularly tools that mitigated the need for adequate handwriting and spelling skills, was a theme that cut across primary and secondary sectors:
They like to use the computer to do spell checking so I have to get them to remember to go through their work first and check it before they start to type because they slump in their spelling otherwise. So I say you check your spelling first rather than rely on the computer to check your spelling. (5, 172, [9])

This is building up a child's dependence on technology. I think you have got to be very careful there. For example I would not want my children to lose their handwriting skills. (30, 177, [9])

The issue of student dependency on ICT was also picked up in mathematics with some participants being careful to avoid the indiscriminate use of calculators:

With calculators we have a very strict policy that they can use them to check. But getting the right answer is not as important as the process. (5, 178, [9])

Participants were cognizant of the rapid changes being brought about by ICT, but were also supportive of maintaining a focus on traditional skills such as handwriting and spelling even though they understood that these skills might become less relevant in wider society.

5.2.2.4  Time for professional learning in ICT

The vastness of web resources coupled with the ever expanding array of software available was daunting to participants. Most indicated that they would integrate ICT more effectively if they had more time for professional learning:

Finding interesting websites for them - it all comes down to not enough time. I could spend all day, every day on it, but I have decided not to. You have to choose, you have to prioritise. I would love to get into wikis and podcasts, but I don't know how beneficial that would be for this level of child. Maybe that's more for high school. I don't know. I haven't got into it yet. (5, 281, [28])

I would like to push the boundaries of learning and do some of these things like making sure that I am incorporating it and getting the kids to incorporate it, but it is just fitting in my timetable to do that. Like with blogging, I don't really know what it is. I know it is like putting in information, writing a comment. I know I’ve seen it but I'm not really interested in it. So I haven't seen the potential. (34, 421, [28])

These sentiments suggest that participants were constrained by time in seeking new knowledge about how to relate recent applications of ICT to their teaching. However,
there was also a sense of being swamped by the vast number of new applications and initiatives, and time to carefully consider those that might be most prevalent was uppermost in participants’ minds.

Three of the 6 secondary participants interviewed in Year 3 indicated improvement in their teaching capability, but stagnation or reduction in their ability to use ICT. These participants revealed that they simply had too many other priorities to dedicate time for keeping up-to-date on developments in ICT. Time was seen as a significant constraint in the first couple of years of teaching particularly when issues of familiarity with the curriculum and classroom management were more immediate.

Seven teachers out of 16 in the Year 2 round of interviewing indicated that they did not know what professional learning they needed, and where to get it:

I would like to be able to skill myself, but then I try to go on PDs [professional development] but I find that it is not what I wanted when I get there. (2, 199, [28])

What is my major challenge in professional learning in ICT? Probably just me being educated further to be able to use it to its optimal capacity and also knowing where to go to get that education. (21, 309, [28])

In this round of interviews, participants were posed with a hypothetical scenario: You have just won a professional development scholarship valued at $5,000. What would you spend this on? Results are shown in Figure 5.2. Of the 16 responses one was not sure and declined to answer. Although it was stressed in the hypothetical that the funds were to be disbursed on professional development, 10 of the remaining 15 participants actually requested hardware and/or software (unshaded in Figure 5.2) with six of these wanting an interactive whiteboard. Of the 5 responses that asked for professional development, 2 expressed a desire to deepen their knowledge and understanding of ICT integration and 2 wanted professional development specifically targeted at the interactive whiteboard. One participant indicated that she would have spent the funds on
literacy and numeracy professional development rather than ICT-focused professional development.

Responses to this question indicate that hardware and software were of greater concern to many of the participants in the study than professional learning. It is significant that the interactive whiteboard was seen as an important ICT that enthused many of the participants in the study.

Sutherland, Robertson and John (2009) believe that teachers are well aware of the risks associated with integrating ICT into the classroom, and that one of the reasons for the slow uptake of ICT is the lack of support through a well thought out and well resourced professional learning process. Findings from the current research are consistent with this view. There was little evidence of spontaneous innovation with ICT or a desire for the transformation of pedagogy through the use of ICT.

Figure 5.2. Responses to the Year 3 interview question: “How would you spend the funds from a $5,000 professional development scholarship?” (n=16).
5.2.2.5 Perceptions of variable student skill levels in using ICT

Bennett, Maton and Kervin (2008) advise against making inappropriate assumptions about the capabilities of Generation Z. Participants in this research were generally congruous with this advice reporting a wide variability in skill levels of their students. A definite gap in learning opportunities was said to exist between those that have ICT at home and those that do not:

I find that in primary schools there is a discrepancy between the “haves” and the “have nots”. The kids who have computers at home they know how to use Microsoft Word, they know how to research on the Internet. Whereas kids that don't, need to use books and things like that. There is just a big gap. (8, 426, [9])

They have not all got the same ability to use the computers. If, for example, I get them to do something at home, some of them have not got a computer at home. So some students will be handing their work in late because they have not got the availability of a computer. (9, 167, [9])

Participants, particularly those located in areas of low socio-economic status and in remote regions, exhibited an ethic of fairness (Somekh, 2004) in their inclination not to set work that required the mandatory use of ICT. However, in acknowledging this new digital divide, participants saw that ICT could also break down disadvantage. For example, the capacity of small remote libraries to keep up to date with non-fictional resources was seen as problematic:

We don't have to maintain such an up-to-date library. The library can move more towards fiction material. The information is there so that children are not being disadvantaged by being rural and remote. (5, 317, [1])

In these situations the availability of the Internet for finding resources was seen as a great equaliser. However, there was a strong sense that using the Web without teacher direction had a dangerous potential particularly in primary schools. Students were seen not to have developed the skills to effectively search and make judgments on the quality of resources:
I don’t think they are discerning at this age. In Year 6 even my brighter kids they would just look at pretty much anything that is related to the topic and take it as truth and that is a problem. That is probably the main thing I would say. Using the Web is good but the process has to be refined so they can access good information. (26, 66, [25])

I don’t think they have got the skills to filter through copious amounts of websites. (27, 41, [25])

Helping students to become skilled in the use of the ICT was a significant issue for participants who worked in early primary contexts. The majority of participants from this sector believed ICT skills development to be important for their students and some felt it was their responsibility:

I just think as teachers, we are becoming more and more responsible for so many things. I don't know whether it is that parents just haven't got the time at home, but they just don't seem to sit down with their kids and show them how to use a mouse or show them how to use applications, and they just kind of expect us to show them. So I guess I do feel a big responsibility to teach my kids. (8, 422, [9])

However this required a time investment that, initially at least, sometimes was a disincentive:

I think I have realised that the more time I give the children to use it and the more exposure to it, the easier it will be for me to be able to teach with it. I think last year I just stopped doing it because it was too hard. (4, 287, [1])

Although using ICT required a time investment up front, this participant discerned that giving students a chance to use ICT may yield benefits for both teacher and student in the longer term.

Participants understood that preparation was required in order to set students meaningful inquiry tasks. Participants in high school environments had more confidence in their students’ ability to gauge the quality of web material, but discerned that the ease in which students could access resources exacerbated problems of plagiarism:

We have a problem with plagiarism especially in the lower years, which is one of the reasons why we do try to limit the use of computers. (9, 450, [9])

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If it is just copying stuff and that they don't understand what they've written about - that is something that we need to be aware of as teachers. (33, 60, [25])

The perceived wide variability of students’ ICT skills and issues in the way in which they access and deal with web material had an impact on the propensity of participants to use ICT. This may have contributed to the rudimentary uses of ICT that emerged throughout the study.

5.2.2.6 A mismatch between ICT and established ways of assessing students

Participants viewed the use of ICT in assessment as problematic for a number of reasons. Firstly, there was a concern that the assessment of students’ capabilities in using ICT would confuse assessment of content knowledge with ICT knowledge:

I think you need to be careful about what you are assessing - whether it’s students’ ICT skills or whether it’s about the curriculum area. (20, 186, [3])

Secondly, there was the issue of fairness. Students with an abundance of access to ICT at home, and who used it in educational ways, were seen to have an advantage over students that either did not have access or simply used computers to play games:

I could use it as an assessment but I think it would advantage some kids over others. Some kids would really struggle with navigating around compared to the kids that are on the computers every afternoon or they are playing the Xbox and so they know how to use the controls of the keyboard or whatever. (10, 162, [3])

Thirdly, there was the issue of competence and whether the computer might get in the way or subvert the assessment process:

I haven’t tried but I suppose when you’re assessing them they would have to be very competent in use in the computer. (4, 232, [3])

Fourth, the potential of ICT to be used as a replacement for skills that teacher’s are actually trying to assess. For example, a participant employed in a secondary school in
the area of English, saw ICT as sometimes intruding on skills that she was trying to encourage (e.g. grammar and spelling). This, she felt, was problematic in being able to accurately assess what her students knew:

I think it is so much easier to type it into a Word document, but the teacher part of me thinks it is hard to assess their skills properly if they do that. Because I don’t know what they can do and what they can’t do. (9, 159, [3])

Finally, there was a perception that schools simply do not have enough computers to facilitate reliable assessment practices.

To conduct assessment you have to have a computer for every child and at the moment I think it is cost prohibitive. (15, 161, [3])

Notwithstanding this, there was an appetite amongst participants to explore the potential of using ICT for assessment, particularly in areas where students could attain immediate feedback:

I’d like to investigate this bit further. I don’t do any assessment at the moment apart from documenting their outcomes. (5, 207, [3])

I’d like to see some online maths and maths assessment using the computer. I think that would be quite interesting. (16, 169, [3])

It’s probably about having ongoing assessment in a range of assessment styles, one of which is technology so they get the opportunity to demonstrate their knowledge in a range of different ways. (35, 170, [3])

Participants who used ICT for reinforcement of concepts modelled formative assessment. However, there were few examples of participants delving deeper, for example, using ICT tools to diagnose problems that students might be having with concepts or to set tasks for students based upon their prior knowledge. Although a number of participants used the Mathletics software, for instance, this was generally aimed at being a fun and motivating reward rather than a serious diagnostic and/or assessment tool.
5.2.2.7 Summary: perceived risks to teaching and learning through ICT use

In summary, the risks to teachers in integrating ICT are bound up with ICT being fundamentally disruptive. The lack of access to ICT for most participants was a disincentive to try innovative student-centred approaches. Many participants reported a lack of confidence with the equipment that was provided to them and a disinclination to troubleshoot this equipment if the need arose. The integration of ICT in creative ways involves a shift in the locus of control from teacher to learner. Teachers in this study were generally either not in a position or not prepared to make this leap of faith. The seductive potential of ICT to distract students from learning objectives along with a perceived dependency on ICT, were also barriers that participants grappled with. These findings are consistent with Russell, Babell and O’Dwyers’ (2005) empirical study that found that whilst new teachers entering the profession are more confident with computers, their beliefs about the negative effects of computers on students are stronger than teachers who have been in the profession for more than 6 years.

There was said to be a wide variability of ICT skills amongst students and a digital divide between those with, and those without, access to ICT. In this environment, participants were sensitive in the way in which they implemented ICT. However, participants, particularly in rural and remote regions, also saw the value of ICT as a mechanism to break down inequalities by tapping into the Web as a way of compensating for sometimes ill-equipped schools. While participants located in primary schools saw that their students lacked the capabilities to search and gauge the quality of web material, participants from secondary schools discerned that plagiarism, fuelled by increased access to web resources, was a serious impediment to learning.
Time to undertake professional learning was identified as an area of concern, particularly in identifying appropriate learning opportunities. However, on the positive side participants indicated that they had confidence and competence to explore recent developments in ICT integration – they just needed time to do this.

There was an identified mismatch between ICT integration and established ways of assessing students and participants, many of whom valued fairness and equality, were not inclined to alter their approach to assessment using ICT.

### 5.2.3 Participants’ perceptions of themselves as users of ICT

In the Year 2 round of interviewing, participants were asked to locate themselves on a continuum of ICT use developed by Newhouse, Trinidad and Clarkson (2005). The continuum, described in Chapter 2, contains categories of Inaction, Investigation, Application, Integration and Transformation. Figure 5.3 shows the spread of responses in relation to this continuum in Year 2. The numbers relate to the participant identifier.

![Figure 5.3](image)

*Figure 5.3. Participant perceptions (Year 2, n=16) of their use of ICT in relation to the continuum developed by Newhouse, Trinidad and Clarkson (2005).*
Most participants situated themselves between Investigation and Integration corroborating the results from Year 1 of interviewing where the majority of participants perceived that they had a weakness in stretching the limits of innovative teaching. All participants attempted to use ICT in some way and no participant rated her/himself as below the Investigation phase. However, participants generally did not believe that their approach to ICT integration was very sophisticated with only 4 participants out of 16 rating themselves at Integration or above. All participants indicated that it was desirable to progress along the continuum, and a follow up question *What is holding you back progressing to the next level?* solicited 13 responses from the 16 interviewed in Year 2. The reasons cited were evenly split between two factors: lack of ICT infrastructure (7 responses) and time to learn (6 responses).

The continuum was presented to participants at the beginning of their second year of teaching at a time where their knowledge of the curriculum, pedagogical approaches and classroom management techniques were developing. These pressures may have combined to an extent that participants may have felt some frustration with their inability to come to terms with the ever expanding set of ICT options that are available to them:

I think it is mainly time. Having the time for me to learn and be comfortable about all the little bits and pieces before I can give it the kids. I think time is the huge thing, because we have got all the facilities here to do it. Time to learn, time to investigate, time to get on the net and search out all of these wonderful websites. It will take me hours to critically appraise those websites. You have to have that time. (5, 367 [23])

I would like to push the boundaries of learning and doing some of these things like making sure that I am incorporating it, and then getting the kids to incorporate it but it is just fitting it in my timetable to do that. There are so many things that I need to do, that I don't know how. Like with blogging, I don't really know what it is. I know it is like putting in information, writing a comment. I know I’ve seen it but I'm not really interested in it. So I haven't seen the potential. (34, 419 [23])

Transformation freaks me out a bit because it has all of the Internet and Wikis and that stuff. I don't understand those. I guess with the professional development question, because I don't know anything about those sorts of things in the
transformation examples. Maybe if I learn more about them then I might be able to use them. ([22, 365, [29])

These comments suggest that participants claimed to be open to using ICT in ways in which they were not familiar. However lack of time (participant 5), lack of interest (participant 34) and limited opportunities for professional learning (participant 22) were all cited as reasons for not engaging in more creative uses of ICT in the classroom. These were typical of most responses gathered at interview.

In acknowledging the gaps in imagining the potential of ICT, there was strong consensus amongst participants that their ICT skills exceeded their schools’ expectations. Comments indicate that participants were actually being cast in leadership roles as far as their ICT knowledge is concerned. In the Year 2 round of interviewing, participants were asked whether their knowledge and skill levels in relation to ICT integration was what their schools expected of them. Typical responses included:

New teachers are a little bit more up to date on the new programs and general computer use. I think we’re more flexible and willing to use it whereas teachers who have been in the profession for a lot longer are a little bit more resistant to it because it’s just too hard to use. ([4, 49, [29])

My [ICT] knowledge would surpass what my school expects of me. At the moment being the only one with a whiteboard and the one that possesses the most skills. No one has much of an expectation of me. ([29, 329, [29])

The expectations placed on participants to use ICT, therefore, were minimal. Simple uses of ICT to prepare and present information were seen by most schools as adequate.

5.2.4 Observed use of ICT

Thirty classroom observations were conducted during the study (8 observations in Year 1, 16 in Year 2 and 6 in Year 3). One of the functions of the observations was to consider if participants’ claims about ICT use translated into their classroom practices.
During observations, a protocol developed by Judson (2006) called FIT:COM was used to gauge participants’ use of ICT in the classroom context. This protocol, fully described in Chapter 3, contains segments for qualitative description of ICT use, but also a 25 item instrument categorised under five subscales: Design of technology integration, Class dynamics, Meaning and purpose, Content and knowledge and Technology as tools. Each subscale contained 5 statements and participants were given a score on each item on a 5 point scale from 0=never occurred to 4=frequently occurred. The total possible score for each subscale is, therefore, is 20 (5 questions at the maximum score of 4) and for the instrument, 100 (25 questions at the maximum score of 4).

Table 5.2 shows the aggregated mean scores for each of the 3 years that participants were observed.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 (n=8)</td>
<td>48.6</td>
<td>12.2</td>
</tr>
<tr>
<td>Year 2 (n=16)</td>
<td>38.9</td>
<td>18.5</td>
</tr>
<tr>
<td>Year 3 (n=6)</td>
<td>52.7</td>
<td>12.9</td>
</tr>
<tr>
<td>Weighted Average</td>
<td>43.9</td>
<td>16.9</td>
</tr>
</tbody>
</table>

Judson (2006) developed FIT:Com and reported an overall mean for his sample of 47.7 (n=32, SD=18.9) concluding that, although most teachers identified strongly with constructivist convictions, they failed to demonstrate these in practice. The overall mean for this research of 43.9 (n=30, SD=16.9) is comparable, and similar conclusions could also be drawn. Figure 5.4 shows the mean scores for each of the subscales for data collected over the 3 years.
An examination of the subscales shows that participants registered low scores on items that called for student control of ICT to solve problems and manipulate information (i.e. the Technology as tools, Meaning and purpose and Class dynamics subscales). The subscales that scored higher were those that emphasised the teacher design of the ICT environment and its linkages with curriculum (Design of technology integration and Content and knowledge).

These results indicate that participants combined Mishra and Koehler’s (2006) content knowledge with technological knowledge reasonably effectively. However, the lessons observed seemed lacking in the assimilation of pedagogical and technological knowledge. For example, on the Class dynamics subscale, students rarely had a choice in the selection of ICT and were not encouraged to use ICT to generate conjectures or alternative solutions; on the Meaning and purpose subscale, ICT were not used to create work or solve problems; and on the Technology as tools subscale, students were not required to construct models or communicate ideas.
Almost half of the lessons observed (n=14) involved the teacher-directed use of interactive web materials typically using a multimedia projector and/or interactive whiteboard in a whole-of-class context or rotational format. A further 7 observed lessons provided computers to facilitate student access of (primarily) web-based resources. However, 4 of these lessons were unstructured and arguably lacked purpose being characterised by students “surfing” through a set of links to interactive games of variable educational quality. It would seem then that 21 of the 30 lesson observed were consistent with a worldview that conceptualises ICT as a mechanism to help make teaching easier through the mediation of perceived motivational and visual web resources. Of the remaining 9 lessons, 7 used ICT for purposeful, student-directed creative work that involved video editing (2 lessons), web design (1 lesson), student use of Word to develop reflective journals (2 lessons), the use of PowerPoint to create a clay animation slide show (1 lesson) and student use of a digital video camera in the making of a puppet show movie about bullying (1 lesson). Two lessons were about acquainting students with software (i.e. teaching students IT skills).

Observations confirmed that students were provided with limited opportunities to seize the locus of control for their learning using ICT. Item 7 of the FIT:COM instrument, *Students had a voice in the selection of technology tools and how the technology was to be utilised*, was particularly revealing. Out of 30 observations on a scale of 0-4 where 0=never occurred and 4=occurred frequently, the mean scores for this item over the 3 years of the study were 1.4 in Year 1 (n=8), 0.8 in Year 2 (n=16) and 0.7 in Year 3 (n=6). These results are alarming given that participants claimed to hold beliefs that resonated with identified attributes of meaningful learning.

In short, it is probable that low FIT:COM scores are related to the tendency of ICT to be used as a teaching tool to reinforce concepts rather than as a cognitive tool for students
to engage in higher-order thinking. In making this claim it is noted, however, that participants observed in this study often had limited ICT at their disposal. Seventeen of the 30 observations were in situations that comprised five or more students per ICT device. Of the 13 instances where the ratio was less than five students per ICT device, 5 of these were in computer laboratories. Figure 5.5 shows observations over the 3 years of the study on this basis as (a) classrooms with five or more students per ICT device and (b) classrooms with less than five students per ICT device.

![Figure 5.5](image)

*Figure 5.5. Mean scores for the FIT:COM observation instrument over the 3 years of the study by number of students per device.*

The observations in classrooms with less than five students per ICT device performed slightly better on the FIT:COM instrument probably because students were empowered...
to use ICT tools in these circumstances rather than simply view the teacher using them or wait to be rotated to an ICT station. However, it should be noted that the FIT:COM scores, even in these circumstances, were quite low.

Observations confirmed that participants tended to use the affordances of the Web for reinforcing learning and for inquiry. This is entirely consistent with participants’ worldview of what constitutes ICT as described in the previous chapter. Participants were not inclined to empower students with the locus of control over the ICT. Again this is consistent with the findings derived from interviewing.

5.3 ICT and school leadership

The way in which participants perceived the leadership at the school, as this related to ICT integration, depended more on implicit rather than explicit messages provided by the school leadership. For example, the following participant notes the critical role of the school principal, but also the impact of concrete initiatives like the 1:1 laptop program along with the outcomes that are expected:

I think it [the vibrant atmosphere in relation to ICT integration] has got something to do with the Principal, and his views on ICT use. Especially if he thinks it's good for the student’s education. I think it is kind of coming from him and spreading throughout. (22, 425, [27])

Participants gauged the quality of decision-making in relation to ICT largely on the extent to which support translated into:

- Concrete ICT infrastructure and technical assistance that would help participants in the classroom.
- A sense of being valued in decision-making processes.
5.3.1 ICT Infrastructure and technical support

A recurrent theme in this thesis has been the lack of physical access to ICT infrastructure particularly in the public education sector. It has been shown that lack of access resulted in teaching approaches such as rotating small groups of students through available computers, booking into computer laboratories to use ICT, or using non-ICT teaching strategies. Participants generally acknowledged the significant costs associated with developing and maintaining ICT infrastructure. However, some questioned the way in which available funds were prioritised in their schools:

We were told that the school had no money for it. I don't think the Principal really valued ICT. I think that was what it was. Anything he valued, money went towards such as sports, and things like that. If he didn't value it money would not go towards it. (8, 567, [27])

You would think that we would have some priority. The money will go elsewhere. If we want anything we have to apply for funds outside of the Finance Committee. We are not a priority. We get verbal encouragement, we get pats on the back, but that is not what we are after. (3, 232, [27])

It is just about resources. Obviously private schools have got the resources, government schools not so much. That’s the way it is. That’s life. (13, 131, [27])

Participants from the secondary sector felt that science, mathematics and English language learning areas were valued more than, for example, their areas of art, music and language studies. In the minds of participants, it followed, therefore, that those learning areas that were valued would have a priority in ICT infrastructure funding along with priority access to the computer laboratories at the school.

In the primary settings observed, there was also a tacit understanding of priority with early primary classrooms being the last to be equipped with ICT infrastructure. For example, in the 11 primary schools visited in the second year of the study all had either implemented the interactive whiteboard beginning with Year 6 and 7 or were planning to do so in this manner.
At interviews with principals or deputy principals the question *What do you see as the major barrier in integrating ICT into your school* was posed. Seven of the 11 principals or deputy principals identified the ability to keep up with IT hardware and software, along with its associated costs, as one of the main barriers. For example:

- Keeping up with the changes in technology. We can be enthusiastic about it, and get things up and running but keeping up with it is quite significant. (2P, 26, [34])

- We have a problem with just trying to keep up to date with all the new technology and software. (23P, 165, [34])

- We have had a barrier with teachers not being able to get enough computers to integrate ICT. We only had the one bank of laptops. Now we have got a couple of computers in every teacher's room. So, now each year, we are going to get another bank of laptops. (32P, 345, [34])

Eight principals or deputy principals also saw the problem of staff reluctance and subsequent need for professional learning as a barrier. For example:

- Actually, I think the teachers are probably a little bit reluctant. Not because they don't see benefit, but because they lack confidence in their own ability. So it is taking some time for teachers to become comfortable with integrating ICT to that pedagogy. (30P, 275, [34])

- They [teachers] think “it is all too hard. It is too much time, I don't think I can use it.” (32P, 345, [34])

- It takes a long time to train people up and then we might have a rotation of staff so we train somebody up who's really good and they are head hunted to be a deputy principal somewhere. You lose expertise so we’re constantly trying to train everybody up. (4P, 96, [34])

School leaders seem to have been faced with a difficult conundrum in managing the transition to ICT integration. If the focus is on ICT infrastructure, then there is a risk of teaching staff not using this because of lack of knowledge and skills. If the focus is on knowledge and skills then there is a risk that teaching staff, fully enthused, will be disappointed with the level of ICT infrastructure available to them in their classrooms. In a sense, the latter characterises the situation that many participants in the study were
faced with. On completing their university studies many expected to find themselves in well equipped classrooms only to discover that this was not the case:

I think last year at [my school] I would have liked the kids to have more access to ICT. It just was not available at school which I think is a real shame because I think those kids are going to miss out on valuable skills that they are going to need. Because they might not have a lot of technology at home, it was important that it be at school for them to be able to access. (8, 563, [38])

I would have liked to use ICT a lot more. Lessons could have been a lot more fun and exciting with the use of it. (9, 480, [38])

Finding an appropriate balance between expending resources on ICT infrastructure and/or staff knowledge and skills could depend on a range of factors including the level of existing ICT infrastructure at the school, the demographic of teaching staff, and whether the culture of the school is open to change. Certainly, the 30 participants observed in this study were open to change and had adequate knowledge and skills to be able to use ICT to benefit student learning. Of those that had access to adequate ICT infrastructure in their classroom (e.g. less than five students per ICT device) all opted to use it. The inference here is that if ICT infrastructure was available to beginning teachers, they would almost certainly use it.

Over the 3 years of the study, 20 different schools were visited during observations. Of these, 12 had less than 150 students. From a perspective of managing ICT infrastructure, these are relatively small business entities and the cost of maintaining dedicated IT support staff is generally prohibitive. Principals or deputy principals identified support for ICT infrastructure as a critical issue:

The cost of technical support is expensive. We’re lucky that we have got a new system. We did a lot of planning before we started so we tried to cut out areas that were going to be problems for us. Technical support costs us a lot of money and we’re only a small school so we have to be very careful with how we run those sorts of things. (4P, 96, [34])
I suppose the technical support is another issue. Being so far away from a major centre, there is no one here that can look after that. With the staff that we have here we do the best that we can. (20P, 374, [34])

Schools, particularly in rural and remote areas found it difficult to develop and maintain their ICT infrastructure. For example, an observation of Participant 20, located in a remote high school, revealed that although the school had purchased an interactive whiteboard 12 months ago, it had not yet been connected:

I have tried chasing it up with the person who was supposed to do it. That was their project. We need to get a quote from an electrician. There is no electrician in town. Until we get the quote, we can't get it properly installed. There is no money in the budget. (20, 252, [9])

Providing pedagogical support to teachers to help harness the potential of ICT was another issue that schools grappled with over the period of the research. At the inception of the study, one school visited had set up a dedicated ICT specialist teacher position within the school to help teachers develop their ideas in integrating ICT. Table 5.3 provides excerpts from interviews with Participant 2 showing that the initiative had some success.

The dialogue in Table 5.3 suggests that the ICT specialist teacher performed a number of functions at the school including mentorship, technical support, coordinator for ICT decision-making, catalyst for other teachers exploring ICT options, and as a means of professional development in ICT integration.

Of the 20 schools visited during the study, 4 had implemented models of ICT pedagogical support. Three of these had put in place a dedicated proportion of an FTE (full time equivalent) teaching staff member and one instituted a teacher/librarian position to assist teachers with their ICT integration ideas. Two schools also implemented a Cybercafe initiative, which was a way in which teaching staff could share ideas in an informal atmosphere before or after school. For all of these initiatives,
it seems that participants sometimes saw that the culture of the school was lacking in enthusiasm for change. This may have been an important factor in stalling participants’ use of ICT. Certainly in the literature, there is evidence to indicate that sustainable use of ICT is difficult without a sense of community either within or beyond the school. As Robertson, Webb and Fluck (2007, p. 21) report:

Our research has failed to find any teachers who had achieved a high level of ICT use in their classes without being part of a community of practice.

Table 5.3: Excerpts of Dialogue With Participant 2 Over the 3 Years of the Study Discussing the Role of the ICT Specialist Teacher

<table>
<thead>
<tr>
<th>Year</th>
<th>Interviewer</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Have you got the confidence to experiment with ICT?</td>
<td>Yes, we have an ICT specialist teacher as well so she helps. There is lots of helping us out and professional development. (2, 57, [27])</td>
</tr>
<tr>
<td></td>
<td>Why do you think your school has had so much success in integrating ICT?</td>
<td>The staff that we’ve got and that teacher, the technology specialist, she is a big technology buff. She uses it a lot herself. When we all came together we decided to make technology a focus. Kids are using it at home and so they are expecting it at school. We need to use it and involve parents. We have a website where we can post kids’ work. We see it as the kids are going to have to use technology in high school next year and they just need to use it. It has to be a priority. (2, 73, [27])</td>
</tr>
<tr>
<td>2</td>
<td>So there is a general feeling that things are happening with regard to ICT?</td>
<td>Yes, definitely. We have been able to get [the ICT specialist teacher] with the kids. She has got more time and also the budget. (2, 187, [27])</td>
</tr>
<tr>
<td>3</td>
<td>Have your school’s ICT infrastructure and support improved in the last 12 months?</td>
<td>[The ICT support teacher] is brilliant at facilitating and she will show you how to do it. We do have cybercafes where we have little projects so that is where I got started. She showed me the basics and I just go to her when I need help. Or access some tutorials on the Internet and try to figure it out. (2, 239, [27])</td>
</tr>
<tr>
<td></td>
<td>Do you feel supported at your school in using ICT?</td>
<td>Definitely. The admin people are really good. They give you time or PD [professional development]. So that's great. [The ICT specialist teacher] is brilliant. You can e-mail her at any time, and she will get back to you and offer support. Or she will come down and have a look. And also we have got the ICT Committee. And they say, if you want to try it go ahead and try it and see if it works. And if it doesn't work, it doesn't matter. (2, 265, [27])</td>
</tr>
</tbody>
</table>
In summary, ICT integration was seen as a priority to most schools visited. It was also seen to pose significant challenges to schools particularly in areas of keeping up with technology and providing appropriate professional learning for staff. Participants gauged the quality of leadership with respect to ICT on concrete actions. Some schools had put in place initiatives to support staff and these seemed to have had a positive impact.

### 5.3.2 Decision-making processes

Research has shown that collaborative decision-making processes lead to greater ownership by stakeholders (Tiegerman & Radziewicz, 1998). In this study, six of those that were observed in Year 3 of the study (participants 2, 9, 22, 29, 30 and 35) were actively involved in school committees that made decisions on ICT strategy and infrastructure. These participants tended to be more active and positive in their use of ICT. Figure 5.6 shows how these participants rated themselves on the schema developed by Newhouse, Trinidad and Clarkson (2005) in Year 3 of the study.

![Figure 5.6. Participant perceptions (Year 3, n=14) of their use of ICT in relation to the continuum developed by Newhouse, Trinidad and Clarkson (2005).](image-url)
It is interesting that 4 of the 6 participants that opted to serve on a school ICT committee rated themselves at beyond Integration in the third year of the study. Although this does not infer a causal relationship, comments made during interviews in Year 2 and 3 suggest that being part of decision-making processes may have helped to connect participants to other staff uniting them behind school objectives. It also encouraged risk taking in ICT integration:

I think the school is very supportive of people trying new things and joining committees, and things like that. So, that is one area where I thought, I want to do it. (2, 269, [27])

I was on the ICT Committee last year. Being on the ICT Committee meant that at least you have a say in what we're going to do. There are a few things that I was pushing for myself at that time. Getting digital cameras in every class and getting a bank of laptops. The whiteboard and everything was already in the works, but something like a bank of laptops would be fantastic. (30, 353, [27])

Membership of ICT decision-making groups clearly gave participants a voice in which to pursue their own interests and also enabled them to tap into collaborative and professional learning opportunities:

As ICT committee leader she tells me that this is on, and that is on, and you want to do this? It has been really good collaborating with her. Really good. (2, 370, [27])

Others found membership of an ICT committee as a way of “managing up” within the school:

[Participant]: I've actually joined the IT committee at the school now.

[Interviewer]: Do you feel you are more empowered by that?

[Participant]: Yes in a way, but also not in a way because the Principal heads it up and he has no idea of technology and it is very difficult for the five of us to explain what we are talking about to him so that he understands it. And understands what we are trying to put forward. (9, 488, [27])

The composition and mandate of the committee made a difference with some participants feeling that, as beginning teachers, their opinions mattered less than others:
[Interviewer]: You mentioned that you were at the ICT committee last year. Did being part of the committee make a difference to you?

[Participant]: Yes and no. I was still a graduate teacher so my voice was not as loud. (30, 430, [27])

In Year 2 of interviewing, the question “Do you feel supported at your school in using ICT?” was posed. Out of the 16 interviewed, 10 indicated that they did feel supported. It was notable that these participants had either been provided with ICT infrastructure or access to professional learning:

The Principal was really “gung ho” about getting these eBoards [interactive whiteboards] in. We’ve all got one now since last week. She is away at the moment and when she gets back, we will be having a few more PDs [professional development opportunities]. We’ve already had a couple this year so it has really been a focus at our school. (21, 388, [27])

Yes my Principal is pretty supportive. She will let me go and do a day’s PD for instance. So yes, I think she sees it as a priority. (29, 335, [27])

Those who did not feel supported were generally those that had limited access to ICT infrastructure, technical support or professional learning. None of those that did not feel supported served on the school ICT committee.

As beginning teachers, participants perceived themselves as being more competent in using ICT than their more experienced colleagues:

We are pretty proficient in using computers but the older teachers just stay away from them. They don't want to use them. I think there could probably be more support. (4, 360, [28])

This generation is all about technology. They are using it at home so they may as well use it here. So keeping up with that and giving students what they need, I guess some of the teachers are not so keen. (35, 160, [15])

These comments indicate that some participants may have worked in environments where other teaching staff might not have been as positive as they were about using ICT. This may have tacitly contributed to an avoidance culture (Selwyn, 2002) or perhaps limited risk taking in using ICT.
Being brought in to decision-making processes, then, seems to have connected participants to school initiatives in ICT and may have enhanced their opportunities to access ICT infrastructure, support and professional learning opportunities. Participants perceived themselves to be more enthused about using ICT than their peers.

### 5.4 ICT and the wider social context

Participants in the study exhibited knowledge of, and interest in, the social implications of being part of a digital and increasingly connected world. ICT was seen as integral to contemporary and future society and therefore many argued that it needed to be embraced for the benefit of their students:

> I think they have just grown up in a multimedia society. They have got used to it. We grew up with books and computers were introduced so we were quite happy with both. I think because they have had computer games, it is just the way they have learnt to understand. (20, 304, [13])

> I think it is such a huge part of their world that we need to try and keep up with it and give them what they want. (35, 466, [13])

Prensky (2001) suggests that today’s generation of students are different from those of the past, exhibiting traits such as multi-tasking and connectedness to others through ICT. This line of thinking was understood and embraced by most participants that took part in the study:

> I don't see any way forward without it because the way kids learn these days is through technology. And they are doing 50 million things at once. They will be on the computer, they will do that work, but they will also be texting a friend and they will be IMing [instant messaging] a friend and listening to music at the same time. So they are multitasking. If you take that away, they don't know what to do with themselves. (23, 402, [13])

Participant 23 acknowledged that she had taught in a conventional way so far in her career, but indicated a desire to re-think her pedagogy in order to move with the times. However, there was an acknowledgement that for all of the opportunities that came with a digital world, there were also down sides. Participants identified two primary concerns
that impacted on the way in which they might use ICT in their classrooms: opportunity costs of using ICT and safety issues.

5.4.1 Opportunity costs of using ICT

Participants, particularly those with responsibility for early primary cohorts, felt that using ICT, in and outside of school, had an important opportunity cost for students. This was perceived as sometimes being detrimental to their learning and development. Attributes such as communication skills, physical fitness and team skills were felt to be at risk in situations where ICT were not used in a balanced way at home and at school:

There was a situation where one of the boys in my class got a PlayStation and he said that getting the PlayStation was the best day of his life and he hated going outside. So one of the negative impacts of ICT is that if they are using it too much, then they’ll miss out on play. (18, 115, [9])

The kids are so motivated by it, it is so visual for them. In a world where, I don't know the statistics, but a lot of kids would just go home and play on the PlayStation and watch TV for most of the afternoon or weekend. It is something that grabs their attention straight away when they see the screen come on. Obviously they don't go out for physical activity. (21, 448, [35])

ICT was clearly framed in a broader societal context and the proliferation of entertainment and social networking tools was sometimes seen as antagonistic to the creation of a safe learning environment. Participants located in upper primary and secondary schools tended to feel particularly frustrated with the pervasive effect that ICT was having on students’ communication skills:

I have got a little bit of a beef with e-mail. I think it stops communication. It affects the way that they write. Just through SMS and typing, it might have affected that kind of communication. They don't really communicate in a very comprehensible way. Some of it, I don't know what that word means. It's situational language. (34, 393, [9])

Kids spend so much time on the computer. I’ve noticed that they go on to that abbreviated sort of language. That type of writing. And they write things as it sounds rather than it is spelt. (12, 13, [9])
These sentiments may have contributed to some participants trying to restore the balance with respect to the time spent on activities that required ICT.

5.4.2 Safety issues associated with the student use of ICT

Three participants from the secondary sector identified cyber-bullying as a significant threat to the smooth running of ICT in a classroom. For example:

"You’ve got Myspace and cyberbullying so you have all of that kind of thing. A lot of different issues can come across." (22, 146, [9])

Three participants from the primary sector identified the threat of students giving out private information on the Internet to potential predators. All three linked this to the use of Myspace, and concluded that they would be reluctant to implement social networking tools in a classroom environment.

In summary, participants showed evidence of being cognisant of the opportunities and challenges of the digital world. Far from being evangelistic about ICT, the majority of participants were skeptical of the value of some recent developments.

5.5 Influence of participants' pedagogical beliefs, knowledge, dispositions and skills on classroom practices

The combined impact of participants weighing up the affordances and risks of ICT contributed to a fairly low level of ICT use in the classroom. Table 5.4 summarizes the relationships between pedagogical beliefs, knowledge, dispositions and skills and classroom practices.
### Table 5.4:
**Relationships Between Pedagogical Beliefs, Knowledge, Dispositions and Skills in Using ICT and Classroom Practices**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Characteristics</th>
<th>Classroom practice</th>
<th>Consistency</th>
</tr>
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<tbody>
<tr>
<td>Pedagogical beliefs</td>
<td>Participants held beliefs in accordance with the principles of meaningful learning as described by Jonassen, Peck and Wilson (1999). In particular, participants were attracted to authentic and communicative attributes.</td>
<td>ICT was not used in authentic problem solving and communicative ways (e.g. Web 2.0). However, the study found examples where ICT were used as a platform for non-ICT based authentic tasks and classroom discussions. These situations could have potentially deepened students’ understanding.</td>
<td>Mostly inconsistent.</td>
</tr>
<tr>
<td>Knowledge of ICT</td>
<td>Participants felt that the Web had strong motivational potential and that this could help them as teachers respond to students’ learning styles.</td>
<td>Throughout the study, participants used the Web as a teacher- and learner-driven reinforcement and inquiry tool that included plenty of graphical and auditory material. Those that used interactive whiteboards attempted to optimise student involvement.</td>
<td>Partly consistent.</td>
</tr>
<tr>
<td>Attitudes</td>
<td>Participants exhibited positive attitudes towards ICT and an openness to using ICT in the classroom.</td>
<td>Participants used a basic suite of ICT tools that they were familiar with and generally did not attempt to take risks or challenge themselves by stretching the limits of innovative teaching. There was limited impetus to do this as participants, in the main, were seen as leading the way in ICT integration in their schools.</td>
<td>Partly consistent.</td>
</tr>
<tr>
<td>Perceptions</td>
<td>Participants perceived that they had a reasonable level of competence with ICT. However, they discerned that the student use of ICT was complex and sometimes had consequences that were not desirable in the classroom.</td>
<td>Participants pursued a “softly, softly” approach to ICT integration not wishing to push the boundaries too far because of concerns about undesirable consequences in their classroom (e.g. distraction and dependency).</td>
<td>Consistent.</td>
</tr>
<tr>
<td>Skills</td>
<td>Participants were competent in the use of the Web and a basic suite of presentation and word processing tools. Those that had an interactive whiteboard quickly became competent in using it.</td>
<td>Participants used the tools that they were familiar with, but apart from the interactive whiteboard did not develop ICT skills to any great extent.</td>
<td>Consistent.</td>
</tr>
</tbody>
</table>
5.6 Influence of the socio-cultural setting on participants pedagogical beliefs, knowledge, dispositions and skills

The socio-cultural setting had a variable impact on participants’ pedagogical beliefs, knowledge, dispositions and skills. In terms of the aspirations that participants had in the performance of their duties as a teacher, the impact appears to have been profound. Nine of the 28 participants interviewed in Year 1 referred to themselves as being idealistic at the inception of the study and having become more realistic as their career progressed:

I think I was idealistic about what teaching was. I think actually being in a classroom and experiencing it hands-on it makes you realise that it is not everything that you think it is. (8, 461 [36])

I think when I left university was very idealistic. I am a bit more of a realist now. (9, 376 [36])

I have more realistic perception of their ability levels. I know that theoretically, you should be letting kids find out and construct their own learning, and I know that computers are supposed to be a great way of doing that. But I find that it is a major consumption of time and time wastage in allowing them to do that without first establishing the proper processes. (32, 257 [2])

The forces that contributed to this shift are complex and may have been bound up firstly with participants having an unrealistic perception of what they were capable of as teachers. However, participants also referred to holding naïve views about their students’ maturity and enthusiasm to learn, the values of their school and the levels of cynicism exhibited by their peers about education in general and change initiatives like ICT integration in particular. These issues will be further discussed in the next chapter in dealing with how they might have impacted on participants’ appetite for change.

Participants’ attitudes remained positive towards ICT, possibly because the uses to which participants were putting ICT were received positively (i.e. students were
motivated). Participants indicated a desire for more ICT by calling for increased student-computer ratios and/or interactive whiteboards.

The relatively low level of technological-pedagogical knowledge (Mishra & Koehler, 2006) exhibited by participants throughout the study seems to have remained constant. This knowledge gap is probably one of the areas where professional learning could have really made a difference to participants. However, the shift from idealistic to realistic beliefs about teaching may have also played out in the area of ICT integration. Many participants seemed to have appraised ICT infrastructure and student attitudes/behaviour as major barriers to the transformative potential of ICT contributing to a level of skepticism about original and inventive uses of ICT. A widespread lack of ICT infrastructure may have also contributed to some deskilling over the period of the study, particularly amongst secondary participants.

The study will now examine the implications of these changes in greater depth.


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CHAPTER 6
Findings:
Changes in Beliefs, Knowledge, Dispositions and Skills

6.1 Introduction

This chapter examines the extent to which participants’ pedagogical beliefs and their knowledge, dispositions and skills in using ICT changed during their time as teachers in the workplace. It follows a similar format to that which was used in Chapter 4 which introduced the research findings through focusing on beliefs and knowledge, dispositions and skills as discrete constructs. However, whereas Chapter 4 provided a snapshot of these constructs in Year 1 of the study, this chapter will use data from all 3 years of the study. This will help to discern (a) what changes (if any) might have taken place and (b) factors that may have contributed to these changes.

6.2 Beliefs and knowledge

As discussed in Chapter 4, the study distinguishes between teachers’ pedagogical beliefs and knowledge, and their beliefs and knowledge in relation to ICT integration. Participants’ pedagogical beliefs were examined through the Pedagogical Beliefs Questionnaire that was administered in Year 1 and Year 3 of the study. Data on beliefs and knowledge in relation to ICT integration was procured through interviews in each of the 3 years of the study.
6.2.1 Pedagogical beliefs

6.2.1.1 Quantitative aspects of the questionnaire

In Year 1 of the study 35 participants responded to the Pedagogical Beliefs Questionnaire; in Year 3, 20 participants responded. Two of the original 35 participants had left the teaching profession by the beginning of Year 3 of the study. Therefore, the response rate for the Year 3 iteration of the questionnaire was 20 out of 33 or 61%.

The Pedagogical Beliefs Questionnaire offers an overall index of the extent to which participants’ pedagogical beliefs resonate with the attributes of meaningful learning as described by Jonassen, Peck and Wilson (1999). The overall mean score for the 20 respondents in Year 3 of the study was 3.6 with a standard deviation of 0.26. The same overall mean score was recorded at the inception of the research. The standard deviation was slightly higher than the 0.21 recorded in Year 1. Participants’ degree of resonance with all of the items of the questionnaire for Year 3 of the study by subscale is presented as Appendices G1-G5.

The highest mean score in Year 3 was 4.1 (compared with 4.2 in Year 1) and the lowest score was 3.0 (the same as in Year 1). In both cases, these scores were recorded by different participants. Of the 20 respondents to the questionnaire in Year 3, nine recorded mean scores that were broadly comparable to the scores that they registered in Year 1 (differences of 0.2 or less). Seven respondents showed an increase in resonance to the identified attributes of meaningful learning and 4 showed a decrease. Participants that exhibited an increase in resonance are denoted by a light shaded line in Figure 6.1. Participants with a decrease in resonance are denoted by a dark shaded line. Of the 20 respondents, 4 were located in secondary schools and 16 were located in primary schools.
Details of the specialist learning areas of respondents from secondary schools are also shown in Figure 6.1.

In Year 3 the number of secondary respondents to the questionnaire was low and therefore inferences should be treated with caution. However, it is notable that all secondary respondents were located in the lower half of the distribution. This is consistent with the results presented in the Year 1 iteration of the questionnaire.

The four participants that registered a decrease in resonance with the identified attributes of meaningful learning did so by fairly small margins. The largest decrease in mean score was recorded by Participant 21 (-0.29) followed by Participant 33 (-0.28). The largest increase in mean score was recorded by Participant 22 (+0.46) followed by Participant 4 (+0.38). Overall, responses to the Pedagogical Beliefs Questionnaire held reasonably constant over the period of the study with individual participants only recording subtle changes in one or two subscales.
Figure 6.1. Changes in participants' degree of resonance with Jonassen, Peck and Wilson's (1999) attributes of meaningful learning (n=20) as measured by overall mean score in the Pedagogical Belief Questionnaire in Year 1 and Year 3 of the study.
Aggregated subscale data collected in Year 1 of the study suggested that participants supported Jonassen, Peck and Wilson’s (1999) cooperative and authentic attributes of meaningful learning to a greater extent than the active, constructive and intentional attributes. Table 6.1 shows that this trend continued in Year 3.

**Table 6.1:**
*Mean Scores for Questionnaire Administered in Year 1 and Year 3 Presented by Subscale*

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Year 1 Mean (n=35)</th>
<th>Year 3 Mean (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Cooperative</td>
<td>4.1</td>
<td>4.0</td>
</tr>
<tr>
<td>Constructive</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Authentic</td>
<td>3.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Intentional</td>
<td>3.6</td>
<td>3.7</td>
</tr>
</tbody>
</table>

In Year 3, participants still registered a lukewarm response to the Active learning subscale, and were more positively oriented to the Cooperative and Authentic subscales. However, there was a slight increase in the Authentic learning subscale and a slight decrease in the Cooperative learning subscale. Decrease in resonance with the Cooperative learning scale was quite widespread with 14 out of 20 respondents either recording the same mean score or recording a decrease. Mean scores for all respondents to Year 1 and Year 3 of the questionnaire are provided by subscale as Appendices H and I.
In summary, data from the Pedagogical Beliefs Questionnaire suggests subtle, rather than fundamental, changes in participants’ pedagogical beliefs. Cooperative learning slightly lost favour amongst participants over the period of the study. The apparent erosion of beliefs about cooperative learning did not seem to have impacted on other aspects of meaningful learning which suggests that each attribute of meaningful learning should be investigated as discrete constructs rather than be collapsed under an umbrella term like social constructivism.

6.2.1.2 Corroborating/disconfirming evidence from qualitative data

As in Year 1 of the study, participants were invited to respond to six open-ended questions in the Pedagogical Beliefs Questionnaire. One of these, What knowledge is necessary for effective teaching, was designed to gain a sense of the balance that participants afforded to content knowledge, pedagogical knowledge and technological knowledge. The findings in Year 1 indicated that participants rated pedagogical and content knowledge reasonably evenly (34% of responses and 31% of responses respectively). However, technological knowledge was not mentioned by any participant as being a necessary ingredient of effective teaching.

In Year 3 of the study, the same question was posed again. Results comparing the 20 participants who completed the questionnaire in Year 3 with their responses in Year 1 are provided as Figure 6.2. A total of 36 specific answers were offered in response to this question in Year 1 (some respondents provided more than one answer); 39 specific answers were provided in Year 3. These answers were organised into eight categories.

In Year 3 participants valued pedagogical knowledge more highly than they did in Year 1 of the study (an increase from 28% to 46%). Participants tended to value
knowledge of students’ needs, behaviour management and knowledge of assessment less in Year 3 than they did in Year 1 of the study. Again in Year 3, technological knowledge was not mentioned by any participants as being necessary for effective teaching.

![Figure 6.2. Comparison of the proportion of participants’ responses (n=20) to question (39) of the Pedagogical Beliefs Questionnaire: What knowledge is necessary for effective teaching? in Year 1 and Year 3 of the study.](image)

As in Year 1, respondents were also invited to articulate their philosophy of teaching by answering two open-ended items on the Pedagogical Beliefs Questionnaire: (36) To you, what is teaching; and (40) Describe the important components of your philosophy of teaching. In Year 3 all 20 respondents provided answers to both questions.

In examining these data, the most striking feature from the Year 3 iteration of the questionnaire is that participants provided more articulate and sophisticated responses. It is possible that the experiences that participants gained in their first 3 years in their profession led to an increase in certainty about what constitutes effective teaching and
learning. For example, the following excerpts show that Participant 8, who incidentally did not register any change in the Pedagogical Beliefs Questionnaire, was more self-assured in her responses to both items in Year 3 of the study.

Item 36: To you, what is teaching?

[Response, Year 1]: Teaching is rewarding, motivating, exciting, fun, interesting, ever-changing. (8, 438, [30])

[Response, Year 3]: Teaching is about letting students discover things for themselves, providing students with activities that allow them to discover the answers for themselves. It’s about supporting and nurturing students, forming relationships with them. (8, 581, [30])

Item 40: Describe the important components of your philosophy of teaching?

[Response, Year 1]: Varied learning strategies, plan for students needs and interests, teach life skills. Plan-teach-assessment in a cycle. (8, 450, [30])

[Response, Year 3]: (a) Allowing students to make errors and to learn for themselves. Not everything is learnt from being told. Students need to be able to explore concepts themselves, to experiment with them and then to make their own understandings. That way, students take ownership of their own learning. (b) Making and forming relationships with the students, so that you are able to find out the important information from them, as well as having mutual respect for each other. You are then viewed and view others as a person rather than just a teacher or a student. (c) Teaching should always be about what the students need to learn, and firstly you need to find out what they already know. It’s about taking the time to allow them to explore concepts, and not rushing them. There is no point in teaching the students what they already know. (d) Also you need to find out what they want to know. Making learning, interesting and making the students want to learn. (8, 593, [30])

These responses were typical of many that exhibited a shift from concerns about teaching to concerns about learning. For example, in her response to Item 36 in Year 1, Participant 8 suggested that teaching was “rewarding”, “exciting” and “fun”. In Year 3 her focus had shifted to nurturing and forming relationships with students, and providing opportunities for students to discover things for themselves. For some who registered an increase in resonance with the identified principles of meaningful learning on the Pedagogical Beliefs Questionnaire, this shift in focus was more pronounced:
Item 36: To you, what is teaching?

[Response, Year 1]: Being responsible for children's learning and giving them the opportunity to do so in a safe and supportive environment. (4, 412, [30])

[Response, Year 3]: Teaching is about giving children the opportunity to become responsible for their own learning, but using the teacher as a facilitator for this to happen. (4, 483, [30])

Item 36: To you, what is teaching?

[Response, Year 1]: Teaching is the impartation of knowledge from one whom knows a subject to another whom does not. (29, 369, [30])

[Response, Year 3]: Teaching is providing students with opportunities to learn and helping this process through modelling and building upon what they already know. It is a calling and only certain types of people can do it. (29, 392, [30])

Clearly, for participants 4 and 29, there was a shift in focus between Year 1 and Year 3 from “being responsible” and “imparting knowledge” to supporting students’ learning through facilitation and modelling.

During interviewing in Year 3 (n=14), one of the questions posed was To what extent has your philosophy of teaching changed since you began teaching? In what ways? Four of the 14 participants reported a shift in their philosophy that was less teacher-and more student-centred. Typically, this took the form of being more responsive to their students’ needs:

It [my philosophy] started off with teach, teach, teach. Give the children all of these things and they will definitely pick it up. Now it is learn, learn, learn. It does not matter what you give them, if the kids are not into it then they are not going to learn. You can do all sorts of awesome planning, but if it is not to their needs, they are not going to learn. (2, 340, [35])

I think what has changed most likely is in the way that I interact with the kids. I think that changes depending on each group and each year level. The dynamics within the class room demanded different types of teaching. So I think that was the biggest thing, you can't think that the way that you teach will fit with the child or group of children. (23, 361, [35])

The shift in thinking amongst some participants from a focus on teaching to a focus on learning would seem to be consistent with the qualitative responses to the Pedagogical
Beliefs Questionnaire where respondents indicated a trend towards learner- rather than
teacher-centred concerns between years 1 and 3. Participant 23 represented this view
when she commented:

I am learning very quickly that you have got to do what suits that group of kids
rather than what you think is going to work. (23, 362, [35])

Of the 14 participants interviewed, 7 reported that they had become “more realistic.”
When extrapolating on what was meant by this, participants talked about (a) extraneous
circumstances, (b) the pressures of getting through the curriculum and (c) setting
themselves unrealistic expectations at the beginning of their careers.

Participants acknowledged that they had limited control over factors such as the levels of
motivation and capabilities of their students. For example, the following participant
expressed a pragmatic view:

[Participant]: I think when I left university I was very idealistic. I am a bit more
of a realist now. I am still idealistic in some areas, but I am a little bit more aware
of how things work. The feasibility of doing different activities with kids. All of
the factors that impact could make it not work as well as it could. External
factors, like the kids being away. (9, 376, [35])

[Interviewer]: Have you found that some of your ideals have been compromised?

[Participant]: Yes, and that is because of extraneous circumstances, and
sometimes behaviour management. You want to do all these student-centred
activities, group work and that sort of thing but the kids just can't cope with that
sort of environment. They are much better when the teacher gives them the
instructions and a copy down from the board working with books, working
independently. That sort of thing is what they are used to. If you try to take them
out of their comfort zone they start running amok or they get too excited and it
just falls into a heap. The amount of training that you have to do to go into with
the student-centred work is, we do not have enough time to spend three weeks
training them to do one group activity because we have got to get through so
much content. (9, 376, [35])

Participant 9 registered an increase in resonance with the identified attributes of
meaningful learning (mainly due to higher degree of resonance in the area of authentic
problem-solving), but has clearly weighed up the learning environment and her students’ capabilities and opted against what she calls “student-centred work” and “group work.” This shift in thinking was reflected in the quantitative data where Participant 9 recorded a 0.5 decrease in resonance on the Cooperative learning subscale.

Participant 32 put his change in philosophy down to a mix between getting through the curriculum and providing students with better learning opportunities:

I find that I am becoming very teacher-centred in my approach now. It’s completely diametrically opposite to what we were taught at university. But I find that it’s so much more effective in getting the bulk of the curriculum materials out and delivered. It is just more effective. I find that they learn more when I teach and guide them through it a lot better. I broke it up with a little bit of hands on stuff, but self-discovery - I just don't see it happening. That is horrible for me to say because I was completely opposite when I came out of university. You have got an espoused philosophy, and then you've got a pragmatic philosophy. They are completely different. (32, 322, [35])

Such comments are echoed in the Australian educational literature in which it is noted that ICT integration is sometimes constrained by a crowded curriculum and exam-based assessment practices (Jordan, 2008).

The move away from what was perceived as idealism was sometimes related to the unrealistic expectations that participants put upon themselves at the beginning of their teaching careers:

I think I still maintain some of the important aspects of my philosophy. I have gone through some disillusionment. I have realised that there is always more work to do and I started to think, that is enough and to take care of myself a bit more. Whereas in first year, I used to spend all weekend making resources now I have realised that that is just going to drain me in the end. I will take care of myself so that I can be a good teacher. (20, 428, [35])

You are not going to get everyone up to that particular ability by the end of the year. I thought I could heal the world. (21, 429, [35])

I think I have just chilled out a bit. I realise that I can't get everything done. It [my philosophy] is still the same, but I am not so stressed about it and I know that it can't all happen at once. (34, 459, [35])
These comments are consistent with literature (Flores, 2006) reporting that many early career teachers feel overwhelmed by the number and variety of duties that they are expected to perform. According to the author, work overload and lack of support typically leads to a shift from a student centred to a more traditional pedagogical approach.

In summary, the qualitative data suggests that participants’ beliefs shifted towards a more realistic perspective of what is achievable in the classroom whilst at the same time increasing the focus on learning as opposed to teaching.

6.2.1.3 Teacher goals

In Year 1 of the study, respondents to the Pedagogical Beliefs Questionnaire were asked to rank their top 5 teacher goals out of 13 that were identified as important by Fives and Buehl (2005). In Year 3, respondents were again asked to rank their top five goals in order of importance. A respondent’s highest ranking goal was afforded a score of five; their second choice a score of four; their third choice attracted a score of three; fourth choice scored two and fifth choice, one. The results are presented as Figure 6.3.

The results in Year 3 are similar to those that were recorded in Year 1 of the study (see Figure 4.9 in Chapter 4). Lifelong learning is still seen as the most important goal (27%, up from 23.9% in Year 1 of the study) followed by Critical thinking in students (14%, up from 11.8% in Year 1 of the study) and then Student independence (12.7%, down from 13% in Year 1 of the study).
Figure 6.3. Participants’ rankings (n=20) of the most important teacher goals from 13 identified by Fives and Buehl (2005).

Figure 6.4 provides a comparison of all 13 items in Year 1 and Year 3 of the study. The results show that participants have been relatively stable in their views on the important goals of teaching between Year 1 and Year 3. The largest decrease was Generalised skills and abilities (-3.4%) and the largest increase was Instruction based on student interests (+3.6%). Lifelong learning was still viewed as the most important teaching goal followed by the perhaps related goal of Critical thinking in students. These results indicate that many participants held views about the importance of learning that transcended constructs of standardised curriculum, assessment and even the role of schools. This seems contradictory to the new found pragmatism that many of the participants in the study claimed to have moved toward, and suggests that the identified teaching goals may be more aspirational than realistic.
**Figure 6.4.** Comparison between Year 1 (n=35) and Year 3 (n=20) rankings of 13 teacher goals identified by Fives and Buehl (2005).
6.2.2 Relationship between epistemological beliefs and pedagogical beliefs

Chapter 4 established a broad measure of participants’ epistemological beliefs through analysing the Year 1 results to the open-ended question *Where does knowledge of how to teach come from?* Participants’ responses to this question were mapped against Buehl and Fives’ (2009) categories describing possible sources of knowledge. It was found that a large number of answers (37%) indicated that knowledge can be ascribed from external expert sources and that this ran counter to the principles that underpinned participants’ claimed pedagogical beliefs.

In Year 3, the same question was posed and Table 6.3 shows a comparison between the responses from participants that completed the Pedagogical Beliefs Questionnaire in both years.

It is evident from the data in Table 6.3 that the proportion of comments suggesting that knowledge can be ascribed from external expert sources grew from 37% to 40%. This was due to a growth in the belief amongst respondents that professional learning (classified as formal preparation) was an important source of knowledge. The proportion of comments that express the source of knowledge as being socially constructed fell from 24% to 16%, and the proportion of comments that indicate that knowledge is individually constructed increased from 39% to 44%. Therefore, it would seem that after 3 years in the profession, participants have strengthened in the viewpoint that knowledge is constructed individually and mainly derived from expert sources.
### Table 6.2:
*Comparison of Year 1 and Year 3 Responses to Question (37) of the Pedagogical Beliefs Questionnaire: Where does knowledge of how to teach come from? By Categories Developed by Buehl and Fives (2009)*

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of responses</th>
<th>Proportion of total</th>
<th>No. of responses</th>
<th>Proportion of total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yr 1 (n=35)</td>
<td>Yr 1</td>
<td>Yr 3 (n=20)</td>
<td>Yr 3</td>
</tr>
<tr>
<td>External source</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Formal preparation</td>
<td>24</td>
<td>27%</td>
<td>18</td>
<td>30%</td>
</tr>
<tr>
<td>2. Formal bodies of information</td>
<td>9</td>
<td>10%</td>
<td>6</td>
<td>10%</td>
</tr>
<tr>
<td>Socially constructed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Observational and vicarious experiences</td>
<td>6</td>
<td>7%</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>4a Collaborative experiences in learning with others</td>
<td>3</td>
<td>3%</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>4b Interactive experiences in learning from other</td>
<td>12</td>
<td>14%</td>
<td>5</td>
<td>8%</td>
</tr>
<tr>
<td>Individually constructed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Enactive experiences</td>
<td>26</td>
<td>29%</td>
<td>17</td>
<td>29%</td>
</tr>
<tr>
<td>6. Self-reflection</td>
<td>9</td>
<td>10%</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>Total responses</td>
<td>89</td>
<td>100%</td>
<td>59</td>
<td>100%</td>
</tr>
</tbody>
</table>

Data gathered through Question 37 of the Pedagogical Beliefs Questionnaire in Year 3 of the study indicates that the “uncomfortable fit” between participants’ epistemological beliefs and their pedagogical beliefs, discerned in Year 1, had not been resolved.

### 6.2.3 Beliefs and knowledge in relation to ICT integration

Participants’ beliefs and knowledge in relation to ICT integration were explored at the inception of the research during interviewing in the first year (n=28), followed up in the second year (n=16) and again in the third year (n=14). This section will discuss how teachers’ beliefs about ICT might have changed through the course of the study.
Two core questions regarding beliefs about ICT were posed to participants in Year 1: Do you believe that ICT makes a difference to the way teachers teach? and, Do you believe that ICT makes a difference to the way students learn? Responses to these questions indicated that participants held a worldview of ICT integration that largely equated to accessing Web resources to make the job of teaching easier. Student use of ICT was limited to fairly superficial application of established presentation and word processing software. However, participants saw the potential of ICT to motivate their students by tapping into a range of visual and auditory learning styles that were perceived as being typical of a new digital generation. These findings are consistent with recent literature (Jordan, 2008; Judson, 2006; Phelps & Maddison, 2008).

In Year 3 of the study, two interview questions were posed to flesh out whether participants’ beliefs and knowledge about ICT integration had changed. Both of these questions were designed to challenge participants to think deeply about the way in which they conceptualised ICT. The first question To what extent has your perception of what constitutes ICT changed since you began teaching? attempted to corroborate or disconfirm the observation that participants held a particular worldview of ICT as described above. The second question Do you think using ICT has led to any improvements in the classroom? prompted participants to take on an evidence-based stance in making links between motivation, engagement and the learning that took place in the classroom. A follow up question Can you see a direct link between students being motivated and the learning that takes place? was asked if the previous question did not solicit an explicit position regarding student learning. This question was also posed in Year 1 of the study and therefore provided an opportunity to compare responses.
6.2.3.1 Participants' worldview of ICT integration

The interviews conducted in Year 3 suggest that participants’ perceptions of what constitutes ICT have changed somewhat since the inception of the study. Of the 14 interviewed 11 reported as having a fundamental shift in what ICT actually was:

I think of when I went to University, my little ICT box. I would say "we will go on a computer and play a game", but that is not what ICT is about. We have got the whiteboard; we have digital cameras; we have got integrating not just going on the computer for the computer's sake. Some schools have got computer skill time. Some schools have got labs, and they go in there and say "let's learn how to make a Word document". We have got an integrated approach where we say "let's make a Word document, but it is going to be part of an English activity." (2, 374, [35])

I would say, ICT is computers, I would even say that it is those storybooks that you can get where you click the pens onto the words and they talk. Things like that as well could be ICT because that could be used quite easily in the younger grades. It is something that is interactive that they can do quite easily and safely as well, without having to worry about having to access 50 billion things on the computer at the same time or click something that they shouldn't. Digital cameras, movie cameras, DVDs, all that kind of stuff is ICT. (8, 513, [35])

These excerpts are revealing in a couple of ways. They show that participants have broadened their perception of what constitutes ICT from “computers” to thinking about how to incorporate mobile devices like digital cameras, digital storybooks and other electronic games. The first comment also highlights that the idea of ICT being integrated across the curriculum has taken hold to the extent that learning how to use specific software seems to have become redundant in the participants’ thinking.

Some participants saw the interactive whiteboard as being partly responsible for the broadening of their definition of ICT:

For me ICT was probably the computer class. Now I rely on my interactive whiteboard from the moment the kids walk in the classroom to the moment they leave. I am using it all the time. All my instructions, everything is on the interactive whiteboard. It is really part of the classroom, whereas when I left university it was not like that at all. It was a special occasion or in the IT Lab that is when you used it. (23, 387, [35])

When I first met with you I was a new graduate and there were no eBoards in our school - in my classroom anyway. I guess I didn't really know much about
anything. It is not something that we really went into at university. We did have one ICT unit but that was more on different software packages. (21, 457, [35])

Prestridge (2009) suggests that critical discussion is vital in transforming teachers’ beliefs. Participants with strong collegial networks that had an interest and expertise in using ICT seem to have transformed their worldview more readily than participants who were situated in schools with no focus on exploring the transformative potential of ICT. The following participant worked in a vibrant and well-resourced environment:

I probably saw it [ICT integration] as the technology and enterprise aspect. I saw it as computers. I guess that is the preconception I had at school. But I think in talking to you, you kind of telling me about stuff and talking to other teachers and finding what is out there, and using different things. Like I haven't used them, but wikis and blogs and just creating Web sites. I think that I am opening up more to technology. (34, 480, [35])

The interviewing and observation process that took place was an intervention of sorts and the extent to which these interventions may have altered the views of participants who maintained involvement with the study is difficult to discern. In saying this, observations confirm that the changes to participants’ worldview, as just described, did not translate into major changes in practice at the point of concluding the study in Year 3. Perhaps this will take a little more time.

6.2.3.2 ICT integration and learning

Possible links between ICT integration and learning were explored over the three years of the study. As discussed, over this period of time participants claim to have warmed to using ICT in the classroom, and were more explicit in identifying the benefits of doing so.

Tables 6.4 and 6.5 show how participants changed their views between Year 1 and Year 3.
### Table 6.3:
**Dialogue with Participant 4 in Year 1 and Year 3 of the Study on the Topic of Whether ICT Leads to Improvements in Learning**

<table>
<thead>
<tr>
<th>Year</th>
<th>Interviewer</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Does learning with ICT have an effect on students’ understanding of ideas and concepts?</td>
<td>I suppose it depends upon what learning style they’ve got. Some kids they learn by doing, they learn through pictures, and they learn by interacting with the computer. So I think that if you are catering for different learning styles then the computer is important. (4, 35, [13])</td>
</tr>
<tr>
<td>3</td>
<td>Do you think using ICT has led to any improvements to learning?</td>
<td>As a motivational tool it is one of the best things that you can do…In terms of classroom management, I used it a lot with my kids last year. It might have been just a particular child that was on a behaviour management plan. He was able to use a laptop, and the other thing was that you could actually put them on the desk. So you didn't have kids outside, they were there. (4, 456, [13])</td>
</tr>
</tbody>
</table>

So you can see the benefits in terms of motivation and behaviour management. Is there a direct link, though, between ICT and learning? Yes. For them, they are playing an educational game that directly links to whatever we are doing whether it is multiplication or whatever it is. The games cater for the children, it’s what they like. (4, 459, [13])

In Year 1 of the study, Participant 4 was initially guarded about the benefits of using ICT before opening up in Year 3 to identify a range of what she felt were good reasons for using ICT. These included increased motivation, behaviour management and focusing on learning that was closely associated with the curriculum.

Table 6.5 provides an example of Participant 21, whose sarcasm in Year 1 of the study was replaced in Year 3 by a high level of certainty with regard to (a) the impact that ICT has on learning and (b) the need to provide learning via a medium that children understand and are comfortable with.
Table 6.4:  
*Dialogue with Participant 21 in Year 1 and Year 3 of the Study on the Topic of Whether ICT Leads to Improvements in Learning*

<table>
<thead>
<tr>
<th>Year</th>
<th>Interviewer</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Does learning with ICT have an effect on students’ understanding of ideas and concepts?</td>
<td>It is just different. It depends what you are teaching. With technology for instance television has definitely changed the way children learn. Speech therapy has never been more needed for kids. (21, 184, [13])</td>
</tr>
<tr>
<td>2</td>
<td>Do you think using ICT has led to any improvements to learning?</td>
<td>Yes, I would say definitely. It is hard to have any evidence to say that, but my perception is that it definitely has. It just responds to the children, all the children respond to it I should say. We are in a technologically advanced world, so it is just right up their alley… In terms of how well they grasp it, I would say ICT has helped. (21, 470, [13])</td>
</tr>
</tbody>
</table>

In summary, the evidence points towards participants having expanded their worldview on what constitutes ICT from a relatively narrow conception of “computers” at the inception of the study to one that encompassed a range of technologies that can be harnessed to enhance student engagement. However, Fredericks, Blumenfeld and Paris (2004) suggest that student engagement with ICT is a multi-faceted construct comprising of behavioural, emotional and cognitive components. Behavioural engagement refers to the extent of participation. For example, a student could be engaged with (and master) a video game, but not necessarily learn anything from it. Emotional engagement refers to an attitudinal shift towards ICT and a propensity to want to use it again. Cognitive engagement refers to the mental effort that is used to understand a concept. Although participants in this study alluded to increased levels of student engagement, the extent to which this comprised a cognitive component is unclear. In saying this, participants did seem to exhibit more certainty in Year 3 of the study on the links between ICT and the consequent learning that took place in their classrooms.

It has been established that some participants became increasingly pragmatic as they established themselves in the teaching profession. This may have been due to the
combination of factors such as a full curriculum, scarcity of time, and perceptions about students’ propensity for self-direction in their learning. At the same time, participants’ pedagogical beliefs changed in subtle ways, becoming more sophisticated through a heightened focus on learning as opposed to teaching. Participants that took part in the study operated in busy and complex workplaces. The impact of these settings on participants’ dispositions towards ICT is now addressed.

6.3 Changes in participants’ dispositions towards ICT

Of the 28 individual participants who were interviewed in the study, 14 were interviewed in all 3 years. The experiences of these 14 participants provide a useful lens in which to gauge the extent of change that occurred over the period of the study. Changes in participants’ dispositions towards ICT are viewed in the context of their socio-cultural setting as recommended by Goos (2005).

Of the 14 participants interviewed in all 3 years of the study, 8 remained at the same school. These are classified as Group 1 participants. Group 2 participants are those that changed school one or more times.

Figure 6.5 shows Group 1 and Group 2 participants, along with their location(s) (metropolitan, rural/remote or overseas school) over the period of the study.
### Table 6.1: Yearly Participants by Group

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 Participants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Metropolitan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Rural/remote</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Rural/remote</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 Metropolitan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 Metropolitan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 Metropolitan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34 Metropolitan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 Metropolitan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2 Participants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Metropolitan</td>
<td>Metropolitan</td>
<td>Metropolitan</td>
</tr>
<tr>
<td>5 Rural/remote</td>
<td>Rural/remote</td>
<td>Rural/remote</td>
</tr>
<tr>
<td>8 Rural/remote</td>
<td>Metropolitan</td>
<td>Overseas</td>
</tr>
<tr>
<td>20 Rural/remote</td>
<td>Metropolitan</td>
<td></td>
</tr>
<tr>
<td>21 Metropolitan</td>
<td>Metropolitan</td>
<td></td>
</tr>
<tr>
<td>22 Metropolitan</td>
<td>Metropolitan</td>
<td>Metropolitan</td>
</tr>
</tbody>
</table>

**Figure 6.5.** Group 1 and Group 2 participants (n=14).
In Chapter 5 it was suggested that access to ICT infrastructure was critical in the way in which the pedagogical reasoning process evolved. Therefore, before examining changes in participants’ attitudes towards ICT it is also useful to consider the access that participants had to ICT infrastructure.

At interview over the period of the research, the researcher asked participants about the ICT infrastructure available to them. From this information, three discrete categories were formed:

- Category 1 – environments that were equipped for teacher- and student-directed learning. In these situations the participant, as a minimum, had a projection device (e.g. an interactive whiteboard) in addition to ready access to a sufficient number of computers for students to engage in self-directed work.

- Category 2 – environments that were equipped for teacher-directed learning. In these situations the participant, as a minimum, had a projection device, but did not have sufficient number of computers for students to engage in self-directed work.

- Category 3 – environments that were poorly equipped for teacher-directed learning (i.e. no projection device) in addition to an insufficient number of computers for students to engage in self-directed work.

Figure 6.6 shows the identified categories for Group 1 participants. Mean scores on the Pedagogical Beliefs Questionnaire (PBQ) in Year 3 and a synopsis of observations conducted are also provided.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Mean</th>
<th>Observation(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3.9</td>
<td></td>
<td></td>
<td></td>
<td>Three observations at pre-primary level. All involved use of an Interactive Whiteboard in conjunction with rotational activities for students.</td>
</tr>
<tr>
<td>3</td>
<td>3.4</td>
<td></td>
<td></td>
<td></td>
<td>One observation (Year 10 Art) that involved the minimal use of ICT.</td>
</tr>
<tr>
<td>9</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td>One observation (Year 11 English) that involved a small number of students in a computer laboratory.</td>
</tr>
<tr>
<td>23</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td>Three observations at Year 4 level. All involved the use of the interactive whiteboard. The first observation took place in the school library where the teacher accessed a mobile interactive whiteboard.</td>
</tr>
<tr>
<td>29</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td>Two observations (Year 7). The first was in the classroom involving a presentation on the interactive whiteboard and completion of a worksheet. The second observation was in the computer laboratory (web searching).</td>
</tr>
<tr>
<td>30</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td>Two observations at Year 4 level. The first took place in the classroom involving a rotation on two computers (accessing a website). The second observation was in the computer laboratory working with Live Mathletics.</td>
</tr>
<tr>
<td>34</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td>Three observations at Year 4 level. (a) In a computer laboratory with students reflecting on a PowerPoint presentation. (b) Using 5 classroom computers as part of a literacy rotation. (c) Teacher-driven use of interactive whiteboard.</td>
</tr>
<tr>
<td>35</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td>Two observations (Years 4-7). The first was collaboratively making a movie about bullying. The second was student use of a problem based website. Both took place in the classroom.</td>
</tr>
</tbody>
</table>

**Figure 6.6.** Identified ICT infrastructure categories for participants from Group 1 (those that remained at the same school).
Participants from Group 1 remained relatively constant in terms of their access to ICT infrastructure. Participants 23 and 29 were provided with interactive whiteboards from Year 2 of the study, and Participant 35 was given access to a suite of mobile laptops from Year 2 onwards. The other six participants in this group had no changes in their access to ICT infrastructure over the life of the research.

The mean scores recorded on the Pedagogical Beliefs Questionnaire for those with category 1 infrastructure were usually higher than those who had access to category 2 or 3 infrastructure.

Figure 6.7 shows the identified categories for Group 2 participants. As would be expected, participants experienced more change to the ICT infrastructure that was available to them when they moved from one school to another. Participant 4 lost access to a trolley of mobile laptops when her school closed down at the end of Year 2 and she moved to a different, less well equipped school. Participant 5 experienced reduced access to computers in the classroom when she transferred from a rural to a remote school in Year 3. Participant 21 inherited an interactive whiteboard in transferring from one metropolitan school to another in Year 2. Participant 20 had poor access to ICT infrastructure in both of her schools; conversely Participant 22, being a Technology and Enterprise teacher, had excellent access to ICT infrastructure in all three of her schools.
### Participant Year 1 Year 2 Year 3 Mean PBQ

<table>
<thead>
<tr>
<th>Participant</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Mean PBQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>3.9</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>3.6</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>3.9</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>3.4</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td>3.7</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td>3.5</td>
</tr>
</tbody>
</table>

**Observation(s)**

- Participant 4: Two observations (Year 3) both in a classroom of computers and laptops with students engaging with interactive websites and/or using a Word processor to type up work.
- Participant 5: One observation (Years 4-7) in the classroom involving the collaborative use of the interactive whiteboard followed by some self-directed work in pairs on computers.
- Participant 8: One observation of Year 1 students in which they rotated through one computer to type their names and addresses.
- Participant 20: One observation (Year 9) involving teacher-directed use of the Web in class in presentation format. This was followed by independent work in a computer room (truncated by network problems).
- Participant 21: One observation (Year 4) involving four rotations (2 ICT). The use of an interactive whiteboard for group work and an independent activity accessing and interactive website.
- Participant 22: Three observations (Year 11, 9 and 12). The first two involved students working independently on multimedia development projects. Observation 3 involved students doing a presentation for a Year 8 group.

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**Figure 6.7.** Identified ICT infrastructure categories for participants from Group 2 (those that changed schools).
Participants with access to category 1 infrastructure tended to have higher mean scores in the Pedagogical Beliefs Questionnaire and exhibited more learner-centred and interactive practices during observation.

6.3.1 Attitudes

Chapters 4 and 5 of this thesis suggest that participants in the study exhibited attitudes towards ICT that were inherently positive, but at the same time highly attuned to possible negative effects of ICT use. This is consistent with recent research (Russell, Bebell, & O'Dwyer, 2005) that suggests that beginning teachers are actually more critical of ICT than their more experienced peers.

Data on participants’ attitudes towards ICT integration was collected in two ways. Firstly, the Pedagogical Beliefs Questionnaire provided an open-ended question, *How would you describe your attitude toward information and communications technologies (ICT) in teaching and learning*, in both iterations of the questionnaire (n=35, Year 1 and n=20, Year 3). Secondly, in the Year 3 round of interviews (n=14) a specific open-ended question aimed at discerning if there had been any attitudinal changes was posed to participants: *To what extent have your attitudes toward ICT changed since you began teaching? In what ways?*

In Year 1 of the study, participants exhibited positive and enthusiastic attitudes towards ICT. Most comments centred on the usefulness of ICT and the fact that they are inextricably linked to how we function in today’s digital society. This theme persisted and even strengthened in Year 3.
Of the 18 participants that responded to the open-ended question in the Pedagogical Beliefs Questionnaire in Year 3, all had maintained a positive attitude and 14 of the 18 registered little differences in the way in which they responded. Some felt that knowledge of ICT had become part of what it meant to be a teacher in the twenty first century. Others could not envision a future without it:

My attitude towards ICT is positive. I see the great value of ICT in the teaching and learning process, to the extent that I do not see a way forward in the profession without it. (23, 453, [29])

Imperative to the future of education. It means that with this inclusion, the dynamics of teaching change for the future. (33, 345, [29])

Of the 4 participants that did answer the question differently, two Category 3 participants (i.e. participants with poorly equipped classrooms in terms of ICT) articulated issues that inhibited their use if ICT. Time and lack of ICT infrastructure featured prominently in these insights. For example:

[ICT is] fantastic to use if everything works, but setting up/packing up time limits the ability to use as it cuts into teaching time. I would like to use it more, but my school and Department of Education limits my ability. The initial outlay of time and effort to transform a teaching program to one that uses ICT regularly is quite large. However, if there are no restricting factors, it is definitely something that is worth doing. ICT can be incredibly motivating for some students. (9, 508, [29])

For the other two participants who registered a change in attitude towards ICT, these changes were all about how to achieve better learning outcomes. Both of these participants were from Category 2 ICT-equipped classrooms.

Table 6.6 shows the responses for both of these participants in Year 1 and Year 3. Although Participant 8 claims to have become “disillusioned”, her attitude is still positive and her response indicates that she has thought critically about the integration of technology to find the right balance for her students. It is interesting that after working in an environment in the UK which she perceived as prescriptive (she was directed to use a
tool called a Visualiser and felt that her students were simply watching a screen), she now seeks to empower her students to experiment and explore with ICT.

Table 6.5:
Participant 7 and 8 Responses to Questionnaire Item - How Would you Describe Your Attitude Toward ICT in Teaching and Learning?

<table>
<thead>
<tr>
<th>Participant</th>
<th>Year</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>Can be very beneficial for student learning. More interesting, motivational tool etc. availability can be an issue. (7, 24, [29])</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>I think this has changed a bit with experience. I used to use the computers as a time filler, but now I have established some numeracy and literacy programs that together with my teaching help the children a lot. I have just recently acquired a Smartboard [interactive whiteboard] and use it when I can to help the children learn more effectively. (7, 46, [29])</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>There are so many ways to incorporate it. It's the way of the future. (8, 453, [29])</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>My attitude has been a little disillusioned since working in the UK. I feel that they have taken certain technologies to the extreme, and some teaching and interaction with the students has been lost. I now realise the importance of finding the balance, so that all needs are being met. I also think that technology is something that should be integrated into all learning areas, rather than just occurring in a separate subject. Students should also be allowed to experiment with technology and explore for themselves. (8, 603, [29])</td>
</tr>
</tbody>
</table>

In the Year 3 round of interviewing, 14 respondents were provided with the opportunity to articulate any attitudinal change that they may have experienced. The data collected was similar to that which was provided in the Year 3 iteration of the Pedagogical Beliefs Questionnaire where generally participants indicated positive reactions to the question. However, one particular ICT (the interactive whiteboard) was specifically mentioned by four participants when answering this question. This indicates that the interactive whiteboard in itself has been an important catalyst for change in the classroom to the point where it is now deeply embedded into some participants teaching. For example:
I love ICT. I said to my Principal the other day that I don't know what I would do if I went into a school that did not have an interactive whiteboard. I don't know what I would do with myself. Which is terrible, I know, but I think it is great. It works really, really well and I love it. The more you can use it the better. (23, 367, [35])

I really like the Smartboard [interactive whiteboard]. It is...an amazing tool. You can't do the same things. I wouldn't be without it. I wouldn't want to go back to having a chalkboard. (34, 472, [35])

Category 1 and 2 participants had access to ICT at the point of need: the classroom. All exhibited strongly positive and critically reflective sentiments about ICT. The 4 participants that operated in Category 3 equipped classrooms (i.e. no ICT at the point of need) whilst still remaining positive, articulated sentiments that were aspirational. For example:

I am still using it but not as much as I would have liked. (9, 386, [35])

I aspire to use it, but it does kind of get put on the backburner. I have got the literacy computer games that I think that I will use one-day on my literacy rotations, but this has not happened. I think that I should be a bit more proactive about that. (20, 453, [35])

It seems that the provision of ICT to participants at the point of need was well received and had a positive impact on the teaching and learning environment. This finding is consistent with research undertaken by Russell, Bebell and O’Dwyer (2005) who suggest that prior experience in working with technology in an instructional setting plays a significant role in shaping the value that teachers place upon the technology used. The above research also alluded to beginning teachers possessing higher levels of confidence with technology. This theme will now be addressed.

### 6.3.2 Self-perceptions of ICT use

It has been shown that participants’ were generally self-assured and confident with using ICT at a rudimentary level (e.g. using the Web and a basic suite of ICT software applications). However, in Year 1 participants acknowledged deficiencies in being able to stretch the limits of innovative teaching using ICT. This theme persisted in Years 2 and 3.
where, at interview (Year 2 n=16; Year 3 n=14), participants were asked to rate themselves on a continuum of ICT integration from Inaction to Transformation (Newhouse, Clarkson, & Trinidad, 2005). Results for both years were presented in Chapter 5 (see Figures 5.3 and 5.6 respectively). This chapter, however, is interested in change and as such Figure 6.8 shows how participants perceived themselves in relation to this continuum in Years 2 and 3. Participants that exhibited an increase are denoted by a light shaded line. Participants with a decrease in resonance are denoted by a dark shaded line. Participants 32 and 33 were interviewed in Year 2 but not Year 3.

Participants 3, 5, 21, 22, 34 and 35 perceived that they experienced negligible movement between Year 2 and Year 3. Participants 2, 8, 23 and 30 perceived that they had moved upwards on the continuum. Participants 4, 9, 20 and 29 perceived that they had moved.

Figure 6.8. Participant perceptions (Year 2, n=16 and Year 3, n=14) about their use of ICT based upon a continuum developed by Newhouse, Trinidad and Clarkson (2005).
downwards on the continuum. It is interesting that 3 of the 4 that perceived a downward movement had Category 3 access to ICT infrastructure at the conclusion of the research.

The secondary teachers that were interviewed in Year 3 (i.e. 3, 9, 22, and 33) had relatively stable self-perceptions with 3 of the 4 teachers registering the same self-perceptions of their ICT use as the year before and only Participant 9 moving slightly down the continuum. This, she contends, was mainly due to lack of opportunities to integrate ICT (see comment 9, 508, [29] on page 223 of this chapter). Participants 2, 8 and 23 exhibited the most positive attitudes towards ICT throughout the study, and all were afforded increased access to ICT in their classrooms in Year 3. It is probable that this had an impact on their self-perceptions as they were all active in developing their skills in ICT integration. In Year 3, Participant 30 had commenced further study in the area of educational technology, and therefore an increase in his self-perception of his potential to use ICT is not surprising.

Of the participants that moved downward on the continuum, all had registered increases in resonance with the identified attributes of meaningful learning on the Pedagogical Beliefs Questionnaire. Although the evidence in this study is tenuous on this matter, it may be that greater levels of resonance with the constructive and authentic attributes of meaningful learning may have led to a questioning of ICT use within the context of a changing belief system and hence a reduction in self-perception of ICT use for the benefit of learning. Certainly, comments made by participants 4 and 29 in responding to open-ended questions from the Pedagogical Beliefs Questionnaire indicate a shift in teaching philosophy from being mainly concerned about teaching to one that was more focused on learning. Comments also made by these participants during interviewing substantiate this. For example, Participant 4 was explicit in articulating her increased knowledge in understanding how students learn:
I think I’ve just really learnt a lot more about how children learn. (4, 434, [35])

Participant 29 also talks specifically about a teaching strategy that he took for granted earlier in his teaching career, but now has largely abandoned:

I try not to use worksheets as much anymore. I found that I took them in, I marked them, and I gave them back. What did they learn? What do we do with them after that? There is a use for black line masters, but I have found various other ways that you can do things more effectively. So I have gone away from them wherever possible. (29, 397, [35])

The shifts in the self-perceptions of participants in this study could have been influenced by a range of factors including an increase in ICT infrastructure, and the existence of peers with a mandate to assist participants in integrating ICT in the classroom. Overall, however, it is notable that self-perceptions of ICT use generally remained at Integration or below and not one participant felt even close to the Transformation category at the conclusion of the study.

### 6.3.3 Perceptions of the ICT environment

As discussed in Chapter 5, the socio-cultural setting is taken to comprise the participants’ immediate school environment which manifests itself through a range of stakeholders including students, teachers, school leaders and the wider social setting.

#### 6.3.3.1 Participants’ perceptions of ICT infrastructure

It has been established that the provision (or absence) of ICT infrastructure had an impact on participants overall use of ICT. Interview data also suggests that perceptions of ICT infrastructure were most pessimistic amongst participants operating in Category 3 ICT environments. For example, of the 14 participants interviewed in Year 3, 12 felt that the ICT infrastructure had improved and only 2 (participants 3 and 20) did not. The other
participants operating in Category 3 ICT environments acknowledged some improvement
in their school even if it did not directly affect them.

The emergence of the interactive whiteboard certainly had a visible impact in the primary
schools in the study and was perhaps responsible for many of the positive comments made
at interview in Year 3. For example:

- Across the board we have better ICT for sure. At the beginning of the year there
  was an interactive whiteboard for every grade whereas now it is in every class. So
  it is a little bit easier. (21, 293, [5])

- [The ICT infrastructure] has changed because of the integration of the whiteboard.
  We have had PD [professional development] on that and we will continue to have
  PD which is good. (23, 249, [17])

These excerpts underline the enthusiasm that participants in this study exhibited for this
particular technology. This level of enthusiasm is consistent with other studies that report
benefits of using interactive whiteboards in terms of student interest and motivation, along
with increased levels of interactivity and communication between students and between
the student and the teacher (Glover & Miller, 2001).

6.3.3.2 Participants’ perceptions of student use of ICT

Throughout the research participants maintained a strong belief that students needed to be
exposed to ICT because it was necessary for them to function in a twenty first century
digital society:

- These days, I think the kids need to know as much about the ICT as we can give
  them. Because that is their world so it is teaching them life skills. (5, 430, [13])

During the period of the research there was a sense that the pace of change was increasing
and that participants (and their schools) needed to keep up. Participants were aware of
experimental projects that were being trialled, and that some of these were thought to be
having success in engaging today’s students:

I have seen a couple of snippets on TV about using iPhones for learning and there
was a story about how a Nintendo DS using brain training games. And there was a
study, where one class did not do it and the upper class did 10 minutes each day.
And they this class performed better. I thought that was very interesting and this is
the way that we are moving. (20, 470, [20])

Others, felt that approaches that used ICT to tune in with students’ lifestyles, at the very
least merited further investigation:

Change has come very quickly in comparison to, look at the last century, it has
taken that long. I know some people are using mobile phones to teach, some people
are using Facebook to teach. There are a whole lot of issues that come with that.
(23, 402, [13])

Principals too saw that ICT was fast becoming far more than simply using computers in
the classroom:

The kids today grow up learning and it’s wider than just using computers in the
classroom. To me it’s the interactive whiteboard, it’s all of the media, it’s the
digital cameras, it’s iPods, Mp3 players all of that. (2P, 9, [13])

However, in acknowledging that teachers needed to keep pace with technology, there was
evidence of frustration amongst participants that schools were not moving at the same
pace as the broader society:

Walking into a classroom is like stepping back 20 years. It hasn't kept up with
society. So as a teacher, I think you have to approach ICT with the knowledge that
you have to be more creative with how you can use it and organise children with
ICT. Children today are not thinking about “how can I use this technology?”- It is
just part of how they think. (30, 477, [13])

Awareness of the pace of change, however, did not translate into concrete action for the
participants involved in this study. Certainly, there no examples of innovative uses of the
technologies that were identified by the participants themselves (e.g. portable ICT like
iPods or mobile phones. Some of the principals in the study suggested beginning teachers simply had too many pressures on them to be burdened with a responsibility for leadership in using ICT. To alleviate pressure on beginning teachers at least five schools implemented mentoring programs and were satisfied that these programs achieved the desired results:

What we generally find with our new graduates is that they come out of university full of vigour and want to conquer the world. And they have a good knowledge of ICT. And what we have done with the new graduates is that we have a mentor program running at the school. We have a more experienced teacher with a graduate and will we find is that the experienced teacher talks a lot about curriculum and behaviour management in classrooms. It is really good having new graduates in because they are not afraid. (4P, 100, [34])

This example of the cross-fertilisation of skills was reported to be a useful strategy that potentially could provide benefits to both the mentor and the beginning teacher. It also served as a way of promoting a broader culture change that embraced ICT as an option in the classroom.

6.3.3.3 Participants’ perceptions of peers

In the Year 3 round of interviewing, the question *Have you discerned any changes in the dispositions of your colleagues at the school towards integrating ICT into the curriculum? If so what sort of changes have you seen?* was posed. Nine respondents answered in the affirmative and 5 respondents did not discern any change. The environments where change had occurred tended to focus on a person being employed at the school to coordinate the ICT integration function:

We have got a full-time ICT person there, who is just there to help them [teaching staff] if they have a question or anything like that. So, that is pretty good. (8, 502, [36])

I am just trying to figure out when the change came in with IT at our school. I’m fairly sure it was last year. Anyway, the new person has come in and he is fantastic. (9, 417, [36])
Others saw ICT infrastructure, particularly the interactive whiteboard, as having been responsible for changes occurring even if this was an overtly manipulative strategy by school leaders:

> Having them in every classroom has forced people to use it, whether just a data projector and not an interactive whiteboard. Some people are using it as an interactive whiteboard, but I think the scariness has disappeared to some extent. Because people have been forced to use it and deal with it and have it there. The fact that they were forced to, I think has been a good thing. (23, 396, [36])

Of the five participants who did not discern any change in the dispositions of their peers, two of these felt that age was an issue in determining how and how much ICT was used in their school. New graduates, it was said, tended to use ICT more frequently and more effectively. For example:

> Without being general, particularly new graduates, and younger staff use ICT. Staff that do not feel confident with computers to start with, very rarely use it. More to watch a movie or something. (21, 459, [36])

Participants who did not see a change in the attitudes of their peers perceived a stark difference in those who knew how to harness ICT and those who used it inappropriately:

> You have got staff members and students who use it properly and those who use it as a tool to keep the students “busy” for a couple of lessons. We have got a contrast the people who are confident and know that you do research and type essays up. The others are there and are not sure what to do in the class. (3, 353, [36])

It is interesting that this participant equated exemplary use of ICT with teachers that know that it should be used for inquiry and to type essays up.

In summary, participants’ self perceptions of the way in which they used ICT remained relatively stable throughout the study. Participants generally felt that the infrastructure available to them was improving and that, as teachers, they were on an important journey to ensure that they kept up with the changes in ICT for the benefit of their students.
According to participants, the attitudes of their peers towards ICT integration was also gradually changing with the introduction of human and physical resources (e.g. ICT coordinators and interactive whiteboards) dedicated to assist in ensuring that ICT had an impact in classrooms.

6.4 Skills

Chapter 4 of this thesis discussed participants’ use of technology at the inception of the study. After considering embryonic relationships among participants’ pedagogical beliefs, knowledge, dispositions and skills in relation to ICT, it was suggested that although participants were skilled in the use of the Web and a suite of basic ICT software, they had limited knowledge and experience to be skilled integrators of ICT. In other words, there was a need for participants to acquire deeper technological-pedagogical knowledge and assimilate this with their content-specific knowledge (Mishra & Koehler, 2006). This segment of the thesis will consider if this need still existed in Year 3 of the study by discussing three specific cases from Category 1, 2, and 3 ICT-equipped classrooms. The research acknowledges that the contexts from which these cases are taken are unique. However, the cases were chosen because the participants were faced with issues that were broadly symptomatic of others that inhabited the same category.

6.4.1 A personal perspective of a negative journey using ICT (Category 3 ICT)

Dawn (participant 20) was in early 20s at the time of gaining her first appointment in a regional secondary school. The circumstances surrounding her appointment were unusual in two ways. First, although she was primary-trained, the position offered was responsible for a mixed Year 8/9 group (middle school); and secondly, she was offered the position on the Friday before the school year commenced early in the following week, and therefore had to make a quick decision on whether to take up the appointment. The school itself was
remote and comprised a large indigenous population. Dawn initially had a class of ten indigenous students who, in her view, were “a little bit socially immature” (20, 35, [9]) and “more or less at Year 5 level” (20, 126, [9]). Her philosophy of teaching initially centred on “providing students the tools they need to succeed in life and to recognise and achieve their potential.” (20, 406, [30])

Although the school was part of a dedicated public-sector ICT initiative (the Western Australian “100 schools project”), the ICT infrastructure was poor, and Dawn was initially frustrated by the fact that three computers had been taken out of her classroom and situated in a laboratory. This was not done very professionally in Dawn’s view and the computers took a long time to be connected to the school network. In Year 2 of the study, an interactive whiteboard was purchased, but was not connected by the time Dawn left the school at the end of Year 2.

Dawn initially had a positive attitude towards ICT and wherever possible tried to incorporate it. She felt that the interactive whiteboard in particular had the potential to transform her classroom by engaging her students who she perceived were “constantly exposed to multimedia” (20, 421, [29]). However, she became increasingly frustrated with the lack of ICT infrastructure available to her. This was noted at an observation in Year 2 where she registered a very low FIT:COM score of 7/100 and struggled to get the available ICT to work in the way she had planned (there were a number of technical problems that Dawn tried to solve without technical support). The planned lesson was on “the components of the computer” as she believed that her students lacked this basic knowledge.

In Year 3, Dawn transferred to a metropolitan primary school, but again was hampered by a lack of ICT in her classroom. She had two computers but rarely used these because her
class size was 25. She is still positive, but has become slightly de-skilled in ICT because in her words she “does not use it enough” (20, 527, [29]). Dawn feels a little isolated from her peers on matters of ICT as shown in the following excerpt:

[Dawn]: I was sitting around a table with the rest of my colleagues, who have been teaching in 20 or 30 years, and they straight away cut down the idea of using the interactive whiteboard. I was more of a feeling that I can't wait to get one.

[Interviewer]: Why do you think it is?

[Dawn]: It is just too hard to set up.

[Interviewer]: Was it a mobile whiteboard?

[Dawn]: Yes. I think there is a little bit of "computing is a great when it is working, but something always goes wrong". (20, 444 [9])

In summary, Dawn’s experiences with ICT in her first three years of teaching have invariably been negative. She has not been well equipped with ICT, nor has she been technically or pedagogically supported in using ICT. Her peers are not enthusiastic and all of these factors have led to a situation where ICT “kind of gets put on the backburner” (20, 454, [9]). Her self-assessment on the ICT integration continuum (Newhouse et al., 2005) slightly decreased in Year 3 to Investigation.

6.4.2 A personal perspective of an unexciting journey using ICT (Category 2 ICT)

Mike (participant 29), in his early 20s, works in a metropolitan primary school teaching at year level 6/7. The school in which he is situated is a small independent school and does not have a particular focus on ICT. Mike sees himself as one of the leaders in the school in terms of his ICT knowledge. There were three computers in his classroom for student use in years 1 and 2 and this increased to 4 in Year 3. Mike also had a laptop and access to a computer room once per week. In Year 2 an interactive whiteboard was installed in Mike’s classroom and he had no hesitation in using it.
In observing Mike in the classroom in Year 2 (n=18), he used the interactive whiteboard to show a PowerPoint presentation which he accessed from the Web. Students did not appear to be interested in this material and were much keener to engage with non-ICT based activities that were also prepared for the lesson. His FIT:COM score was 23/100. The computers were not used in this lesson and at interview Mike revealed that the computers were seldom used except for early finishers as a reward, and according to Mike “not for educational benefit” (29, 274, [25]). He suggests that, with current class sizes, it is difficult to use the computers meaningfully for student-directed activity other than for interactive games.

In an observation conducted in Year 3 (n=13) Mike provided a lesson on Web searching that began with a 20 minute presentation using the Interactive Whiteboard as a projection device before moving to a computer lab for student independent work. The task centred on completing a worksheet after finding Web-based information relating to a poem by Edgar Allen Poe called *The Raven.* It was not related to other educational outcomes that Mike had planned for the term. His FIT:COM score for the lesson was 48/100.

Although Mike is still positive about using ICT in his classroom, his skills have remained static. He sees professional learning, “how can I teach them to get a deeper understanding” (29, 220, [28]), as his major barrier in being able to integrate ICT.

In summary, Mike’s experiences with ICT in his first 3 years of teaching have been unexciting. This may be because he has used ICT mainly in teacher-centred ways and feels discouraged when his students fall short of reaching the deeper understandings that he plans for. His self-assessment on the ICT integration continuum (Newhouse et al., 2005) slightly decreased in Year 3 to Application.
6.4.3  A personal perspective of a restrained journey using ICT (Category 1 ICT)

Rhonwyn (participant 34) was in her mid-20s when she obtained her first teaching appointment at a metropolitan catholic boy’s school teaching at Year 4 level. The school is well equipped and has a Principal who takes a particular interest in ICT. Rhonwyn’s class of 26 in Year 3 had five computers for student use and she also had a laptop and an interactive whiteboard which is fixed. On the same floor as Rhonwyn’s class, is a library that has dedicated space for a suite of 31 computers and another interactive whiteboard. A teacher librarian helps other teachers to use these ICT facilities effectively.

In Year 1 Rhonwyn exhibited a positive attitude to ICT believing that:

ICT is an important tool for learning. It is a medium in which students can learn content, present information, communicate with others. It is also vital to them to learn how to use it effectively as they will need it when they join the workforce.

(34, 451, [29])

Rhonwyn exhibited competent ICT skills at all of the lessons observed and believed that her capacity to use ICT had improved over the three years although not as much as she would have liked. The main barrier to successfully integrating ICT from Rhonwyn’s perspective was finding the time in the context of all of the other pressures that she felt she was under, particularly at the early stages of her career.

In Year 1 a lesson was observed in which students worked in groups of two to reflect upon a PowerPoint presentation that they had previously put together which told a story using some clay figures that had also been developed previously. The students finished off their PowerPoint presentations and electronically completed a rubric in this lesson and it achieved a FIT:COM score of 62/100 which indicates a reasonably high level of student-centred ICT use.
Rhonwyn fared slightly lower on the FIT:COM instrument in a Year 2 observation scoring 54/100. This lesson was a rotation where the class was split into 4 groups (with parental assistance) one of which worked on the computers in the classroom to develop a summary using Word of an endangered species of animal. The students tended to focus on form rather than content, experimenting with a range of fonts, graphics, backgrounds and borders and most did not finish the activity. One of the problems was that, as they rotated, students were largely left to their own devices to complete the task as Rhonwyn was using the interactive whiteboard with other groups.

An observation in Year 3 involved a whole-of-class interactive whiteboard session where Rhonwyn used a combination of her own materials with the Brainpop website (www.brainpop.com) to stimulate teacher-directed learning on quadrilaterals. Rhonwyn expertly used the interactive aspects of the whiteboard by inviting students to engage with it, along with actively questioning the students about the content. The FIT:COM score for this lesson was 53/100. The decrease from the previous years score was mainly due to the more teacher-centred approach taken.

Rhonwyn’s ICT skills improved over the three years of the study particularly in using the interactive whiteboard where she became very proficient. However, she felt stressed with other priorities and as a result was irritated with what she saw as constant pressures to use ICT:

I have been a bit resistant to go into that world. It is the extra work. For me it is just another thing that I have to do.

This suggests that, in weighing up the affordances and the risks of using ICT in a technology-rich environment, Rhonwyn opted not to prioritise ICT integration very highly.
In summary, Rhonwyn’s experiences with ICT in her first 3 years of teaching have been restrained. Although she felt compelled to use ICT, her preparation was always pressured by time and other priorities. As a result she invariably fell back on what she knew which generally involved accessing the Web for preparation and presentation and setting activities that involved student use of Word and PowerPoint. At the early stages of her teaching career, she did not see the benefits of harnessing ICT in ways that were in tune with her pedagogical beliefs. However, her self-assessment on the ICT integration continuum (Newhouse et al., 2005) slightly increased in Year 3 to just beyond Application. This was probably symptomatic of an increase in skills particularly using the interactive whiteboard.

6.5 Factors that contributed to (lack of) changes to pedagogical beliefs, dispositions and skills

In searching for change themes across the contexts of categories 1-3 and in the qualitative data generally, one of the most interesting findings is that there was so little change in participants’ pedagogical beliefs as a result of using (or not using) ICT. One of the reasons for this might be the suspected uneasy fit between participants’ epistemological beliefs, their pedagogical beliefs and their beliefs about ICT. The strong presence of authoritative knowledge sources in participants’ beliefs about where knowledge comes from in Year 1 and Year 3 of the study also casts some doubt over the authenticity of their pedagogical beliefs. Similarly, the relative superficiality of ICT use by participants does not sit well with notions of meaningful learning, particularly those that emphasise cooperative and authentic learning.

The perceived shift identified by participants from idealism to realism might in some respects explain why ICT use bore so little resemblance to stated pedagogical beliefs. Participants were on a steep “learning curve” not only in terms of curriculum and
pedagogical knowledge, but also coupled with overarching issues like classroom management and establishing relationships with students, parents and peers. In pressure situations, the participants of this study set priorities. For many, exploring the transformative potential of ICT was not one of these. This was not surprising given that participants probably did not feel that technological knowledge was necessary for effective teaching in either Year 1 or Year 3 of the study.

According to Zhao and Cziko (2001), the extent to which teachers use ICT depends upon what their goals are and how ICT can contribute to these goals. The theme of goal-orientation and how professional learning can contribute to participants’ goals, explored through a framework of technological-pedagogical-content knowledge (Harris, Mishra, & Koehler, 2009; Mishra & Koehler, 2006), will be addressed in Chapter 7.

The other theme noted in this chapter was a shift from teacher- to more learner-centred conceptions of education. It is significant that the teachers that experienced this transition were generally constrained by their context in terms of ICT infrastructure (3 of the 4 were situated in Category 2 ICT infrastructure environments). However, the interactive whiteboard was used as a platform in which to realise learner-centred goals, particularly in the realm of group communication. This research confirms the literature (Cranmer, Potter, & Selwyn, 2008) in noting an absence of ICT used to facilitate electronic communication between students (e.g. Web 2.0), but at the same time also notes a prevalence of non-ICT based communication spawned by simple projection devices.

Whilst participants claimed to have moved in a learner-centred direction, observed evidence still points towards the teacher-centred use of ICT. The lack of suitable ICT infrastructure, scarcity of time to consider ICT options within a pressured school environment and a lack of technological-pedagogical knowledge may have all come into
play. However, the bottom line is that participants used ICT mainly for administration, preparation and presentation and in this respect the findings concur with those reported in the literature (Cuban, 2001; Judson, 2006; Palak & Walls, 2009).

On the important question on the relationship between ICT and learning, the study can make the following observations. Firstly, participants’ worldview of what constitutes ICT broadened between Year 1 and Year 3 of the study. Although this did not have immediate impact on participants’ teaching (apart from the use of the interactive whiteboard), the opportunities that this may open up in the future in exploiting a suite of complimentary ICT in the classroom and providing students with a range of options to produce their own knowledge may be profound. Participants gained an awareness of a range of ICT. The next step is to become knowledgeable in harnessing these ICT for the benefit of learning. Again, the gap in technological-pedagogical knowledge may be a barrier.

Secondly, participants were more confident in articulating the relationship between student motivation and engagement through ICT, and learning even if this was only through activities such as using software like Microsoft PowerPoint and Word or interactive websites. Participants indicated an awareness of the changes that they might need to make to move forward on the continuum provided by Newhouse, Clarkson and Trinidad (2005) and as reflective practitioners it is likely that they will make judgments on whether these changes are worth the effort in future pedagogical reasoning processes. In short, although participants grew in their ability to articulate their understanding of ICT integration, they seldom put these more developed understandings into practice for reasons mainly bound up with ICT infrastructure and the pressures of being a new teacher.

Participants were equally eloquent in articulating the negative impacts of ICT throughout the research. This is consistent with findings from other studies that question the
assumption that ICT use will increase simply because new teachers grew up in a technology rich world (Russell et al., 2005).

The adjectives used to help explain Dawn, Mike and Rhonwyn’s experiences with ICT, negative, unexciting and restrained, are perhaps an indictment of the complexities and sheer energy that is required to successfully integrate ICT into the classroom. It could be said that all three participants lacked technological-pedagogical knowledge (Mishra & Koehler, 2006) to some degree. However, it could equally said, that after their initial experiences in the teaching profession generally, and with using ICT specifically, that all are still open to using ICT and in fact indicated a desire to accelerate their use:

Maybe a couple of years ago, when we did not have the interactive whiteboard, I would not have cared [about using ICT]. But now that we have the technology and I want it, I would like to learn. (20, 464, [35])

I would hope to be up to Integration [next year]. If we get some more PCs into the classroom hopefully I will get to Integration. That is where I want to be next year. (29, 360, [35])

Initially I was just coping with making sure that my kids were on task and I was using good behaviour management. Now I am using technology more and more and as I get better I feel more confident in teaching. (34, 471, [35])

This might indicate that after an initial period of acquainting themselves in the profession, beginning teachers will take up ICT with vigour even if their early experiences were negative. Participants’ attitudes towards, and confidence in, ICT were certainly positive throughout the study. However, some research (Russell et al., 2005) has noted that beginning teachers seldom require their students to use technology and that this contrasts with the approach of more experienced teachers. Certainly in this study the locus of control for ICT was almost always in the hands of the teacher.

Recent literature suggests that teachers’ use of ICT in technology-rich environments does not in itself transform teaching towards student-centred practices (Judson, 2006; Palak &
Walls, 2009). This research corroborates this contention specifically for beginning teachers with one caveat: it has found that interactive whiteboards did possess some transformative potential for some participants. For example, whilst Mike adopted largely teacher-centred practices, those with a more student-centred orientation were able to harness greater value:

[My skills] have improved incredibly. Having access to the electronic whiteboard, particularly in the last couple of years, was brilliant because I was able to learn a lot about that and develop a lot of programs. (5, 410, [35])

Of the participants who operated in Category 3 ICT environments, three of the four dedicated a lot of their own time to keeping up-to-date:

I was really experienced in Publisher software, and I try and keep up with it for posters and so on (3, 347, [35])

I do a lot of reading. Keeping on top of it. I am interested in ICT myself. It is amazing what you pick up. (30, 422, [28])

This may indicate that, although these participants currently operated in ICT-poor environments, they acknowledged the longer term benefit of maintaining their skills and therefore expended effort in this area.

The next chapter will discuss the implications of these findings in the context of the study’s research questions.
Chapter 6 - Findings: Changes in beliefs, knowledge, dispositions and skills


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Chapter 7: Discussion
CHAPTER 7
Discussion

7.1 Chapter overview

The purpose of this chapter is to bring together core themes from the findings chapters and relate these to the literatures as described in Chapter 2. The study is guided by six research questions that probed teachers’ pedagogical beliefs, knowledge, dispositions and skills. By addressing the seventh research question What implications do these factors have for the future uptake of ICT in schools? the chapter attempts to make sense of the findings and go some way towards answering the “so what?” question that is central to doctoral-level research.

Before articulating the themes that emerged from the research, a summary of the key findings is provided.

7.2 Summary of key findings

The study has shown that participants claimed to hold pedagogical beliefs that are in tune with contemporary student-centred theories of learning. Participants also revealed themselves to be positively disposed to using ICT, and skilled in using a defined set of ICT software and tools. However, consideration of relationships among participants’ pedagogical beliefs, knowledge, skills and dispositions in using ICT suggests that pedagogical beliefs play a limited role in participants’ actions. This may be explained by a number of factors including:
Lack of access to appropriate ICT.

Lack of time to think about how to implement ICT.

Limited knowledge of how ICT can add pedagogical value.

Inconsistencies between the complex set of relationships between participants’ domain-general and domain-specific beliefs.

In order to use ICT more effectively in the classroom, teachers need to first embrace the notion that they can improve the teaching and learning experience as a result of introducing ICT. Most participants discerned enhanced levels of motivation amongst their students, and were therefore open to using ICT in the classroom. However, because of an endemic view of ICT that equated to a narrow band of software and the Web (certainly at the inception of the study), participants tended to use ICT in fairly mundane ways. It should be stressed that participants themselves did not perceive their use of ICT as mundane. Indeed, most were looked upon as ICT leaders in their schools. Although there were references to becoming more familiar with what is “out there” in terms of ICT, participants were seldom open to the notion that there was a problem in the way in which they used ICT, and they were not inclined to critically reflect on their practices of using ICT or seek to diagnose barriers that prevented them from more sophisticated use.

Most participants operated in busy, high-pressure environments where issues such as interpreting the curriculum, assessing student performance, managing student behaviour and parent liaison tended to take priority. ICT were used in situations that minimally disrupted these other priorities, for example, in teacher presentation, reinforcement of
learning, and for simple inquiry or reward activities. Innovative, experimental applications of ICT that required time and risk-taking were largely absent.

Although some participants broadened their understanding of what constitutes ICT over the period of the study, changes in the use of ICT by participants were slow, unremarkable, and in some cases antagonistic to notions of student-centred learning. There was little evidence of participants harnessing ICT to help realise the possibilities of personalisation of teaching and learning (Brown, 2008), transforming learners from consumers to active producers of knowledge (Finger, Russell, Jamieson-Proctor, & Russell, 2007), or creating learning communities around the traditional classroom (Thomson, 2006). The findings from the research, then, suggest that there are still many complex barriers to overcome in order to tackle the stated problem of slow and unimaginative uptake of ICT in Australian schools.

Participants were situated in unique socio-cultural settings and, therefore, were confronted with a range of different challenges throughout the first 3 years of their teaching. However, the following four core themes consistently emerged as significantly inhibiting the use of ICT in the classroom:

- Lack of clarity over beliefs and how ICT can support these beliefs.
- Variability of perceptions within schools of the affordances and risks of using ICT.
- Embedded structural constraints that inhibit the creative use of ICT.
- Deficiencies in technological-pedagogical-content knowledge.
These themes are not trivial and necessitate an appetite for change at systemic, local and personal levels (e.g. Fullan, 2003). Participants dealt with one or more of these themes on an ongoing basis throughout the 3 years of the research, and it is suggested that each theme may provide a useful focus in which to expend energy on future policy development and research. The four themes are all consistent with the metaphor, presented in Chapter 2, which likened the transformative potential of ICT to the building of a bridge. In a sense, the themes represent weaknesses in the bridge that undermine innovation using ICT. This is shown in Figure 7.1.

**Figure 7.1. Core themes to emerge from the research.**

These themes will now be discussed. To highlight the significance and inter-relationships between the themes, the experiences of Participant 4, Chanpreet, will be brought into the
discussion. Chanpreet was selected because she provided a particularly rich data set having participated in data collection processes in all 3 years of the study.

7.3 Lack of clarity over beliefs and how ICT can support these beliefs

Understanding and articulating beliefs about knowledge, teaching, learning, subject areas, classroom management, student motivations and abilities, and ICT are worthy endeavors for teachers and researchers. Undertaking this process potentially leads to greater clarity on what beliefs teachers might hold, and how important these beliefs are in the classroom. On achieving clarity in their beliefs, teachers are in a position to better align these beliefs with practices, and also to harness ICT in ways that bring their beliefs to life.

It is clear from the study that there was some confusion amongst participants over which beliefs to enact. The case of Chanpreet highlights this confusion. Chanpreet is in her early 20s and has been teaching a Year 2 class in the northern suburbs of metropolitan Perth in Western Australia for 3 years. She has worked at two state schools, the first of which was well endowed with ICT. Chanpreet had access to a bank of laptops, and used these particularly in her second year of teaching. However, she did not have a projection device which was of some concern to her. Chanpreet’s second school was not so well endowed. She had access to two computers in her classroom, and again had no projection device. In terms of Chanpreet’s beliefs, she contended (in her third year of teaching) that her knowledge of how to teach came from:

University ideas on how different children learn, regular professional development and Education Department documents. (4, 484, [30])
For Chanpreet, knowledge has an external basis. She sees her own learning, at least as this applies to pedagogy, as a process of accessing knowledge from legitimate sources (Buehl & Fives, 2009). In answering the question *What knowledge is required for effective teaching?* Chanpreet grounded her response in matters of her own content knowledge:

> Knowing what you want your children to know and learn. (4, 487, [30])

It would seem then that Chanpreet (a) believes that knowledge comes from external sources and (b) sees herself as an important and legitimate source of knowledge for her Year 2 students. This concurs with Chanpreet’s stated philosophy of teaching which focuses on modelling (a term that she selected on the Year 3 Pedagogical Beliefs Questionnaire as best representing her beliefs about teaching) and relationship-building:

> Relationships are built with students first and foremost before any type of learning is to occur. (4, 487, [30])

However, there would appear to be some inconsistencies in Chanpreet’s belief system. If knowledge comes from external sources, then Chanpreet’s students’ learning will be heavily influenced by her role as a teacher in providing and mediating appropriate resources. In these circumstances Chanpreet would not be expected to resonate strongly with student-centred and exploratory modes of learning as embedded in the attributes of meaningful learning as espoused by Jonassen, Peck and Wilson (1999). This is not the case. In fact, in the Pedagogical Beliefs Questionnaire Chanpreet registered mean scores that were higher than the average on all scales and recorded overall mean scores of 3.57 in Year 1 and 3.89 in Year 3 indicating that she strongly resonated with the identified attributes of meaningful learning. Chanpreet claimed to be particularly attracted to cooperative and authentic learning achieving mean scores well above the overall mean (0.52 and 0.49...
respectively). In the two lessons observed, however, there was a strong focus on reinforcement through the use of interactive web materials and little evidence of cooperative group work or an authentic problem-solving approach.

Like most participants, Chanpreet also claimed to value lifelong learning, a body of thought that appreciates the constant quest for knowledge in a range of both formal and incidental contexts. Candy, Crebert and O’Leary (1994, p. 43) describe the profile of a lifelong learner as having “an inquiring mind, helicopter vision, information literacy, a sense of personal agency and a repertoire of learning skills.” The authors lament what they see as a preoccupation with content knowledge and the concomitant trend of relegating attributes of lifelong learning to the periphery of the learning experience. This tension was experienced by many of the participants of the research. Chanpreet, for example, genuinely wanted to instill a love of learning in her students, but equally acknowledged her responsibility as a teacher to keep students on task (the antithesis of incidental learning?) and focused on curriculum goals via regular assessment against curriculum outcomes. As a result of the pressures of the curriculum, Chanpreet, was unable to enact her beliefs about lifelong learning.

For generalist primary-level teachers it is sometimes difficult to gain a sense of their content-specific beliefs. However, the following comment from an interview with Chanpreet in Year 1 is revealing in the sense that it places the focus of learning mathematics, for example, on teaching and the role of the computer as reinforcement:

Maths games reinforce what you have been teaching them. I think that would be more beneficial. So it is about consolidating rather than exploring. Consolidating what they have learned in a different way. (4, 190, [2])
The notion of students’ consolidating mathematical knowledge through a legitimate source (the Web) rather than exploring and building mathematical knowledge themselves is consistent with Chanpreet’s beliefs about the source of knowledge, but seemingly inconsistent with her stated pedagogical beliefs. Similarly, when asked about providing opportunities for students to inquire and create knowledge using ICT, her response suggested underlying beliefs about students’ inability to use ICT in these ways:

They do not use it [ICT for inquiry], but I model that. When they ask questions at times I’ve said that we could have a look on the Internet and do a search on it. (4, 303, [24])

The mismatch between Chanpreet’s beliefs about knowledge and beliefs about pedagogy is reflected in the literature where, for example, Schommer-Aikins (2004) has raised a number of pertinent questions about the relationships between beliefs about knowledge and beliefs about pedagogy. For example, which beliefs develop first? Is there a reciprocal developmental path between the two types of beliefs? Do they contribute to each other, and if so, in what way? These questions, it is argued, remain unanswered.

Chanpreet’s beliefs about ICT indicate that she perceived it as an important skill and “the way of the future” rather than being integral to providing active, constructive, cooperative and authentic contexts for learning. In short, Chanpreet’s beliefs about knowledge, teaching concepts like mathematical and ICT seem to be consistent with her actions. However, her more general beliefs about how students learn and her beliefs about the importance of lifelong learning seem to be inconsistent with her actions. This state of affairs is represented graphically in Figure 7.2.
The lack of coherence between Chanpreet’s pedagogical beliefs and her actions is consistent with findings from similar studies that have been reported in the literature (Judson, 2006; Lim & Chai, 2008; Palak & Walls, 2009). In these studies, it is suggested that the mismatch between beliefs and actions has resulted in a marginalisation of the way in which ICT is used to support learning. Two explanations are offered by Palak and Walls (2009). Firstly, teachers lack models of technology integration that support student-centred practices and secondly, teachers’ beliefs and practices are inextricably tied to other contextual factors such as class size and student ability. Both of these could be true in the case of Chanpreet. She worked in schools that did not push the boundaries of student-centred learning using ICT, and was not exposed to innovative models of ICT use. She also managed relatively large and diverse classes in an area of low socio-economic status.
Contextual factors could have indeed profoundly impacted on the extent to which her pedagogical beliefs could be enacted. However, the lack of consistency between Chanpreet’s pedagogical beliefs and her other beliefs is difficult to understand.

In an empirical study involving 42 teachers in the United States, Olafson and Shaw (2006, p. 79) came to the conclusion that teachers actually endorsed multiple worldviews, and the lack of coherency between these worldviews is because teachers can be:

… somewhat naïve and have not closely scrutinized their own beliefs to examine whether they are conceptually consistent.

Some teachers may be somewhat naïve while others may have limited time or feel disinclined to critically question their beliefs. However, if the problem of slow and unimaginative uptake of ICT in Australian schools is to be addressed, then the alignment of teachers’ beliefs to their practices is at the heart of the matter.

Paradoxically, it is perhaps the spectacular success of constructivist learning theory that may have led to a widespread misalignment of teachers’ beliefs with their practices. The apparent ease and rapidity in which constructivism has become educational orthodoxy in Australian schools may have brought with it a quiet revolution in pedagogical beliefs in which beginning teachers have seemingly adopted this theory of learning as part of their belief system without due consideration for the implications for their teaching practice. Constructivism is a messy construct with many variations (Phillips, 1995). Kirschner et. al. (2006) contend that it has been ideologically driven into education systems rather than through considered and dispassionate research. Brown (2008), points towards a lack of specificity around the concept and Richardson (2003) reminds us that the translation of a theory of learning into a theory of teaching is fraught with challenges. Whilst Chanpreet,
for example, wholeheartedly supported collaborative learning, the implications of using ICT in the context of creating group activities, assigning roles within groups, ensuring that individuals within groups equally contribute, and assessing the performance of groups and individuals within groups, were too complex in the busy environment in which she inhabited. A variety of reasons for not using ICT were provided by Chanpreet:

I just think that the process can be quite time consuming. (4, 7, [1])

You have to keep an eye on them and look after the rest of the class at the same time. (4, 73, [9])

The socio-economic area is such that the children don’t have computers. (4, 77, [9])

At an early stage in her career, it was preferable for Chanpreet to reflect on being idealistic opting for the safety of familiar ICT software and tools. Interestingly, though, participants (Chanpreet included) tended to hold on to their beliefs about meaningful learning even if they were not enacted, presumably as aspirations to be implemented at some undetermined time in the future. Hofer (2006, p. 90) proposes that we need to know more about:

How teachers resolve the cognitive dissonance that presumably arises from strongly endorsing a worldview that appears incongruent with the practices of the educational systems in which they are placed.

Schommer-Aikins (2004) reminds us that changes to beliefs do not come easily. Like old clothes, they become comfortable. This research suggests that beginning teachers may subconsciously resolve cognitive dissonance by making constant compromises (real or contrived) that serve to situate their ideals just beyond the horizon. This enables them to maintain a self-perception of themselves as sympathetic with contemporary learning theory, whilst at the same time, enacting their more pragmatic beliefs as best they can in
environments that are typically characterised by embedded structural constraints that inhibit the creative use of ICT.

This discussion has implications for teachers, school leaders and universities. Encouraging teachers to reflect on their various domain-general and domain-specific beliefs can only lead to more adaptive and flexible teaching (Clark & Peterson, 1986). A useful starting point may be, where appropriate, to embed reflection on beliefs into professional learning that deals with enhancing the use of ICT.

Critically discussing the issue of beliefs and their relationships with ICT within school forums can also be a positive move. Prestridge (2009) suggests that this is vital in transforming teachers’ beliefs. Providing models of good practice in applications of ICT that encourage meaningful learning (Palak & Walls, 2009) may also help to close the gap between the ideal and the pragmatic. School leaders can also encourage teachers, where appropriate, to take risks by establishing policy environments that allow teachers to fail without feeling like failures (Bitner & Bitner, 2002).

Finally, by acknowledging the eclectic nature of teaching (Uhlenbeck, Verloop, & Beijard, 2002) and critically discussing the strengths and weaknesses of a range of learning theories in relation to ICT, along with identifying potential gaps between these theories and practice, universities can better prepare pre-service teachers for the challenges that they may face in the profession.

Teachers’ beliefs, then, are a foundation stone for ICT integration as articulated in the bridge metaphor which has been introduced in this research. The other foundation stone is school culture, which will now be discussed.
7.4 Variability in perceptions within schools of the affordances and risks of using ICT

There is no universal and shared vision underpinning the use of ICT in education.

According to Dede (2008), the general public is confused about what types of ICT (if any) are effective in education. Auld et al. (2008) extends this observation to the teaching profession pointing out:

Teachers are confronted with an eclectic array of theories and instructional designs and bombarded with confusing, even romantic views on what technology is capable of delivering.

Crucially, the research literature suggests that the evidence linking ICT with student attainment is inconsistent (Condie & Munro, 2006). Although participants in the current study exhibited a surprising certainty in establishing a link between the use of ICT and student learning, in reality this link might be more tenuous. Student engagement was observed across behavioural, emotional and cognitive domains and sometimes on all three simultaneously (Fredericks, Blumenfeld, & Paris, 2004).

The beliefs and attitudes of participants’ more experienced peers towards ICT were generally unenthusiastic. Participants felt that they possessed superior knowledge on how to use ICT than their peers; participants also believed that they had more positive attitudes than those exhibited by their peers. Many perceived themselves as different from their colleagues particularly in relation to what, how and when to integrate ICT.

This was certainly true in the case of Chanpreet who felt that her ideas about ICT were not shared with others in the school. She also suggested that enhancing the skills of her peers would lead to improved attitudes:
If they are confident in using a computer then their attitude will also become positive. Once they see that you can do these fantastic things with computers they will begin to use them, but I think probably my ideas are not shared with everyone in the school. (4, 204, [15])

The research literature does not support the notion that a different generation of teachers, with enhanced levels of digital literacy, will necessarily use ICT more effectively. In fact, the opposite appears to be true. In a study conducted by Russell, Bebell and O’Dwyer (2005) which analysed survey data from 2,894 teachers, the researchers found that beginning teachers seldom require their students to use technology and that this contrasts with the approach of more experienced teachers. Given that beginning teachers comprise a relatively small proportion of the total teaching population, an important question is the extent to which the dominant culture of the school might impact on beginning teachers’ beliefs and actions and vice versa. For example, a study of pre-service teachers’ ICT experiences while on their practicum (Pegg, Reading, & Williams, 2007) revealed that by simply observing classes that did not use ICT, pre-service teachers very quickly formed a view that student or teacher use of ICT was unnecessary.

Fishman, Marx, Blumenfeld, Krajcik and Soloway (2004) looked at school culture as one dimension of change in developing a model that seeks to explain why cognitively oriented learning innovations have not become widespread in K-12 contexts. In examining two examples of large scale change, the authors concluded that issues of school culture, capability, policy and management was at the heart of the matter. A usability cube was developed to locate innovations within a three dimensional space where distance between the innovation and current capacity can be conceptualised. The usability cube is shown as Figure 7.3 in relation to two ICT innovations that have been discussed in this study with contrasting success: the interactive whiteboard and Web 2.0.
It is clear that the interactive whiteboard is a highly usable innovation for teachers. It’s “fit with existing practice” (Somekh, 2009, p. 452) is one of the reasons for the extraordinary success of interactive whiteboards in UK primary schools. This ICT is also likely to be scalable and sustainable. The distance between the innovation and the three dimensions as identified by Fishman et al. (2004) is negligible. For example, it can be used as a simple projection device or more interactively depending on teachers’ requirements. Also, its uses are consistent with a range of pedagogical approaches, and therefore tend not to confront any one approach. Secondly, there are minimal issues in terms of professional learning as teachers can generally gain familiarity with the technology as they use it. Finally, policy and management issues that inhibit its use are primarily limited to cost and roll-out (e.g. who should have access first). The introduction of the interactive whiteboard was,
therefore, not antagonistic to participants in this study or the dominant cultures of the schools in which participants resided.

Web 2.0 tools on the other hand, create dilemmas on all three dimensions. Fundamentally, Web 2.0 is about empowering students to be producers of knowledge and broadening their communication networks. Teachers with beliefs that are not congruent with these purposes are likely to resist the innovation. Further the availability of Web 2.0 options (e.g. blogs, wikis, Twitter, Myspace and YouTube), including how to use these in pedagogically appropriate ways, is confusing for many teachers as was certainly the case in this study where the use of Web 2.0 was largely absent. Finally, whilst the issue of Internet safety might be somewhat overstated in schools (Somekh, 2004), there are policy and management issues around student safety that need to be balanced with the learning benefits of using Web 2.0 tools. In summary, the distance of Web 2.0 from the current capacity of participants and their schools on the dimensions identified by Fishman et al. (2004) is significant. The application of the usability cube may help explain the more general reluctance of teachers to embrace Web 2.0 that is reported in the literature (Cranmer, Potter, & Selwyn, 2008).

The above framework suggests that the scalability and sustainability of innovations depend, to a large extent, upon smooth and complimentary relationships between formal leadership as mediated via policy and management, and informal leadership which, according to some research (Bidwell, 2001; Somekh, 2007), is shaped and articulated by dominant cultures within schools. Generating a shared understanding of the construct of ICT is central to the effectiveness of a whole-of-school approach (Robertson, Webb, & Fluck, 2007). However, Bidwell (2001, p. 112) sees formal leadership (i.e. the principal) as a largely ineffectual
player in the face of autonomous teachers located within devolved subject sub-cultures, concluding that:

Broad national movements for instructional improvement are not likely to diffuse widely, and where they do spread, they are not likely to be implemented successfully.

The notion that there is a dysfunction between the formal school leadership and informal networks within schools is also supported by Somekh (2004) who argues that schools are locked into mechanisms of mutual constraint. For example, whilst informal networks of teachers tend to adapt ICT use in conformance with traditional practices, they do so within the constraints of policies and management which stifle creativity, experimentation and risk-taking. These forces of mutual constraint, it is argued, provide grounds for understanding why ICT is not a transformative force in most schools. Findings from the current research support the ideas expressed by Somekh (2004) and Bidwell (2001). There was little coherence both between and within schools about how to best respond to the challenges that ICT presents. To return to the bridge metaphor, it is of little wonder that the other foundation stone to ICT integration, school culture, was weak and fractured in most of the schools visited in the study.

The research found that principals were generally open and supportive to using ICT. However, principals had variable success in stimulating their staff to be creative and innovative with ICT. Many principals lacked the necessary helicopter vision about the potential of ICT due to deficiencies in their own technological knowledge.

At an early stage of their careers, participants tended to be valued by principals, presumably for their enthusiastic and positive orientation towards ICT. A number of participants in the
study forged close relationships with their principal and were provided with ICT infrastructure and also took on pseudo-leadership roles within their school. Participants saw themselves as different to their more experienced peers and resisted being absorbed into dominant cultures that exhibited negativity or ambivalence to using ICT.

The implications of these dynamics are worthy of further research. It may be that beginning teachers comprise a discrete subculture of their own with common characteristics across settings. School leaders may choose to assist beginning teachers to enhance their technological-pedagogical knowledge as a priority since this cohort appears more open to change. Although the literature suggests that beginning teachers may lack pedagogical knowledge to be able to use ICT in student-centred ways (Russell et al., 2005), they are nevertheless a potentially important source of change agentry who may be an important force in re-inventing ICT innovations within localised settings. Consistent with findings from Lim and Chai (2008), Selwyn (2002), and Somekh (2004) though, the study also found that a raft of embedded structural constraints inhibit the creative use of ICT by participants. These constraints will now be discussed.

### 7.5 Embedded structural constraints that inhibit the creative application of ICT

The move to encourage teachers to use ICT in their classroom is one of many reform initiatives encountered by the education community. However, the ICT reform agenda is perhaps different to other reforms in that it brings with it sociological, as well as educational, implications. Put simply, society, and in particular the new digital generation, will adopt forms of ICT irrespective of how the education industry perceives, and responds to, the new digital landscape. Many students have access to (and regularly use) tools that
help them to engage with knowledge outside of the formal structure of the school. The institution of the school has been playing catch-up in policy development terms since the emergence of ICT, and according to Somekh (2004; 2007) not very successfully. One of the reasons, she argues (2004, p. 174) is that the power relations underpinning schools are fundamentally antipathetic to ICT:

Schools are notoriously sites for control in which students are required to conform to a regime of practice which places the teacher in the role of authoritative individual and students in the role of members of an ignorant and potentially oppositional group.

7.5.1 Curriculum and assessment

If the creative use of ICT is about empowering students to set their own goals; re-purpose and produce knowledge; develop communication networks; and find unique ways of solving problems, then the school, as described by Somekh above, is inappropriate for this purpose without fundamental structural reform. Mandated curriculum and high stakes assessment practices, for example, put pressure on teachers to get through the curriculum (Jordon, 2008; Lim & Chai, 2008; Voogt, 2008) and teach for tests (Demetriadis et al., 2003; Lim & Chai, 2008; Selwyn, 2002; Voogt, 2008). The participants in this research certainly felt these pressures. For example, in this study Chanpreet had to make decisions in relation to the time that it would take her Year 2 class to learn ICT skills as opposed to the curriculum outcomes that she was expected to teach:

It’s just very hard when you’ve got the outcomes that you must teach. And the question is where do you fit this [ICT skills] lesson? (4, 45, [9])

The challenge of ensuring that the curriculum is covered is particularly important to beginning teachers who may be finding their way in linking appropriate pedagogical
approaches with their content knowledge. A number of participants in the research reflected on curriculum content as being their most significant learning curve in the first couple of years of teaching. The demands of getting through the curriculum, in many cases, were seen as adversarial to the beliefs that participants claimed to hold. In such cases, if ICT were to be used at all, then their application was to support the goal of efficiently mediating content rather than for more creative uses such as using ICT to promote communication or problem-solving.

Assessment can drive curriculum and pedagogy at all levels of education (Erstad, 2008; Newhouse, 2008). In a study of six teachers from two Singapore primary schools Lim and Chai (2008) concluded that the final frontier in ICT integration is likely to be the assessment system. It is argued that assessment can be antagonistic to both teachers’ beliefs and their capacity to integrate ICT.

Lane (2004, p. 12) points out that “large scale assessments are the primary tools for communicating what teachers should be teaching and what students should be learning.” However, she suggests that, in recent attempts to address issues of accountability, cognitively rich assessment practices have been compromised. Zevenbergen, Dole and Wright (2004) identify six practices that should guide assessment design: evidence should be gathered continuously; assessment should be integrated with teaching; a range of tools should be used; opportunities should be provided for students to self-assess; multiple forms of evidence should be gathered; and continual feedback should be provided to students. All of these are contrary to high-stakes assessment practices which reflects the needs of mass education (Erstad, 2008).
Assessment practices that measure the processes underpinning learning (e.g. performance-based assessment) provide an avenue to measuring higher order learning and ICT has been shown to enhance the quality of performance-based assessment through the use of digital portfolios (BECTA, 2007). However, the use of digital portfolios is embryonic in K-12 education. Paper-based exam-driven assessment is still the dominant mechanism for gauging what students know, and unfortunately this is seemingly incongruent with the use of ICT. For example, some participants in the study saw a contradiction between using a wordprocessor or a spreadsheet to conduct a task when in exam conditions this task would need to be done manually using pen and paper.

Participants in this study did not consider digital portfolios as an option for assessing their students for two reasons. Firstly, most schools in the study were not technically set up to implement a comprehensive system of digital portfolio assessment (i.e. ensuring that students have ready access to a network and software that can be used to develop and store digital artefacts); and secondly, participants were not aware of the potential of using digital portfolios in their assessment mix. For example, when Chanpreet was asked whether she had considered using ICT in her assessment, she indicated that she “had not thought of it” (4, 232, [3]).

7.5.2 Educational leadership

Lack of technical and pedagogical capability to form a response to the opportunities that digital assessment affords, raises questions about the type of educational leadership that is provided in the schools discussed in the study. If the quality of teaching and learning is the central preoccupation of school leaders (Macneill, Cavanagh, & Silcox, 2005; Southworth, 2004), then why would something as fundamental as the improvement of assessment using
ICT have escaped the attention of the leaders in this study? Some studies suggest that principals themselves may lack the necessary ICT knowledge to genuinely lead (Schiller, 2003). This was certainly the case in some of the schools covered in this study where participants indicated outright frustration with the school leadership. Like teachers, though, principals and other school leaders have professional learning requirements particularly in the area of understanding and evaluating the capacities of new digital technologies (Dawson & Rakes, 2003; Russell et al., 2005; Schiller, 2003). In a study involving 1,104 principals, Dawson and Rakes (2003) found that professional learning that is specific to principals’ needs and long-term was most effective. It is suggested that the conceptual framework proposed in this study may be a useful way in which to plan for professional learning in ICT integration for principals as well as teachers. This is a holistic model that deals with teachers’ beliefs and school culture as the foundations of ICT integration, along with the synergy of technological, pedagogical and content knowledge on the practitioner side and leadership, policy and infrastructure on the school side, all in the context of innovation through pedagogical reasoning.

Empirical studies of school leaders in Canada (Isabelle & Lapointe, 2003) and Ireland (McGarr & Kearney, 2009) indicate that one of the reasons for the lack of pedagogical leadership in integrating ICT into the curriculum has been a preoccupation with developing ICT infrastructure at the expense of other considerations. This was also born out in this research. All principals interviewed identified the purchase and maintenance of ICT infrastructure as their main consideration in responding to the challenge of integrating ICT. Although some principals achieved success in equipping and maintaining their schools, there was a wide variation in terms of access to ICT infrastructure amongst participants,
and the only schools that were adequately set up for the student use of ICT among the sample were private schools. This heavily impacted on the extent to which participants were able to creatively use ICT particularly for student-centred learning. Even the most enthusiastic participants could do little more than rotate students through the limited number of devices in their classrooms. In situations where a centralised computer laboratory was provided, participants struggled to gain appropriate and timely access. Unfortunately, this state of affairs is common in the literature (Groff & Mouza, 2008).

Chanpreet, equipped with a mobile bank of laptops, was reluctant to use these in her classes of 22+ students without support. In Year 2, when asked what the biggest barrier was in being able to integrate ICT into her teaching, Chanpreet replied:

> I think the major challenge is being able to have someone else in the classroom to help teach. To get an hour lesson of our ICT, you need someone else. If you don't it is very difficult. (4, 291, [9])

### 7.5.3 Class sizes and ICT

Using ICT in short curriculum-defined bursts (to fit into the timetable) in large class sizes can be problematic, particularly in situations where infrastructure is not robust. Kompf (2005) suggests that ICT further complicates teacher-learner-knowledge interactions and the larger the class size, the more exponential this effect will be. The issue of adopting ICT in large class sizes has received little attention in research literature, although this emerged as a significant barrier in this research. One notable exception is a study by Goodson and Mangan (1995) who point out that the computer demands a more individualised approach to learning than most subject areas allow. The authors conclude that most subject cultures are fundamentally incompatible with the pedagogical and organisational changes that are required for ICT use.
Participants in this study were sometimes cast in the role of technical support, and this function detracted from what they felt they were supposed to be doing (i.e. facilitating individualised learning). The technical support function can be exacerbated by wide disparities in students’ ICT skills and participants also alluded to a raft of behavioural issues that emerged, typically associated with increased levels of enthusiasm for using ICT. Large class sizes may be appropriate for transmissive models of teaching (e.g. lecturing), but as schools move towards 1:1 student-computer ratios, empowering students with ICT may require a re-think of how to best support this level of empowerment.

7.5.4 ICT policy development

Most of the principals interviewed in this study were enthusiastic about the potential of ICT. However, consistent with the literature (e.g. Schiller, 2003) there was a wide variation in terms of their competency with ICT. This has perhaps led to different policy development and interpretations on how some ICT should be dealt with in schools. For example, mobile phones were banned in some schools, but seen as an interesting and creative opportunity in others. Similar bans were evident in some schools on social networking sites like MySpace and FaceBook, but some participants reported on having heard that innovative examples of ICT integration were possible by engaging with these sites. There was a sense amongst participants of policy being developed ad hoc, and that school leaders were out of their depth, although in fairness to the school leaders involved, much of the ICT policy development in Australia is undertaken at the district or state level.

The issue of including ICT activities as part of homework was another contestable issue that emerged from the study. Research has discerned the existence of a second digital divide where some students, not only have access to ICT, but also appropriate forms of ICT
and parent support that will help them in their learning (Somekh, 2004). This is clearly different and more educationally advantageous than the use of ICT, for example, around Playstation or Nintendo. In a study involving 1,340 students from diverse backgrounds from Years 2, 6, 9 and 11, Valentine, Marsh and Pattie (2005) found a statistically significant positive association between students’ home use of ICT for educational purposes and improved attainment. The researchers also found negative relationships between using ICT at home for purposes of leisure, and attainment.

Whilst some participants in this study did not set homework tasks that included ICT presumably in an attempt to ensure a level playing field, others encouraged students to be creative with ICT at home. Again, there was a perception amongst participants that the policy environment was not helpful. Teachers were generally left to make their own judgments and this only served to reduce confidence in leadership.

### 7.5.5 Unresolved questions

There is a need, then, to resolve some difficult structural dilemmas in the terrain of curriculum, assessment, pedagogical leadership, timetabling, class sizes, managing emerging technologies and ensuring equitable access to ICT. The following questions may assist in framing future research to inform ICT educational policy, and ultimately promote the take-up of ICT in Australian schools:

- How can teachers balance the demands of a crowded curriculum with providing students with opportunities to use ICT in ways that embrace the principles of lifelong learning?

- In what ways can students set their own goals within the context of stated
curriculum goals? To what extent is incidental learning incompatible with curriculum outcomes? Can ICT be used in creative ways to bridge the gap between planned and incidental learning?

- What changes can be made to the way in which students are assessed to help drive pedagogical decisions in a direction of higher order learning? And how can ICT assist in this process?

- What suite of support do principals need to help them provide the type of pedagogical leadership in ICT integration that will inspire their staff to push the boundaries of using ICT? How should this support be delivered?

- Are there effective models of ICT use that cut across curricula and timetable constraints? Can these models be facilitated with appropriate and cost effective levels of content, pedagogical and technical support?

- How can educational leaders anticipate and respond to the rapidly changing ICT environment in measured ways to promote equal opportunity for students at the same time as encouraging innovation?

If the above questions are to be addressed, no doubt they will require a range of strategies at all levels of education. It is likely that professional learning will be at the centre of many of the future strategies that will be adopted in an attempt to resolve the impasse between ICT and rich teaching and learning experiences (Selwyn, 2002). Calderhead (1996) proposes that the professional development for teachers is particularly crucial to ensuring that innovations in the curriculum are implemented.
The final theme in this chapter seeks to add to the conceptual framework developed by Mishra and Koehler (2006) and Harris, Mishra and Koehler (2009) by discussing a significant reported deficiency at the teaching and learning interface: the ability to synergise technological knowledge with pedagogical and content knowledge in ways that benefit student learning.

### 7.6 Deficiencies in pedagogical-content-technological knowledge

In the third year of the study, when asked *What knowledge is required for effective teaching*, 85% of participants replied that it was a combination of one or more of (a) pedagogical knowledge (46%), (b) content knowledge (28%) or (c) knowledge of student needs (10%). Other types of knowledge such as knowledge of how to communicate and how to manage behaviour in the classroom were also mentioned (8% and 3% respectively). The study has found a clear deficiency, amongst participants, in the type of technological knowledge required to enhance and support pedagogy. Perhaps the most compelling evidence supporting this, is that not one participant mentioned technological knowledge as a requirement for effective teaching. It simply did not register on the radar as being part of the essence of being a teacher. It may be that teachers in the study viewed technological knowledge as a subset of pedagogical knowledge. It could be argued that ICT comprises one set of pedagogical options available to teachers. However, most teachers in the study acknowledged its significant transformative potential. They also highlighted that ICT had particular currency with contemporary students. Given these factors, coupled with intense government energy for stimulating interest in ICT, it might have been expected that technological knowledge would receive some attention in a consideration of the types of knowledge required for effective teaching.
The absence of consideration of technological options in teachers’ pedagogical reasoning may be why Harris, Mishra and Koehler (2009) argue that many methods of technology integration are technocentric, that is, they fail to take into consideration that the use of ICT takes place within specific content-based and pedagogical contexts. In this research participants looked upon technological knowledge as an optional extra in the pedagogical reasoning process. This typically resulted in its use being limited to an efficient aide or an extension device. The primary rationale for participants bringing technological knowledge into the pedagogical reasoning process was the advantages that it held in terms of increasing student motivation.

Although most participants felt that they had sufficient technological knowledge, it was evident that this equated to a fairly narrow view of what constitutes ICT and the affordances that it offered. There was a clear knowledge gap in the intersections between pedagogical knowledge and technological knowledge, content knowledge and technological knowledge and the synergy of all three. This is consistent with the findings from Mishra and Koehler (2006) and Harris, Mishra and Koehler (2009). Mishra and Koehler (2006) provide a comprehensive explanation of these terms and the relationships between them. A short summary follows.

Technological pedagogical knowledge includes knowledge of the existence, components and capabilities of ICT, as they are used in a teaching and learning setting, and knowing how teaching may change as a result of using ICT. This may include an understanding of the range of tools that exist for a particular pedagogical dilemma, the ability to use a tool based upon its fitness, and the application of strategies to optimise the use of ICT tools for learning. Technological content knowledge includes knowledge about the manner in which
ICT and content are reciprocally related, particularly the way in which ICT can provide opportunities for greater and more varied representations of content. For example, using Google Earth to explore concepts of day and night in northern and southern hemispheres may make it easier for students to understand how the Earth spins and its relationship to the sun. Technological pedagogical content knowledge is the epitome of good teaching with ICT. It requires an understanding of the representation of concepts using ICT; pedagogical techniques that use ICT in ways that allow learners to construct their own understandings and build on their prior knowledge; knowledge of what makes concepts difficult or easy to learn and how the appropriate use of ICT can challenge and add-value to students’ prior knowledge.

It is clear that most participants in this study did not consider using ICT in the ways described above. Further, the fact that most participants were generally seen as exemplary ICT users in the school setting led to the erroneous view that these beginning teachers did not require professional learning in ICT integration. The participants in the study generally did not see the need to transform their teaching. There was no impetus for “cognitive disequilibrium” (Zhao & Cziko, 2001, p. 23) and therefore teachers adopted ICT without changing or challenging their pedagogy. The typical rationale provided for using ICT was that it made the teaching and learning process easier. There was also an acknowledgement that students were motivated by it, and would benefit from using ICT more often as it was “the way of the future.” There was very little critical reflection on how ICT was used in practice or could be used in future practice.

Teachers can display levels of technological knowledge from rudimentary to sophisticated whenever an ICT tool is used in the classroom. The extent to which all ICT options are
considered, and the teacher reflects upon how the implementation of these options might benefit the teaching and learning environment, are crucial to exhibiting sophisticated technological knowledge.

Figure 7.4 shows the relationships between Chanpreet’s technological, pedagogical and content knowledge.

![Diagram showing the relationships between technological, pedagogical, and content knowledge]

**Figure 7.4.** Depiction of the relationships between Chanpreet’s technological, pedagogical and content knowledge using Mishra and Koehler’s model (2006, p. 6).

In the case of Chanpreet, her limited knowledge of the range of ICT options available to her (represented by a smaller circle depicting her technological knowledge) was an obvious barrier to the sophisticated use of ICT. More significantly, though, she was not aware of what she did not know. When asked what the biggest barrier was for her in moving forward on the continuum developed by Newhouse, Clarkson and Trinidad (2005), she replied:
Teaching the actual skills. I think what is holding me back is not having a projector or something. A bigger screen to show the children first. (4, 406, [28])

This comment indicates that Chanpreet sees the teaching of ICT skills as her most important consideration as opposed to integrating ICT across the curriculum. She also perceives that having access to a projector that would assist her demonstrate more effectively, would significantly improve the teaching and learning environment. Whilst this may be true, Chapreet’s comment implies that she may have not considered other ICT options that offer opportunities to transform her pedagogy for the betterment of student learning.

The integration of content knowledge and pedagogical knowledge can create engaging learning environments. Although Chanpreet exhibited inconsistencies in her beliefs about knowledge and her beliefs about pedagogy, it is probable that her pragmatically enacted pedagogical knowledge was transmissive in most circumstances. Given that her primary goal was to mediate the mandated curriculum to her students, and she felt pressure to achieve this within limited time constraints, it is likely that her pedagogical knowledge was also subservient to her content knowledge. Chanpreet’s pedagogical knowledge, therefore, again is represented by a smaller circle with a significant cross-over with content knowledge in Figure 7.4.

Combining technological and content knowledge can lead to better availability of, and engagement with, resources. This is precisely how Chanptreet used ICT: as an alternative legitimate source of knowledge to reinforce learning (represented by a significant cross-over between content knowledge and technological knowledge in Figure 7.4).

In the case of Chanpreet, the combination of pedagogical knowledge with technological knowledge would have probably involved using a tool like a projection device in order to
more efficiently deliver the curriculum. However, a projection device was not available to Chanpreet throughout the study. It is significant that when asked what she would do if she was awarded a $5,000 professional development scholarship, Chanpreet’s reply was:

*I suppose an interactive whiteboard would be awesome. I think that would be great. I don’t know what else. What other options are there? I can’t think of any.* (4, 364, [17])

Combining technological-pedagogical-content knowledge potentially enhances learning outcomes for students. The harnessing of generic ICT tools for activities such as brainstorming, expressing current understandings, authentic problem-solving, producing knowledge in different ways and/or discussing concepts with others, were absent from Chanpreet’s thinking.

Like most participants in the study, Chanpreet has some clear opportunities for professional learning based upon the model espoused by Mishra and Koehler (2006). For example:

- Build on pedagogical knowledge and experience concrete examples of students constructing their own understandings using ICT thus better aligning beliefs and actions.

- Build on technological knowledge to develop a more comprehensive understanding of the options available.

- Better integrate pedagogical and technological knowledge in ways that facilitate the enactment of beliefs.

- Synergise technological-pedagogical-content knowledge to create environments in which students consistently engage in higher order thinking and meaningful
The chances of Chanpreet, and other participants, engaging in this type of disruptive and long-term professional learning are slim. This is likely to be expensive, certainly if the professional learning program was to involve ICT and pedagogical mentoring. The study has shown that where experienced ICT coordinators with well developed pedagogical knowledge were employed at the school, and were given time to work with beginning teachers, this had a positive impact. However, it is suspected that most participants in the study (and their principals) would not have seen this as a priority.

The matter of participants’ priorities is worth discussing further. Zhao and Cziko (2001) suggest that it is important to look at the goals underpinning teachers actions as a way of understanding why so many teachers choose not to use ICT in ways that transform the teaching and learning process. Applying Perceptual Control Theory (PCT) to look at the problem of under-utilisation of ICT in schools, the authors (2001, p. 6) concluded that three pre-conditions need to be satisfied from a teacher perspective in order for an innovation like ICT to be taken up in the classroom:

1. The teacher must believe that technology can more effectively meet a higher-level goal than what has been used.

2. The teacher must believe that using technology will not cause disturbances to other higher-level goals that he or she thinks are more important than the one being maintained.

3. The teacher must believe that he or she has or will have sufficient ability and resources to use technology.

As in the Zhao and Cziko study (2001), the primary goal for participants in this research was to be (and to be seen to be) an effective teacher. This found expression in articulating priorities such as ensuring that content is delivered, maintaining positive relationships with
parents and colleagues, and generally being in control of the classroom. Most participants acknowledged that ICT potentially could help them to be more effective teachers and were therefore open to its use. However, ICT can be disruptive. Participants needed lead time to think about how to best harness ICT in ways that advance their students’ learning and also time to de-brief and reflect at the conclusion of using ICT. Using ICT in ways that transform the teaching and learning environment can also be dangerous. Achievement of curriculum outcomes may be more ambiguous, assessment could be problematic and handing over the locus of control of the ICT to students may lead to classroom management issues. Although participants were confident in using a limited range of ICT, they sought to ensure that the ICT environment did not extend beyond what their skills and aptitudes could manage.

In short, participants perceived significant disturbances to the higher level goal of being an effective teacher. Most participants lamented that, given more time they would seek to integrate ICT. However, lack of time is really another vernacular for “not a priority”, and if school leaders were to make it a priority then ICT use might move in an upward direction on the hierarchy of their goals. Participants understandably did not seek to move out of their comfort zone by extending themselves into unfamiliar territory at an early stage of their careers.

The hierarchy of teachers’ goals as described by Zhao and Cziko (2001) has some important implications for this study. Beginning teachers need to perceive that ICT will help them be effective teachers. If in the early years of teaching the important goals are to deliver the curriculum, maintain positive relationships with parents and manage the classroom, then developing strategies in accordance with these goals would appear to be a
sensible approach. Such strategies may include providing appropriate levels of infrastructure, ICT-integrated lesson plans and assessment rubrics, activity-based ICT resources, and pedagogical and mentoring support from ICT leaders. As far as the participants in this study were concerned, the support received was generally piecemeal. It is not remarkable, therefore, that participants used ICT in unsophisticated ways that tended not to disrupt their other important goals. The transformation of the teaching and learning environment in ways that support higher order thinking and meaning-making may require new goals to be articulated by school leaders and taken up by teachers.

7.7 Usefulness of the proposed conceptual framework

The research literature on ICT integration provides a comprehensive basis in which to consider factors that support and inhibit the use of ICT in K-12 contexts. Because the subject of ICT integration is so complex, though, contributions have tended to either focus on one or two factors in detail or present “system-based conceptual frameworks of constructs that explain ICT use” (Levin & Wadmany, 2008, p. 238). For example, Groff and Mouza (2008) provide a useful framework called i5 that enables teachers to predict the likelihood of success of technology-based projects. However, as Levin and Wadmany (2008) point out, this does not explore the relationships between factors.

The holistic nature of the conceptual framework provided in this study through the bridge metaphor has the potential to explain these relationships. For example, Chanpreet’s beliefs about ICT were closely associated with the use of the Web and a fairly narrow range of software. Her beliefs about knowledge, accessed from legitimate sources, were consistent with her views about ICT. When provided with opportunities to implement a student-centred approach to learning through the laptops that were available, Chanpreet sensed the
danger of students straying off track and called for more support in her classroom to better control the environment. Her primary goal of getting through the curriculum, again consistent with her beliefs about knowledge, relegated ICT to what were typically reinforcement activities. Using the conceptual framework of the bridge metaphor has thus led to an understanding of Chanpreet’s pedagogical reasoning processes highlighting areas of potential focus for professional learning (i.e. clarification of beliefs and development of technological-pedagogical knowledge).

The conceptual framework presented in this thesis, then, has proven to be useful in explaining how participants in the research responded to the challenge of ICT. The framework may also be of use to teachers, school leaders and policy makers in navigating a course through the complexities of ICT integration. Specific benefits of using the framework in the planning and execution of change using ICT are:

- The process of building a bridge begins with beliefs as a logical starting point for teachers and school culture as the logical starting point for principals. The crucial role of beliefs and culture in instigating and sustaining change using ICT are well documented (Buehl & Fives, 2009; Fishman et al., 2004; Hofer, 2006; Olafson & Schraw, 2006; Schommer-Aikins, 2004; Somekh, 2004).

- The framework acknowledges that ICT can be adopted in a variety of forms using a range of pedagogical approaches. In the final analysis, the challenge of matching pedagogical approach with ICT resides with the teacher.

- The framework integrates other useful concepts such as pedagogical reasoning (Harris et al., 2009; Webb & Cox, 2004) and the hierarchy of goals (Zhao &
Cziko, 2001) and thus builds upon, rather than competes with, the thinking and tools provided by others.

The final chapter of the thesis will conclude the study and suggest some ideas for further research.
Chapter 7: Discussion


Chapter 7: Discussion


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CHAPTER 8
Conclusion

8.1 Chapter overview

This final chapter concludes the study by summarising key findings in relation to the study’s seven research questions and re-capping on the implications of these findings. Some suggestions for further research are also provided.

8.2 Key findings

Although the study was undertaken in a specific geographical location and involved a relatively small cohort of participants, the research questions, probing beginning teachers’ beliefs, knowledge, dispositions and skills in using ICT, have a much broader application.

In responding to the research questions, the study adopted a mixed method approach involving a synthesis of qualitative and quantitative techniques. The research attempted to approach the subject of ICT integration scientifically and, as an interpretive study, seeks to be judged in terms of auditability and credibility (Guba & Lincoln, 1994). The extent to which the findings of this study have parallels with, and implications for, other contexts is for the reader to decide. The key findings of the study in relation to the seven research questions are set out in Table 8.1.
<table>
<thead>
<tr>
<th>Research question</th>
<th>Key findings</th>
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<tr>
<td>1 What are the characteristics of beginning teachers’ pedagogical beliefs?</td>
<td>At the inception of the study, participants articulated pedagogical beliefs that resonated with Jonassen, Peck and Wilson’s (1999) attributes of meaningful learning, particularly cooperative and authentic learning.</td>
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<td></td>
<td>At the conclusion of the study, pedagogical beliefs, as measured by responses to the questionnaire, remained largely the same. Whilst some participants noted a shift from being idealistic to more realistic, others claimed to have become more learner-centred over the period of the study.</td>
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<td>There was a general lack of clarity over the relationships between participants’ pedagogical beliefs and other beliefs (e.g. beliefs about content, ICT, classroom management) including which beliefs should be enacted and why.</td>
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<td></td>
<td>Participants may have resolved this lack of clarity by making compromises (real or contrived) that situate their ideals just beyond the horizon. Participants thus maintained self-perceptions of being sympathetic with contemporary learning theory, whilst at the same time, enacting their more pragmatic beliefs.</td>
</tr>
<tr>
<td>2 What are the characteristics of beginning teachers’ knowledge, dispositions and skills in using ICT?</td>
<td>At the inception of the study, participants’ knowledge about how ICT can support teaching and learning emphasised the capacity of ICT to make teaching easier.</td>
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<td></td>
<td>Participants’ worldview of what constitutes ICT broadened between Year 1 and Year 3 of the study. Although this did not have immediate impact on participants’ teaching (apart from perhaps the use of the interactive whiteboard), the opportunities that this expanded worldview may open up in the future may be profound.</td>
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<tr>
<td></td>
<td>Participants generally did not feel that they had deficiencies in technological-pedagogical knowledge and may not opt to challenge themselves in this area in the future.</td>
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<td></td>
<td>Participants were attuned to possible undesirable consequences in using ICT and this may have been another factor in their pursuing a “softly, softly” approach to ICT integration not wishing to push the boundaries too far.</td>
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<td></td>
<td>Participants exhibited positive attitudes toward ICT through the study and indicated that they were competent and confident in their ability to develop their understanding of the possibilities of ICT. However, actual use of ICT for teaching and learning was found to be relatively superficial and mainly teacher-driven.</td>
</tr>
<tr>
<td></td>
<td>Participants generally felt that they had superior knowledge and more positive attitudes and beliefs from those held by their peers. This was consistent throughout the study.</td>
</tr>
<tr>
<td>3 What are the relationships among beginning teachers’ pedagogical beliefs, knowledge, dispositions and skills in using ICT?</td>
<td>Although most participants claimed to hold learner-centred ideals, these ideals were generally not put into practice and therefore had little impact on participants’ knowledge- and/or skill-base as this relates to ICT integration.</td>
</tr>
<tr>
<td></td>
<td>The broadening of participants’ world view mainly emanated from students, peers and broader societal trends rather than from actually experiencing different ways using ICT.</td>
</tr>
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</table>
Participants remained positively disposed to the possibilities of ICT, probably because of the advantages they saw in using ICT in terms of student motivation.

ICT was not used in ways that were consistent with participants’ stated pedagogical beliefs (e.g. as a student knowledge production or collaborative tool). However, there were some examples of ICT being used as a platform for subsequent non-ICT based tasks and classroom discussions.

Throughout the study, participants used ICT mainly as a reinforcement and inquiry tool that provided motivating graphical and auditory material. This may indicate a gap at the intersection of technological and pedagogical knowledge.

Participants used a basic suite of ICT tools that they were familiar with, and generally did not attempt to take risks or challenge themselves by stretching the limits of innovative teaching.

Participants had positive dispositions towards ICT and used it where possible although most were disadvantaged in terms of the ICT infrastructure that was available.

Infrastructure available to participants was generally not conducive to original and inventive uses of ICT.

The shift towards a more “realistic” view of what was achievable in the classroom in terms of using ICT was bound up with inadequate infrastructure and perceptions of students’ abilities to be self-directed using ICT.

Principals interviewed during the study were generally supportive of integrating ICT, but they themselves had gaps in technological-pedagogical knowledge and therefore were not inclined to inspire participants to push the boundaries of teaching and learning using ICT.

Participants’ attitudes remained positive towards ICT, possibly because the uses to which they put ICT were generally well received by students.

Participants were on a steep “learning curve” not only in terms of content and pedagogical knowledge, but also with overarching issues like classroom management and establishing relationships with students, parents and peers.

Participants’ priorities over the period of the study focused on becoming familiar with the curriculum, developing teaching strategies and managing the classroom. Exploring the transformative potential of ICT was not prioritized highly and therefore the knowledge- and skill-base of participants only shifted slightly.

Four interrelated factors are posited to explain the generally slow and unimaginative response to ICT that was exhibited by participants: lack of clarity over beliefs and how ICT can support these beliefs; variability of perceptions within schools of the affordances and risks of using ICT; embedded structural constraints that stall the creative use of ICT; and deficiencies in technological-pedagogical knowledge.

It is suggested that dealing with these factors will assist educators in grappling with the implications of using ICT in the classroom and facilitate better exploration of its transformative potential.
8.3 Implications of the findings of the research

The above findings indicate that participants articulated pedagogical beliefs that aimed to engage students in active meaning making. However, the way in which participants used ICT was generally unimaginative, limited to presentation style delivery or use of the Web along with a narrow range of ICT productivity software. There was a mismatch between the ideals that participants claimed to hold to be important, and their capacity to use ICT to help realise these ideals. Four interrelated factors are posited to explain this: lack of clarity over beliefs and how ICT can support these beliefs; variability of perceptions within schools of the affordances and risks of using ICT; embedded structural constraints that stall the creative use of ICT; and deficiencies in pedagogical-technological-content knowledge.

The implications of these factors permeate individual, school and systemic domains across K-12 education.

8.3.1 The individual domain: critical reflection and ongoing professional learning

To help build a repertoire of innovative practice using ICT, teachers would benefit from developing a solid base in which their beliefs and actions are congruent. Critically reflecting upon the range of beliefs that teachers might hold can have a positive impact on professional learning choices, and ultimately, practices. Some questions that might aid reflective practice include:
To what extent are my beliefs about the nature of knowledge (epistemological) congruent with my beliefs about teaching (pedagogical) and my beliefs about learning in specific content areas (e.g. mathematics and science)?

How are my beliefs about ICT (e.g. interactive whiteboards, computers and mobile devices) consistent with my epistemological and pedagogical beliefs?

To what extent are my beliefs about classroom management and children’s behaviour congruent with my beliefs about ICT and pedagogy?

Clarifying and prioritising the range of beliefs that teachers hold may be a useful step towards closing the gap between the idealistic and the realistic classroom as far as the use of ICT is concerned.

The study has found that technological knowledge was not recognised as part of the essence of being a teacher. Although participants exhibited a strong skill-base in using the Web and a defined set of productivity tools, there was a clear knowledge gap amongst participants in terms of understanding what ICT are available, and how these can be best harnessed to support the eclectic range of pedagogical approaches that are implemented in the classroom. Developing professional learning in the use of ICT in an authentic, continuous improvement context (i.e. one that mirrors the pedagogical reasoning processes that teachers engage with on a day to day basis), embedding consideration of ICT options within the dimensions of pedagogical knowledge and content knowledge would appear to be a sensible approach.
8.3.2 The school domain: building a culture for ICT use

The school culture was found to be an important backdrop for participants’ use of ICT in the classroom. Although participants saw themselves as different from their more experienced colleagues, their use of ICT was constrained by the lack of ICT infrastructure available to them, and a range of other pressing issues that were given priority. Building a strong and supportive school culture that values the use of ICT is an important consideration for school leaders. Some ways in which school leadership teams can stimulate the improved application of ICT include:

- Provide mechanisms (e.g. ICT forums) by which ICT and pedagogy can be discussed in an open, non-judgmental manner.
- Make ICT decisions within a strategic planning framework.
- Consider equity issues (e.g. access to computers at school and access and the type of access at home) in decision-making.
- Become familiar with, and regularly update knowledge on, the range of ICT options that are available in teaching and learning.
- Allow for the disruptive nature of ICT and, where appropriate, encourage teachers to take risks and sometimes fail.
- Make the use of ICT a priority or if this is not possible, model practices where ICT is harnessed to help achieve current priorities.
- Focus on beginning teachers as potential change agents, involve them in ICT decision-making, and where possible equip them with infrastructure, tools and templates that will help them enact their beliefs.

- Create a mentoring (e.g. ICT coordination) role that supports other teachers in experimenting with ICT.

- Liaise with other schools, universities and industry partners to develop a knowledge-base on ICT use in educational contexts.

### 8.3.3 The systemic domain: tackling the tough issues

Most participants in the study claimed to value lifelong learning, and in some cases presented this as a cornerstone of their teaching philosophy. It has been shown, however, that some of the principles of lifelong learning (e.g. an inquiring mind or a sense of personal agency) are sometimes undermined by a school system which is focused on intended learning mediated through the curriculum. An inquiring mind that delves into learning that is incidental to the curriculum is sometimes seen as “off task”, and this is exacerbated by the seductive nature of ICT, particularly the Web. Intended learning, which is usually assessed through high-stakes testing, forms the basis of students’ progression through the Australian education system and subsequent life choices. The current manner in which high-stakes testing is conducted is a barrier for those that are seeking to transform teaching and learning through ICT.

Schools are required to cover a lot of intended learning, and this certainly impacted upon the time that participants in this study were able to devote to individual goal setting,
inquiry, problem-solving, communication and collaboration between students, and creative work using ICT. A teacher’s role is to guide student learning and participants in this study had well developed views on what constitutes appropriate learning in their classroom. However, teachers who support lifelong learning surely also support individual goal setting, and at times, incidental learning. This raises a dilemma. How can teachers’ best resolve the apparent incompatibility of incidental learning with the pressure to achieve defined curriculum outcomes? On the one hand ICT can be seen as problematic, seducing learners away from curriculum outcomes; on the other hand, the flexibility of ICT and the range of options available could be viewed as potentially liberating for both teachers and students. For example, ICT can provide opportunities to develop innovative cross-curricula activities that may be consistent with both learner goals and curriculum outcomes. Discovering and testing this type of innovative practice is one of the key challenges for those who seek to transform learning through ICT.

High stakes testing through written examinations is incongruent with the type of higher level ICT use advocated in this study (e.g. inquiring into information sources, using tools to synthesise and make sense of information, and transforming information into personalized knowledge). In many cases, current assessment practices are predicated on the assumption that ICT is not available at the time of assessment (e.g. calculators and computers). In these circumstances it is not surprising that, in preparing students for assessment, ICT are not used. Contemporary assessment practices emphasise its integration with teaching along with a continuous approach in which multiple forms of evidence are gathered over time. It would seem that fundamental and significant changes to assessment practices are required in order to bring ICT into the fold and help drive pedagogical decisions in a direction of
higher order learning. Performance-based assessment through e-portfolios may be an appropriate direction in which to go.

Finally, the study has shown that participants were seldom able to use ICT in ways in which the locus of control for the ICT resided with students. One of the reasons for this was a lack of ICT infrastructure available to teachers in the classroom. However, the ability of teachers to provide the level of support for individualized learning using ICT was also found to be problematic. Large class sizes, coupled with the way in which schools are structured into discrete subject areas and allocated relatively short timeframes in which to deal with segments of the curriculum, may be antagonistic to using ICT in innovative ways. Problem-based, interdisciplinary solutions may be more appropriate in engaging students with ICT.

### 8.4 Suggestions for future research

ICT has been fired at teaching and learning from point blank range, forever disturbing the existing order in education (Kompf, 2005). Each new wave of ICT carries with it opportunities and risks. The ubiquitous use of mobile phones, for example, challenges educators to harness personal mobile devices, engaging students in meaningful tasks that enhancing learning outcomes. The risks associated with using personal mobile devices in the classroom are significant (e.g. off-task frivolous use of the device, a focus on social networking rather than learning, predatory behaviour from outside of the classroom). However, the potential benefits in terms of student engagement and learning are compelling. The dilemma will persist until educators find ways of optimising the use of the
ICT for learning whilst at the same time minimising or eliminating risks. ICT, therefore, presents a constant barrage of dilemmas, each an avenue for future research.

As far as this study is concerned, the four factors posited to explain the lack of teacher imagination in using ICT present a springboard for research into deeper understanding. The reported lack of clarity over teachers’ various domain-specific beliefs and how ICT can support these beliefs requires more attention. Research into the relationships between teachers’ different, sometimes competing, beliefs is embryonic (Buehl & Alexander, 2006; Olafson & Schraw, 2006) and the task of unravelling the impact of beliefs on teaching is complex (Buehl & Fives, 2009; Pajeres, 1992). However, the following questions may prove useful: how do teachers prioritise the range of beliefs that they have? What socio-cultural factors have most impact on teachers’ beliefs? To what extent do teachers’ beliefs about learning and pedagogical constructs (e.g. lifelong learning and constructivism) accurately depict these constructs? What strategies can be adopted to help teachers make their beliefs explicit?

The issue of why some beliefs are enacted and some are not, is a particularly perplexing question. A number of studies (e.g. Ertmer, 2001; Judson, 2006; Lim & Chai, 2008; Palak & Walls, 2009) have noted that teachers’ beliefs and their practices are incongruent. Better understanding why beliefs and practices are incongruent, in the range of contexts in which teaching takes place, is a worthy research endeavour in itself.

The research found significant variability within and between schools regarding perceptions of affordances and risks of using ICT. One of the most important and as yet unresolved questions facing educators is the vexing issue of whether there is a link between ICT use
and student attainment (Condie & Munro, 2006; Voogt, 2008). Systematic, evidence-based, longitudinal studies seeking to confirm or disconfirm links between the use of ICT and student attainment across a range of educational contexts are required. Where ICT has been successfully embedded in the classroom experience and a link to student attainment is established, a description of the context surrounding this implementation and the principles underpinning its success would represent valuable new knowledge. A mix of qualitative and quantitative data is required in the quest to confirm and disconfirm links between ICT use and student attainment. The voices of students, parents, teachers and school leaders all have a place, and discerning how these voices might change over time is also a useful endeavour.

In relation to structural factors that constrain the use of ICT, three priorities for research are proposed. Firstly, the development and evaluation of innovative applications of interdisciplinary ICT curriculum that breaks down timetabling barriers and is consistent with both learner goals and mandated curriculum outcomes would be useful, particularly in 1:1 computer environments. Secondly, research into the extent to which models of performance-based assessment using e-portfolios enhance learning outcomes, perhaps in comparison to traditional assessment methods, again in 1:1 computer environments, would also help to inform assessment reform. Design-based research may be an appropriate methodology to adopt in both of these circumstances. Thirdly, research into optimal class sizes for personalized learning and support models for learning in ICT-rich environments (e.g. facilitation, group work, information literacy support) could also be of value in informing decision-making at a systemic level.
Finally, research into exemplary practices in the fusion of technological-pedagogical-content knowledge could provide models for teachers to improve the use of ICT in their practice. This type of research is required across subject areas, year levels and should include a range of ICT.

### 8.5 Final comments

This chapter has concluded the study by summarising its key findings in relation to the study’s seven research questions. The implications of these findings were then discussed over individual, school and systemic domains. Some suggestions for further research have been provided.

The research is set in a remote part of the world and comprised a relatively small number of beginning teachers. However, insights provided by these participants were honest and interpretation, as far as is possible, strived for auditability and credibility. On one level, therefore, the study is a small segment in the large and complex knowledge tapestry. On a conceptual level though the research has attempted to take a holistic view acknowledging the complexity of ICT, and how it intersects with education and society in general. The research found that there is a long way to go before ICT are naturally and intuitively used as part of the mix to optimise student learning: the journey is only just beginning. However, the teachers in this study cared enough about their profession (and their students) to recognise that the journey was worth taking.


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APPENDIX A:  
Pedagogical Beliefs Questionnaire

Name __________________________________________ Date __________
(All names are treated as confidential and will be coded to protect the identity of the respondent)

Gender  Male/Female

This is a longitudinal study that is being run over three years. It is important that the researcher is able to contact you as part of the data collection process. Please provide contact details below:

Telephone number: ________________________________________

Mobile: _________________________________________________

Email Address: ___________________________________________

Instructions:

For each statement below, circle the number under the response that best describes what you think or feel. There are no right or wrong answers. We are interested in your ideas about teaching and learning. Your answers and comments will remain confidential.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly agree</th>
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<tbody>
<tr>
<td>1.</td>
<td>Learning mostly involves trial and error.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>Learning mostly involves accessing and understanding factual information.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3.</td>
<td>Students’ mistakes are usually caused by a lack of practice.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4.</td>
<td>Being able to memorise facts and procedures is important for learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>It is not appropriate to encourage students to manipulate data.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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</table>

Comment  

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Appendices
6. Effective teachers plan so that students spend most of their time working independently. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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7. Encouraging independent learning is more important than encouraging collaborative learning. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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8. Cooperative group work is an important aspect of effective teaching. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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9. Effective teachers limit collaboration because it is difficult to determine who is responsible for what. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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10. Effective teaching involves class discussion in which students share ideas and negotiate meanings. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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11. Students should be given the opportunity to discuss, with each other, how to approach tasks. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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Comment

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12. Learning mostly involves creative thinking. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</table>

13. There are often several different ways to interpret something. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</table>

14. Effective teachers show students the proper procedures to answer questions. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</table>

15. Students learn by being shown the correct ways to interpret symbols and situations. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</table>

16. Students should be encouraged to build their own ideas, even if their attempts contain much trial and error. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</table>

17. Effective teachers provide students with solutions to problems. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
<table>
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</table>

18. Students’ errors often reflect their current understandings of ideas or procedures. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</table>

19. Learning is about getting to the truth. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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20. Learning is enhanced if students are encouraged to use their own interpretations of ideas and their own procedures. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</table>

21. Effective teachers value periods of uncertainty, conflict, confusion or surprise when students are learning. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
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</tbody>
</table>

22. Students learn best if they are shown clear, precise procedures for doing things. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
<table>
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</tr>
</tbody>
</table>

23. The role of the teacher is to provide students with activities that encourage them to wonder about and explore their subject. | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
<table>
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</table>

Comment

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Appendices
24. Problems should be solved in one consistent way.  
   1  2  3  4  5

25. Solving a problem usually involves finding a truth, rule or formula that applies.  
   1  2  3  4  5

26. Effective teachers regularly devote time to allow students to find their own methods for solving problems.  
   1  2  3  4  5

27. Effective teachers show students lots of different ways to look at the same question.  
   1  2  3  4  5

28. Effective teachers teach only what is important for assessment.  
   1  2  3  4  5

   1  2  3  4  5

30. The use of physical objects and real life examples to introduce ideas is an essential component of learning.  
   1  2  3  4  5

31. Engaging with lots of problems is the best way for students to learn.  
   1  2  3  4  5

Comment

_________________________________________________________________________
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32. Students should always be encouraged to articulate their own learning goals.  
   1  2  3  4  5

33. Regular assessment against curriculum outcomes is an effective way to monitor student progress.  
   1  2  3  4  5

34. It is important for students to monitor progress towards their own goals.  
   1  2  3  4  5

35. Students should be encouraged to think carefully about how they learn.  
   1  2  3  4  5

Comment

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Appendices
36. To you, what is teaching?
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

37. Where does knowledge of how to teach come from?
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

38. What do you believe is the purpose of schools?
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

39. What knowledge is necessary for effective teaching?
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

40. Describe the important components of your philosophy of teaching.
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
41. How would you describe your attitude towards information and communications technologies (ICT) and teaching and learning?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

42. Choose one or more of the following that best represents your beliefs about teaching. Please explain your selections.

a. Teaching is an art.
b. Teaching is a science.
c. Teaching is persuasion.
d. Teaching is transmission.
e. Teaching is transformation.
f. Teaching is modelling.
g. Teaching is scaffolding.
h. Teaching is ________________.
i. Teaching is ________________.
j. Teaching is ________________.
(add your own)

Explanation:
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

43. The following Teacher Goals have been identified in a variety of research studies. Please rank what you would consider the most important five of these goals in order of importance (one through to five).

Teachers should emphasise…

____ Equality among students
____ The products of learning
____ Instruction based on student interests
____ Student independence
____ Learning standards
____ Content specific knowledge
____ Academic excellence
____ Critical thinking in students
____ Life-long learning
____ Generalized skills and abilities
____ Instruction based on subject matter
____ The process of learning
____ Student creativity

Thank you for participating in this questionnaire
APPENDIX B:
Interview Questions

ICT INTERVIEW, Year 1

A  ICT AND TEACHING

Do you think ICT makes a difference to the way teachers teach?
Does it change the teacher’s role in the classroom?
(How well do you think teachers cope with challenges: technological, pedagogical?)

B  YOUR USE OF ICT

Opportunities
Have you had any opportunities to use ICT in a teaching environment? Describe how you used ICT?

What kinds of ICT? How often?
• Communicative tool
• Concept development
• Research tool
• Computational tool

Rationale
What were your reasons for using ICT in this environment?

Constraints
Were there any constraints or restrictions that influenced whether, when, and how you used ICT?
(Availability of/access to hardware, teaching materials, time, training/competence, confidence, incentive/support from peers)

Is your use of ICT consistent with or different from the typical classroom practices that you experienced during your university studies?

C  OBSERVED USE OF ICT

Opportunities
What is the best use of ICT that you have ever seen in a teaching and learning context?
• Communicative tool?
• Concept development?
• Research tool?
• Computational tool?

D  TECHNOLOGY AND CURRICULUM CONTENT

For what topics is ICT most helpful or appropriate?
For what topics is ICT least helpful or appropriate?
Are there topics or tasks for which you would never use ICT?
How do your opinions on these matters compare with those of your peers?
E ICT AND LEARNING
Do you think ICT makes a difference to the way students learn?

Does ICT have an effect on students’ attitudes to learning?
- Motivational attributes?
- Confidence

Any negative effects? (fear, confusion, dependence)
Differential effects (some students)?
Do your peers share these perceptions and beliefs?

Does learning with ICT have an effect on the way students work in the classroom?
- discussion/communication
- group vs individual work
- more student questioning, less listening to teacher

Any disadvantages? Differential effects?
Do your peers share these perceptions and beliefs?

Does learning with ICT have an effect on students’ understanding of ideas and concepts?
- Does deeper, faster, better learning occur?
- Differential effects?

Do your peers share these perceptions and beliefs?

F ICT AND ASSESSMENT
What do you think about ICT and assessment?
Have you observed students being allowed to use ICT for assessment tasks?
- exams
- assignments

Does using ICT in assessment advantage or disadvantage any students? Which ones? Why?

G ICT AND YOUR DEVELOPMENT AS A TEACHER
How competent and confident do you feel about the following?

<table>
<thead>
<tr>
<th>Mastering the ICT yourself</th>
<th>Competence</th>
<th>Very</th>
<th>Reasonably</th>
<th>A little</th>
<th>Not at all</th>
</tr>
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<tbody>
<tr>
<td>Confidence</td>
<td></td>
<td>Very</td>
<td>Reasonably</td>
<td>A little</td>
<td>Not at all</td>
</tr>
<tr>
<td>Stretching limits of innovative teaching using ICT</td>
<td>Competence</td>
<td>Very</td>
<td>Reasonably</td>
<td>A little</td>
<td>Not at all</td>
</tr>
<tr>
<td>Confidence</td>
<td></td>
<td>Very</td>
<td>Reasonably</td>
<td>A little</td>
<td>Not at all</td>
</tr>
<tr>
<td>Adopting appropriate teaching approaches using ICT</td>
<td>Competence</td>
<td>Very</td>
<td>Reasonably</td>
<td>A little</td>
<td>Not at all</td>
</tr>
<tr>
<td>Confidence</td>
<td></td>
<td>Very</td>
<td>Reasonably</td>
<td>A little</td>
<td>Not at all</td>
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</table>

In what areas do you feel the greatest need for your own development as a teacher using ICT?

Have you heard of the Learning Federation? If so, have you used any Learning Federation content in your teaching?

Would you prefer to be in a job in a school which uses much or little ICT? Why? How would you feel about implementing a 1:1 laptop program in your class?
ICT INTERVIEW, Year 2

A  CHANGE

1. Have you changed as a teacher in the last 12 months? If so, in what ways?

B  FACILITIES AND EQUIPMENT

2. Describe the ICT equipment and facilities that are available in your classroom (if observation has not taken place).

3. Are there any school facilities (e.g. a computer lab) that you access? How many hours per week?

C  ICT AND CHANGE

4. Have your school’s ICT infrastructure and support systems improved in the last 12 months?

5. To what extent has your attitude towards ICT integration changed over the last 12 months?

6. To what extent has your approach to ICT integration changed over the last 12 months?

7. What do you see as the major challenges in being able to successfully integrate ICT into your teaching in the next couple of years? Is this a priority for you?

D  YOUR USE OF ICT

8. The Statements of Learning for ICT suggest that ICT should be used for inquiry, communication and creativity. Give yourself a mark out of 10 for the way in which you have integrated ICT in each of these categories. Which do you think is most important?

9. Do you use ICT in other ways (e.g. to reinforce learning through a drill and practice activities or rewarding students by allowing them to play games on the computer)? Do you feel that this use of ICT was justifiable?

10. To what extent do you think that using ICT has enabled you to be more flexible and responsive as teacher?

11. Have you discerned any incidental outcomes of using ICT in your teaching (e.g. students being able to communicate more effectively or work better in teams)?
E  OBSERVED USE OF ICT

12. What is the best use of ICT that you have seen in the last 12 months?

F  ICT AND YOUR DEVELOPMENT AS A TEACHER

13. Is your knowledge and skill level in relation to ICT integration in tune with what your school expects of you?

14. Do you think that your knowledge and skills in ICT integration have improved over the last 12 months?

15. Do you feel supported at your school in using ICT?

16. You have just won a professional development ICT integration scholarship valued at $5,000. What would you spend the money on?

17. Rate yourself on this ICT integration schema.
ICT INTERVIEW, Year 3

1. To what extent has your philosophy of teaching changed since you began teaching? In what ways?

2. To what extent have your skills in using ICT changed since you began teaching? Are there any particular ICT that you use more than others?

3. To what extent have your attitudes toward ICT changed since you began teaching? In what ways?

4. Has your confidence in using ICT grown, diminished or stayed the same? What factors affect your confidence?

5. To what extent have your perceptions of what constitutes ICT changed since you began teaching?

6. Have you discerned any changes in the dispositions of your colleagues at the school towards integrating ICT into the curriculum? If so what sort of changes have you seen?

7. Do you think using ICT has led to any improvements in the classroom? (e.g. motivation, classroom management, learning)

8. Can you see a direct link between students being motivated and the learning that takes place?

9. The Statements of Learning for ICT suggest that ICT should be used for inquiry, communication and creativity. Give yourself a mark out of 10 for the way in which you have integrated ICT in each of these categories. Which do you think is most important?

10. Rate yourself on the following schema.
Focus on Integrated Technology
Classroom Observation Measurement
(FIT:COM)

Based upon Judson’s (2002) instrument

1. Background information

Name of teacher: ____________________________________________________

School: _____________________________________________________________

Location (e.g. classroom, lab, other): ________________________________

Subject: _______________________ Grade level: _______________________

Start time: ______________________ End time: _______________________

Date of observation: ________________________________________________

2. Contextual background and activities

Description of lesson

Classroom setting (e.g. space, seating arrangements etc)

Number of students ________________ gender ratio ________________

Transcriptions of pertinent dialogue
3. Technology context

Number of computers _______________ Other media _________________

Description of the technology incorporated into the lesson including hardware and software specifications, student to media ration, locus of control in terms of technology

Amount of use (i.e. proportion of the lesson) _______________________

Kinds of use (e.g. instructional game, drill and practice, presentation, exploration, creative work, productivity tool etc)

Context for use (e.g. independently for students, in the context of the learning situation, as a reward etc)

Sketch of physical lay out of classroom (i.e. placement of technology, teacher and students; indicate mobility)
### 4. Design of technology integration

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<th>Never occurred</th>
<th>Occurred frequently</th>
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<tbody>
<tr>
<td>1</td>
<td>The design of the technology integration allowed students to learn in ways not otherwise possible.</td>
<td>0 1 2 3 4</td>
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<tr>
<td>2</td>
<td>Technology was a means for supporting curricular objectives, as opposed to being a separate curricular focus.</td>
<td>0 1 2 3 4</td>
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<td>3</td>
<td>The selection of the technology (hardware and software) was appropriate to meet the learning objectives.</td>
<td>0 1 2 3 4</td>
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<td>4</td>
<td>This lesson embedded basic student operation of technology.</td>
<td>0 1 2 3 4</td>
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<td>5</td>
<td>The integration of technology was designed to promote intellectual challenge (students pose questions, direct their own work, and assess their own work).</td>
<td>0 1 2 3 4</td>
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**Section score /20**

**Comment**

### 5. Class dynamics

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<tr>
<td>6</td>
<td>The teacher and/or use of technology prompted students toward higher-order thinking.</td>
<td>0 1 2 3 4</td>
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<td>7</td>
<td>Students had a voice in the selection of technology tools and how the technology was to be utilised.</td>
<td>0 1 2 3 4</td>
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<td>8</td>
<td>Interaction with technology provided students with a sense of independent control and mastery over an environment.</td>
<td>0 1 2 3 4</td>
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<tr>
<td>9</td>
<td>The teacher provided appropriate assistance to guide student activity.</td>
<td>0 1 2 3 4</td>
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<tr>
<td>0</td>
<td>Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence.</td>
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**Section score /20**

**Comment**
### 6. Meaning and purpose

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<th>Description</th>
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<th>Occurred Frequently</th>
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<tr>
<td>1</td>
<td>Connections within the content and to other content disciplines were explored and valued.</td>
<td>0 1 2 3 4</td>
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<tr>
<td>1</td>
<td>Students took pride in new learning and/or work produced with the aid of technology.</td>
<td>0 1 2 3 4</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Technology was used to investigate real phenomena and real world situations.</td>
<td>0 1 2 3 4</td>
<td></td>
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<tr>
<td>1</td>
<td>Students developed problem-solving strategies. Where appropriate, technology tools aided the development of these strategies.</td>
<td>0 1 2 3 4</td>
<td></td>
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<tr>
<td>1</td>
<td>Students used technology to solve problems and make informed decisions.</td>
<td>0 1 2 3 4</td>
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</table>

**Section score** /20

**Comment**

### 7. Content and knowledge

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<th>Description</th>
<th>Never occurred</th>
<th>Occurred Frequently</th>
</tr>
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<tr>
<td>1</td>
<td>The lesson emphasised fundamental concepts outlined in the curriculum framework.</td>
<td>0 1 2 3 4</td>
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<tr>
<td>1</td>
<td>The integration of technology into the lesson promoted strong, coherent conceptual understanding.</td>
<td>0 1 2 3 4</td>
<td></td>
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<td>1</td>
<td>The teacher had a solid grasp of the subject matter content and the use of technology.</td>
<td>0 1 2 3 4</td>
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<tr>
<td>1</td>
<td>Students were reflective about their own learning.</td>
<td>0 1 2 3 4</td>
<td></td>
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<tr>
<td>2</td>
<td>Students used technology to aid the construction of meaningful knowledge.</td>
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<td></td>
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</tbody>
</table>

**Section score** /20

**Comment**
### 8. Technology as tools

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<th>Description</th>
<th>Score Distribution</th>
<th>Section score</th>
<th>Total score: /100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The use of technology aided the clarification and communication of ideas.</td>
<td>0 1 2 3 4</td>
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</tr>
<tr>
<td>2</td>
<td>Students employed technology to develop strategies for solving problems.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Students used technology to construct models, increase productivity, and produce creative work.</td>
<td>0 1 2 3 4</td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>Students utilised technology to collect information, process data and report results.</td>
<td>0 1 2 3 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Students used technology for inquiry and exploration.</td>
<td>0 1 2 3 4</td>
<td></td>
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<tr>
<td>5</td>
<td>Students made predictions, estimations and/or hypotheses and devised means for testing them.</td>
<td>0 1 2 3 4</td>
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Comment

Total score: /100
APPENDIX D: 
Principal Interview Questions

To be administered in conjunction with all observations

Principal Name: ____________________________________________________________

School: __________________________________________________________________

Date: ____________________________________________________________________

1. What is your overall attitude towards ICT integration?

2. What role do you see yourself as having (if any) in helping to integrate ICT into the curriculum at your school?

3. What do you see as the most significant recent developments in ICT?

4. What do you see as the major barrier in integrating ICT into your school?

5. Do you think new graduates have a special role in integrating ICT?
## Appendix E:
Student Feedback on the Questionnaire

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<th>Question</th>
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<td>2</td>
<td>Question 2 was said to be odd and covered 2 issues (method and answers) Suggested substituting the word “strategies” for “methods”, and deleting the words “and answers” from the question.</td>
<td>Agreed.</td>
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<tr>
<td>8</td>
<td>Substitute the word “good” with “is vital”</td>
<td>Agreed.</td>
</tr>
<tr>
<td>9</td>
<td>The phrase “good teaching” grated on the students. Substitute “good teachers” with “effective teaching”</td>
<td>Agreed.</td>
</tr>
<tr>
<td>Various</td>
<td>The phrase “good teachers” grated on the students. Substitute “good teachers” with “effective teachers”</td>
<td>Agreed.</td>
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<tr>
<td>37</td>
<td>Typo – insert word “be” rather than “b”</td>
<td>Agreed.</td>
</tr>
<tr>
<td>44</td>
<td>Need more space to answer the question. Leave (it “forces” respondents to be succinct).</td>
<td></td>
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<tr>
<td>46</td>
<td>Extrapolate ICTs (first time it is mentioned).</td>
<td>Agreed.</td>
</tr>
<tr>
<td>47</td>
<td>Add 3 more lines for “teaching is” (e.g. i, j, and k)</td>
<td>Agreed.</td>
</tr>
<tr>
<td>48</td>
<td>Instead of ranking 1-13, ask students to rank the most important 5.</td>
<td>Agreed.</td>
</tr>
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</table>
Appendix F: ICT Integration Schema

**Inaction**
General lack of interest. No use of ICTs.

**Investigation**
Developed some interest in using ICT with students (e.g. uses PowerPoint for presenting information; develops and photocopies worksheets).

**Application**
Regularly uses ICT with students and knows how to do so competently and confidently (e.g. encourages students to research the WWW, play interactive games; uses an interactive whiteboard; requires worksheets to be developed electronically by students).

**Integration**
ICT is critical to support the learning environment and for students to achieve learning outcomes. Mandatory introduction of ICTs into the daily routines for students (e.g. as a cognitive tool for problem-solving and creativity, brainstorming, collecting and analysing data or as a communicative tool, like blogging, for building understanding).

**Transformation**
Takes on leadership roles in the use of ICT at the school and is knowledgeably reflective on its integration personally and with others. Experiments with new ways of using ICTs to push boundaries of student learning. Empowers students to make choices on a range of ICTs to use to respond to project-based and interdisciplinary approaches (e.g. development of complex Webquests or class web or Wiki pages using multiple media formats).
Appendix G:
Participants’ Degree of Resonance with the Pedagogical Beliefs Questionnaire (Year 3)

Figure G1: Participants’ degree of resonance (n=20) with the Active dimension of learning (Year 3 Pedagogical Beliefs Questionnaire).
Effective teachers plan so that students spend most of their time working independently.

Encouraging independent learning is more important than encouraging collaborative learning.

Cooperative group work is an important aspect of effective teaching.

Effective teachers limit collaboration because it is difficult to determine who is responsible for what.

Effective teaching involves class discussion in which students share ideas and negotiate meanings.

Students should be given the opportunity to discuss, with each other, how to approach tasks.

**Figure G2:** Participants’ degree of resonance (n=20) with the Cooperative dimension of learning (Year 3 Pedagogical Beliefs Questionnaire).
Figure G3: Participants’ degree of resonance (n=20) with the Constructive dimension of learning (Year 3 Pedagogical Beliefs Questionnaire).
24. Problems presented should be solved in one consistent way.

25. Solving a problem usually involves finding a truth, rule or formula that applies.

26. Effective teachers regularly devote time to allow students to find their own methods for solving problems.

27. Effective teachers show students lots of different ways to look at the same question.

28. Effective teachers teach only what is important for assessment.


30. The use of physical objects and real life examples to introduce ideas is an essential component of learning.

31. Engaging with lots of problems is the best way for students to learn.

**Figure G4:** Participants’ degree of resonance (n=20) with the Authentic dimension of learning (Year 3 Pedagogical Beliefs Questionnaire).
Students should always be encouraged to articulate their own learning goals.

Regular assessment against curriculum outcomes is an effective way to monitor student progress.

It is important for students to monitor progress towards their own goals.

Students should be encouraged to think carefully about how they learn.

**Figure G5:** Participants’ degree of resonance (n=20) with the Intentional dimension of learning (Year 3 Pedagogical Beliefs Questionnaire).
**APPENDIX H:**
Mean Scores by Subscale for Respondents to the Pedagogical Beliefs Questionnaire (Year 1)

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**Average** 3.0 4.1 3.5 3.8 3.6
## APPENDIX I:
Mean Scores by Subscale for Respondents to the Pedagogical Beliefs Questionnaire (Year 3)

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