Science and Mathematics Education Centre

Teacher and Student Factors Related to the Use of ICT in Upper Primary School

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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 person except where due acknowledgement has been made.

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Date: 30 November 2012

ABSTRACT

The use of Information and Communication Technology (ICT) in education has changed in many ways since computers were first installed in the classroom. Changes have reflected what ICT has been made available in the classroom, how the ICT are used, the role of the teacher, and the ICT skills of both the teacher and the students. Research has been conducted to find out the effect of ICT on students, teachers, schools, the education sector, and the community. With the rapidly changing nature of ICT and the growing of the child of the technological revolution into the teacher, policy maker, and parent, consideration of how ICT has been used, and how its use was perceived by the teacher and students, needs to be examined regularly to look for relationships between the ICT and those who use it.

This research was conducted to investigate teacher and student factors related to the use of ICT in upper primary classrooms. As the teachers and students each have had experiences within which they interpret the world and upon which they base their actions and perceptions, the research was situated within the constructivism ontology. The influence of the individuals within the confines of the classroom emphasised the connections to social constructionism epistemology.

Multiple case studies were conducted within classrooms settings to enable the environment and the participants of that environment to be studied. Comparisons were made of the most frequent behaviours when ICT were used and when ICT were not used. Teacher and student perceptions of ICT use in the classroom were compared with each other and with ICT use. The teachers' self-reported competence and confidence in ICT use and the students' self-reported competence and confidence in ICT use were investigated. These factors were then considered for each case and across the cases to examine how these teacher and student factors were related to ICT use.

Differences were found in the most frequently occurring behaviours when ICT was used by students or by teachers or was not used at all. In most cases, whomever used the ICT also initiated most interactions, although this did not happen if the teacher's average self-reported competence or average self-reported confidence was below

competent or below confident. Teacher perceptions of student learning, the ICT used, who used the ICT, and the student perceptions of the importance for using ICT in the observed session were related. Student perceptions of why teachers should be able to use ICT in the classroom were related to the students' use of ICT and their self-reported competence and self-reported confidence. There were strong correlations between teacher self-reported competence and self-reported confidence and strong correlations between student self-reported competence and self-reported confidence.

Although multiple case studies were the most appropriate methodology for this research, it has limited the generalisability of the results. Likewise, the decision to use mixed methods necessitated more case studies be conducted, resulting in a greater breadth of data but an imposition of less depth. The use of Likert-style and open-ended questionnaires, interviews, and observations enabled triangulation, but the lack of experience of the researcher meant that the full benefits of the use of this range of data collection methods were not achieved. Conducting research with children and teachers within classrooms involved issues ranging from obtaining access to the participants and classrooms through to the difficulties of determining whether the existence of the observing researcher in the classroom affected the environment or if the act of asking questions changed the answers that were offered.

While there are limitations in generalising the results of case studies, the nature of teachers, students, and classrooms are such that there are some opportunities for providing recommendations. Implications of the research relate to teachers, students, and practice in upper primary classrooms. Teachers need to be clear in how they are using ICT in their lessons – whether it is to develop specific ICT skills or to support learning – as this is related to the ICT that is used, who uses it, and student perceptions of ICT use. Teachers also need to be aware of the connections between the ICT that is used, who uses the ICT, and the behaviours in the classroom, particularly if their preferred teaching techniques lean toward a specific theoretical approach. School administrators and governments who provide funding also need to acknowledge that physically providing ICT is only part of the issue – ensuring teachers consider themselves competent and confident in its use also needs to be taken into account. Finally, the relationship between student perceptions of their competence and confidence with ICT and their perceptions of its worth in lessons needs to be recognised as a potential de-motivator in ICT use – which could have adverse consequences in a world that both embraces and pushes ICT literacy.

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CHAPTER 1

INTRODUCTION

INTRODUCTION

New technology is emerging at a rapid pace (Meggs, Greer, & Collins, 2011) and the variety of available technologies, both as hardware (such as computers, scanners, printers, digital cameras, iPads, iPods) and software (for example, document processors, statistical packages, Facebook, Twitter, iTunes) is changing constantly and has grown almost exponentially (Goldman, 2003). The use of information and communication technology (ICT) in the classroom has been increasing since technology was first introduced (Passig, 2001) and is now readily available within school communities (Martinovic & Zhang, 2012). Additionally, the amount of money spent on technology for schools is substantial, from both the perspective of provision of funding and of spending, with the Australian Government announcing $2.4 billion in funding (Department of Education, Employment and Workplace Relations [DEEWR], 2011a) as well as stating costs per student for ICT infrastructure could be as high as several hundreds of dollars (Department of Education, Employment and Workplace Relations [DEEWR], 2011b). However, the interactions between factors that affect ICT use in education have not been thoroughly investigated within a primary classroom.

Background
Research Aim
Significance
Conceptual Framework
Research Questions
Overview
Summary

Figure 1.1. The organisation of the introduction.

As shown in Figure 1.1, this chapter provides an outline to situate this research. The research aim and significance will be positioned within the existing literature and conceptual framework. The research questions will then be identified and an overview of the thesis will be provided. Finally, a summary of the setting and research methods for the research will be given to provide context.

BACKGROUND

Hew and Brush (2007) viewed technology as "computing devices such as desktop computers, laptops, handheld computers, software, or Internet" (p. 225). Their description included both hardware and software, using an argument for technology that was common across K-12 years at schools. For this research, the definition for ICT incorporated aspects from Hew and Brush (2007) and states that ICT includes desktop computers, laptop computers, and handheld computers that can run software and can enable access to the Internet, along with software and using the Internet itself. Computers are defined as hardware that runs a variety of software, similar to Baylor and Ritchie's (2002) description, that enables users to process documents, access and create graphics, use spreadsheets and databases, and access information both stored on the system and via the Internet. The range of ICT available for use in the classroom means that choice exists in what ICT is used (Hus, 2011) and how it is used (Russell, Bebell, O'Dwyer, & O'Connor, 2003). These decisions can and do affect the impact of ICT in the classroom (Inan, Lowther, Ross, & Strahl, 2010).

There is much pressure on teachers from governments and businesses (Kennewell, 2003) to successfully introduce ICT into the classroom. Policies have been enacted at the international, national, local, and school level (Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA], 1999; Organisation for Economic Cooperation and Development [OECD], 2010; Sanchez, Salinas, & Harris, 2010; Tondeur, van Keer, van Braak, & Valcke, 2008; Vanderlinde & van Braak, 2010), but at times the aims of education and these policies do not coincide (Rubagiza, Were, & Sutherland, 2011). In particular, the imposition of ICT in the classroom may occur regardless of teacher concerns (Jimoyiannis & Komis, 2007). Although the opportunity does exist for ICT to impact positively on both teaching and learning (Ananiadou & Claro, 2009; Levin & Wadmany, 2008; Wiseman &

Anderson, 2012), the factors that affect whether teachers incorporate ICT are important, particularly if Franklin's (2007) proposal that teachers will be the individuals who will determine student use of ICT and will therefore "have the most impact on the quality of technology use in schools" (Levin and Wadmany, 2008, p. 237).

Beardon and Way (2003) claimed "a school in the modern world without computers is now almost as disadvantaged as a school without books", (p. 153). Pegrum (2010) saw the internet as offering opportunities to participate in the world in ways that had not been envisaged in the past but requiring "digitally literate citizens" (p. 350). Crook, Harrison, Farrington-Flint, Tomás, and Underwood (2010) described ICT as having the potential to modify practices in the classroom through increasing the range of learning practices. This, in turn, can impact on learning affordances, that is, the theoretical opportunities students have to learn (Delgarno & Lee, 2010). ICT can increase learning affordances without adding to teacher work load (Beardon & Way, 2003; Underwood, 2009) as well as enabling meaningful and authentic contexts (Herrington & Kervin, 2007; Moore-Hart, 2004/2005) and student-centred activities (Bidarian, Bidiarian, & Davoudi, 2011; Inan et al., 2010) that can further impact on learning (Ananiadou & Claro, 2009; Underwood, 2009). However, teachers have to make two changes – learn new ICT and change how they teach – to enable ICT to be incorporated in their teaching (Scrimshaw, 2004, cited Levin and Wadmany, 2008, p. 235). Furthermore, these changes have to incorporate and address what Koehler and Mishra (2009) referred to as "technological pedagogical content knowledge" (p. 60).

RESEARCH AIM

The purpose of the research was to investigate teacher and student factors that are related to the use of ICT in upper primary classrooms. Specifically, the teacher and student perceptions of ICT use in the classroom, the teachers' self-reported competence and confidence in ICT use, the students' self-reported competence and confidence in ICT use, and the frequency of behaviours exhibited by students when ICT is used and when it is not used, were investigated.

SIGNIFICANCE

Levin and Wadmany (2008) stated that the impact of ICT on our world is mimicked in education in some aspects but is more involved due to the participants within the classroom. They believe that the effects are greater than just the social and cultural aspect, as it also impacts on pedagogy and teacher skills. Kennewell (2003) believed that the issue is not one of proving that ICT is the best method of teaching nor necessarily better than other ways of teaching – it is of finding the best way of using ICT in the classroom. Teachers may use the same ICT but can use it differently and therefore change the potential impact on education (Balanskat, Blamire, & Kefala, 2006; Robertson, 2002). However, teachers may feel threatened by the higher ICT skill level of their students and the loss of control in their students' learning (Beardon & Way, 2003; Goldman, 2003) or the classroom environment (Leander, Phillips, & Hendrick Taylor, 2010). The concerns teachers may feel at the loss of control may be negated if the teacher has a high level of teacher self-efficacy (Ross & Bruce, 2007). Nevertheless, "although some teachers may feel confident in their own capacity to enhance student learning as a general construct, their level of confidence may vary between subjects" (Welch, 1995, p. 78).

There are conflicting findings regarding the impact of the different access each successive generation has had to ICT in their environment. Initial research into teacher and student use of ICT proposed that students would be different in either their knowledge or use of ICT. Papert (1999, cited Nikolova, 2001), used the term 'kidpower' to refer to the ICT knowhow of students. Prensky (2001) referred to 'digital natives' who communicate and think differently as a result of their interaction with ICT. Guha (2003) believed student exposure to ICT in their daily lives will create the expectation that their teachers should be as knowledgeable. This could result in situations where "teachers feel that students know more than they do" (Fryer, 2003, p. 4). Beardon and Way (2003) added to this, stating "teachers can feel threatened in such an open-ended learning environment in which the children take control of their learning, and often develop new ICT skills unfamiliar to the teacher" (p. 157). Goldman (2003) concurred with the possibility of teachers perceiving a lack of control, particularly if they believe that the students have a higher level of skills.

In contrast to the research outlined above on the disparity of teacher and student ICT skills, in his study on students at a secondary school, Kolikant (2010) found “about a half of the students perceived themselves as inferior to the pre-ICT generation when it comes to performing information processing actions in the school context. This finding implies that students’ perceived self-efficacy in this respect relatively low” (p. 1390). The finding regarding the lower ability perceptions of the students was supported by Waycott, Bennett, Kennedy, Delgarno, and Gray (2010) in their research on digital divides between university staff and students. They reported that their findings “do not support the claim that there is a *substantial* gap between more technologically adept younger students and their less savvy teachers caused by differences in exposure to technology during their lives” (p. 1208, italics in original). Furthermore, “where differences between students and staff were identified they were often subtle distinctions in the context of technology use” (Waycott et al., 2010, p. 1209).

Additionally, there is a variety of ICT skill levels in teachers. Killi (2003) proposed possible scenarios to account for the variety – teacher prejudice against technology, poor technology skills, or the conscious decision not to use technology in education even though they have the technological skills. She suggested that the lack of value attributed to using ICT in education or difficulties in school access to technology may contribute to these choices not to use ICT in the classroom. Nussbaum (2010) listed four first level barriers to integrating technology in pedagogy – access to equipment and the internet, lesson planning integrating both conventional and digital resources, training teachers appropriately (in terms of time and catering to their abilities), and the support of ICT projects by the leadership. He also stated that how confident teachers were to use ICT and competency and flexibility in pedagogical practices were second level barriers. Papanastasiou and Angeli (2008) proposed that teacher knowledge and use of ICT would affect whether it would be integrated in the classroom, with Hinostroza, Labbe, and Lopez (2010) finding it was the interaction between what teachers knew of ICT and how they developed this knowledge that was crucial.

Nikolova (2001) stated that ICT will change how we learn and “teachers have to adapt to this change, even more – to act as ‘change agents’ and help shaping new school cultures" (p. 73). Almost 10 years later, Ertmer and Ottenbreit-Leftwich (2010) stated that teachers needed to incorporate the use of ICT in everyday ways. This moving focus changes the role of the teacher from just using ICT to being able to use it in a pedagogically sound manner (Guzman & Nussbaum, 2009), a reflection of Koehler and Mishra's (2009) "technological pedagogical content knowledge" (p. 60), indicating that it is how it all fits together that is the strongest indicator of successful use of ICT.

CONCEPTUAL FRAMEWORK

Research on the use of ICT in education has considered a variety of factors. The skills of teachers and students have been examined (e.g., Beardon & Way, 2003; Fryer, 2003; Guha, 2000; Kolikant, 2010; Tomte & Hatlevik, 2011). Possibilities in how ICT can be used and how it is used have been documented (such as Franklin, 2007; Hughes, 2005; Hsu, 2011; Zhong, 2011). Factors that can affect the use of ICT in the classroom have been identified and discussed (for instance, Ertmer & Ottenbreit-Leftwich, 2010; Franklin, 2007; Hughes, 2005; Underwood, 2009), as have the factors affecting teacher use of ICT (e.g., Dawson, 2008; Nussbaum, 2010; Levin & Wadmany, 2008; Prestridge, 2012). Finally, the learning opportunities provided to students have been determined and examined (see Leander et al., 2010; Inan et al., 2010; Underwood, 2009).

However, although instances of relationships between some of these factors have been identified (e.g., see Crook et al., 2010; Jarvela, 2010; Stevenson, 2008), these factors together have not been considered in terms of their interactions and interrelationships. In addition, there is a lack of investigation of the relationships between these factors within the primary school classroom.

To investigate the relationships between these factors, there must be acceptance of both the world as existing concurrently – both external to the individual (Creswell, 2009) and as constructed internally by the individual (Crotty, 1998; Olsen, 2004), as well as the recognition of the interaction between the individual, other individuals, and the world (Creswell, 2009). In this research, this acceptance and recognition were vital as it justified the exploration of the behaviours, opinions and beliefs regarding ICT and how it can be used in the classroom.

RESEARCH QUESTION

How do teacher and student perceptions of ICT relate to ICT use in Catholic primary school classrooms? Specifically:

1. What behaviours are observed when ICT is used and when it is not used?
2. What are the teacher and student perceptions of ICT use in the classroom?
3. What are the teachers' self-reported competence and self-reported confidence in ICT?
4. What are the students' self-reported competence and self-reported confidence in ICT?

This interpretive research study was conducted in eleven classrooms in seven Catholic primary schools in Western Australia. All schools had one class per grade (referred to as "single stream") and were located in metropolitan Perth, the capital city of Western Australia. Data were collected during two terms, Term 4 of 2009 (mid-October to mid-December) and Term 1 of 2010 (start of February to start of April). Multiple case studies utilised fully mixed methods as the research combined "qualitative and quantitative approaches in an interactive way throughout the study" (Ary et al., 2010, p. 563).

RESEARCH METHOD

The investigation of factors affecting ICT use in upper primary classrooms needed to be conducted with participants from and within these classrooms. The pre-observation interview with the teachers enabled questions regarding how the teacher used ICT when teaching and how they intended to use ICT in the observed sessions. The post-observation interview asked teachers for their views on the student behaviours during the observed session. The unstructured natural observation provided data on the classroom environment (including ICT) and the behaviours of those within the classroom (Cohen, Manion, & Morrison, 2002). The self-reported competence and confidence of teachers and students were collected via Likert-style questionnaires. Teacher and student perceptions of the importance of ICT skills in the role of the primary school teacher and the use of ICT in the observed session were obtained via open-ended questionnaires. The use of multiple case studies enabled the analysis of collection of data from interviews, observations, and questionnaires to be conducted within each case as well as across the cases to strengthen the interpretation (Merriam, 2009). Additionally, the use of quantitative analyses enabled emerging themes to be used to compare cases (Stark, 2006).

LIMITATIONS

There are limitations to the use of case studies. Merriam (2009) lists generalisability, reliability, and validity as potential limitations for case studies. Several of these limitations are addressed through the use of multiple case studies (Merriam, 2009) and through the use of both qualitative and quantitative methods (Cohen et al., 2002). Peer review (Merriam, 2009) is utilised to address validity and triangulation via multiple data collection methods is used to address the credibility of findings (Lincoln & Guba, 1985; Tobin & Begley, 2004; Yin, 2009). In addition, this research has limitations due to the context of the research. Accessing teachers and their students can be problematical due to the demands resulting from the research. This shaped aspects of the methodology, for example, via the use of questionnaires due to their capacity to expediently collect a variety of information (Anderson, 1998; Punch 1998). Likewise, the use of videos for the observations was discounted due to the potential to be disruptive (Merriam, 2009). A final limitation of the research relates to the use of self-reported data from the participants. Although there are concerns regarding whether self-reported competence actually measures actual competence (Ballantine, McCourt Larres, & Oyelere, 2007), self-reported competence of adults (van Braak, 2004; van Braak & Goeman, 2001) and children (Shih, 2004) have been used with research regarding ICT.

OVERVIEW OF THESIS

The thesis is presented in seven chapters. The first chapter (this chapter) is a brief introduction to the research. The second chapter, the Literature Review, is a review and critique of the main themes from the existing literature. These themes investigate what ICT encompasses, ICT use in education, the effect of ICT use, and factors related to ICT use in education. The third chapter is the Methodology chapter. It provides the ontological, epistemological, and theoretical perspective within which the research is situated. The next two chapters are the results chapters. The first of these presents the Case Study results, where each of the cases is discussed. The cases are grouped in terms of the teachers' descriptions of the student learning from ICT use the observation. The second results chapter is the Cross Case and Quantitative Analysis, where the case studies are compared within the framework of the subsidiary research questions. Chapter 6, the Discussion, situates the results in terms of existing literature, considers implications for teachers and students in upper primary classrooms, and outlines limitations of this research. Chapter 7 outlines implications for practice in upper primary classrooms, recommendations for further research, and concludes the research.

CHAPTER 2

LITERATURE REVIEW

INTRODUCTION

This chapter discusses relevant theories and research regarding the use of ICT in education. As shown in Figure 2.1, four broad headings are used to discuss ICT in education. A description of what ICT incorporates for this research is provided. ICT use in education is considered in terms of the past and the future, the types of ICT used in education, and the factors affecting the ways ICT can be used. The effect of ICT use in education, particularly the expectations surrounding its use, how it affects the relationship between teaching and learning, as well as teaching and learning themselves, are discussed. The factors related to ICT use in education are then considered in terms of the school, teachers, students, and learning environments.

What is ICT?
ICT use in education
Effect of ICT use
Factors related to ICT use in education

Figure 2.1. The organisation of the literature review.

WHAT IS ICT?

Hew and Brush (2007) focused on the usability of the technology when creating their definition of ICT. They included hardware and software that could be used for instruction in classrooms from kindergarten to year 12. This research incorporates most of the elements of Hew and Brush's definition, but adds in the element that the technology must enable access to the internet. However, as shown with Martinovic and Zhang's (2012) description of ICT as "including personal computers, laptops, printers, LCD projectors, palm devices, iPods, cell phones, and Internet" (p. 461), the definition is continually changing to incorporate new technologies. An example of one technology that appeared and was quickly adopted is the iPad, which was first available in Australia on May 28, 2010 (Apple Inc., 2010). However, due to the completion of the data collection phase of the research occurring in 2010, iPads and similar android devices were not available.

Modarres (2011) focused more on access provided by ICT rather than access to ICT. The issue of whether different ICT used by groups of people would impact on their access the digital world differs and, if so, would these differences affect how these groups can interact with the content available digitally. He proposed that these concerns were relevant and possible due to the affordances for engaging with and creating digital content. Modarres suggested that the level of engagement available via less expensive and more readily available mobile devices was not the same as the level of engagement available via laptops and desktop computers. In addition, he queried whether the capacity to create content to share digitally was also impacted by the reduced capabilities or functionality of mobile devices. Modarres finished with a query regarding the possible view that historians of the future may hold – that some of the digital voices were more equal than others.

Summary

The preceding section discussed how the description of ICT is changing as more ICT become available (Martinovic & Shang, 2012), though it can generally be separated into hardware and software components (Hew & Brush, 2006). Although ICT is becoming more readily available to all, it is possible that the usability of ICT is variable and this could result in different levels of connectivity (Modarres, 2011).

ICT USE IN EDUCATION

The types of ICT used vary in education. As shown with the definition of ICT above (Hew & Brush, 2006), these can be broadly grouped into hardware and software. In this section, ICT use in education are discussed in terms of what has happened in the past and might happen in the future, the types of ICT used, the ways ICT is used, and how ICT can be integrated into education.

The past and the future

ICT has long been recognised as having the potential to change education. Rushby (1984) recommended the use of computers in education as they could create a more effective educational environment in terms of the resources required and the "intellectual challenge" (p. 18) they could provide. Chan (1987) wrote of the focus on using computers in education at the 1986 World Congress on Education and Technology, particularly that the use of computers needed to be examined for all school levels. Bolter (1989) considered the potential of ICT to change how we write and how we read. He referred to an advertising headline in the Wall Street Journal from 1987 that compared the impact of the new Apple computer to the Gutenberg press.

Papert (1990) stated in his paper presented over 20 years ago that the computer will impact all facets of our lives, but had the greatest potential for impact in education. However, he proposed that it is what we do with the computer that will be significant, rather than the computer itself. Papert cautioned educators towards focusing on either the ICT or the information made available via the technology, as he stated that the appropriate focus was and should always be on the individual, their development, and their empowerment. However, to enable this focus, Papert believed that ICT must become invisible, something that the students have appropriated into their learning on their terms and are enthusiastic about learning possibilities generated by its use.

In Australia, The Adelaide Declaration on National Goals for Schooling in the Twenty – First Century (MCEETYA, 1999) recognised the important role ICT had within education. All of the National Reports on Schooling in Australia produced by MCEECDYA from 2000 to 2008 addressed ICT. The initial focus was on student access (MCEETYA, 2000), then potential student benefits (MCEETYA, 2002), then implications for teaching (MCEETYA, 2004), and, finally, assessment of student ICT literacy (MCEETYA, 2006, 2007, 2008).

In 2010, the potential impact of ICT was explored by Warschauer and Matuchniak (2010). They viewed the effects of ICT as the fourth wave of communication following on from the waves generated by the development of language, the use of writing, and the creation of the printing press. Their discussion of the educational use of ICT considered the results of Warschauer, Knobel, and Stone (2004, as cited in Warschauer & Matuchniak, 2010, p. 189), who described the difficulties of using ICT in situations where students lacked sufficient language and ICT skills, were considered at-risk, or had teachers facing greater pressure to improve performances of their students in high-stake testing. As a consequence, the availability of ICT was pushed aside due to the need to focus on other learning. Although Warschauer and Matuchniak reported that the different practices around ICT use, generally described as constructivist versus traditional, were changing to more constructivist approaches, they stated that lower socioeconomic schools were more likely to engage in what Scardamalia and Bereiter (2003, as cited in Warschauer & Matuchniak, 2010, p. 199) described as shallow constructivism as opposed to deep constructivism. This would result in different activities and learning, such as developing basic computer skills rather than higher level thinking skills.

In outlining the Programme for International Assessment of Adult Competencies (PIAAC), Levy (2010) discussed the impact of ICT on the future employment of children who are currently being educated. He proposed that as ICT can complete procedural tasks, the focus of education should on developing advanced skills needed for the future world. Levy described two advanced skills – complex communication, "the ability to establish a common understanding of information" (p. 7) and expert thinking, "a collection of specific solution methods that vary with the problem at hand" (p. 7). These two skills were deemed of importance for the positions that will be available in the workforce as other procedural-based positions will be completed by ICT. However the successful application of these skills necessitated the effective and appropriate use of ICT.

Types of ICT

The types of ICT used vary in education inasmuch as the variety of software available to consumers. As a result, choices have to be made in what ICT is provided for use in education, and these choices are then viewed by educators and selected for use in the classroom.

The choice of ICT used has been related to how and why it was used. In their study of 64 pre-service teachers, Martinovic and Zhang (2012) referred to how ICT that was readily available within communities was becoming available within the schools of those communities. Martinovic and Zhang (2012) pointed to Ontario Ministry of Education curriculum documents that referred to ICT tools such as "multimedia resources, databases, Web sites, digital cameras, and word-processing programs" (p. 461). Similarly, they referred to UNESCO documents that highlighted the need of teachers to use ICT to support their students in their activities, particularly those of a problem solving or project-type nature. They found that pre-service teachers considered ICT to be important in their role when teaching and stressed this is more so if it is connected to improving student learning outcomes. However, Martinovic and Zhang (2012) proposed that access to ICT they could use did not mean pre-service and existing teachers would use it effectively. In addition, they found that the pre-service teachers valued ICT most when used to prepare for classes or to present information during class, rather than using ICT for collaboration or communication. This indicated that the use was more teacher-centric as it focused on teacher use for preparation or presentation purposes.

The teacher-centric use of ICT has been found when ICT was used in the classroom. In her study of teacher perceptions of using the computer as a tool and using the computer as a tutor, Chan (1989) found the most common software used when the computer was used as a tool were word processing, graphics, spreadsheets, and messaging, whereas when the computer was used as a tutor, the most frequently used program enabled students to program the computer within an explorative environment. Chan (1989) stated the main finding was that teachers controlled whether the computer was used in the classroom and the quality of the student learning, with the best use evident when the computer was used "as a supplement to traditional teaching" (p. 275). This aspect of teacher control and the congruence noted between use and teaching approach indicated that ICT use did not necessarily result in changes in teaching.

However, as more ICT began to be used in the classroom, changes in teacher control became evident. Inan et al. (2010) observed 143 lessons integrating technology at 39 schools to investigate the teachers' use of ICT, the strategies used by the teachers when ICT was integrated in the classrooms, and the classroom practices when ICT was used. The most commonly used application was found to be internet browsers, followed by word processing software, programs for drill and practice, and presentation software, with the ICT more likely to be used as a learning tool than for delivering instructions for the lesson. Student-centred strategies were observed more than teacher-centred strategies. Additionally, Inan et al. found the use of internet browsers, word processing and presentation software were associated with more student-centred activities, whereas the use of image creation or manipulation software was found to be related to independent seatwork. They concluded that student-centred practices were more likely when internet browsers, word processing software, or presentation software were used.

The relationship between the ICT used and teacher behaviours is influenced by other factors. The experiences that a teacher brings to teaching were found to relate to the likelihood of the teacher engaging in teacher-centric practices with ICT. Russell et al. (2003) surveyed 2,894 teachers to investigate the prevalence of ICT use both within and outside of the classroom. Their data indicated six ways ICT were used – for preparation, for delivery, teacher-directed student use, for addressing the needs of diverse students, for email, and for storing student grades. They found that ICT was most frequently used for preparation for teaching and for communication, and that the teachers' beliefs about whether ICT was important for teaching and their confidence with technology were related to ICT use, though the latter was stronger, particularly for ICT the teacher had access to and used. They also found differences in teacher use based on how long they had been teaching, with newer teachers indicating a higher level of comfort and more frequent use for preparation, teachers with more teaching experience reported more frequent use of ICT in the classroom for delivering lessons or engaging students in learning activities. In addition, Russell et al. surmised that their finding regarding newer teachers and both their comfort with technology and their stronger beliefs regarding the possible negative impacts of ICT may be due to their growing up with more ICT, though they stated it was unexpected considering their exposure to ICT during their teacher training.

Ways of using ICT

As with the variety of ICT, there are also a plethora of ways of using ICT and a range of factors that affect how it is used. ICT can be seen as an essential component of education due to how prevalent it is in the world (Passig, 2001) and the importance of students being able to use it (Tucker, 1987). In addition, ICT can be used in the classroom and its use can change the environment and teaching (Zhao & Frank, 2003).

Necessity of ICT use

In his 1987 paper, Tucker proposed that the high-cost of investing in technology in schools had the potential to reap benefits by moving schools forward from the 1900s model of instilling facts and procedures to a model of schooling that "emphasizes creativity, problem solving ability, conceptual mastery, the ability to express oneself clearly, and the capacity to work collaboratively with others" (p. 111). However, he stated that this would only be possible if students had access to and used technology appropriately, which would rely on sufficient funding for suitable software and hardware that could be used by teachers who were trained to use it effectively in their teaching and for their students' learning.

Almost 15 years later, Passig (2001) noted that the use of ICT in the classroom had been increasing since technology was first introduced into the world. This introduction has resulted in a potential upheaval in society, particularly with the level of connectivity that has arisen with ICT. However, Passig stated that ICT would also be the means by which the upheaval could be survived and even triumphed. The consequences for each individual would depend on the skills they have with the ICT and how they use those skills. Passig proposes that an example of such a skill is melioration, as the individual will need to be able to select what to use and to use it in a way that is beneficial to the situation, regardless of that situation. He concluded that new ways of assessing will be needed to determine whether these skills are present, as the existing ways of assessing would not be able to measure them.

Zucker (2008) stated that the incorporation of ICT into education needed to be carefully considered to ensure that how it is used transformed the way schools operated. He stated that any investigation of ICT in education needed to look at the impact on students and teachers within the school, as well as the potential consequences outside of the school. The use of ICT also needed a level of accountability. Zucker acknowledged that "educational technology is not a panacea … improving schools is a complex, difficult process" (p. 15), but he proposed that the use of ICT should enable six goals to be met. ICT use should better prepare students for their lives after schooling by improving academic achievement through a more challenging curriculum, the use of instructional strategies that focus more on problem solving, and more effective assessments. ICT use should also make schools more interesting for children by creating a more engaging and relevant environment which goes beyond what was the traditional narrow focus on academics to connect to the world outside the classroom. ICT use should enable education to meet the needs of a more diverse range of students, enabling all students to benefit from the educational experience. ICT use should make teaching more interesting as a position, attracting people who are interested in working in the school environment. ICT use should enable the parents and the community to be more involved with the children through access to school information and the provision of quality resources for children and parents to use at home. Finally, ICT use will enable more efficient accountability as information will be more accurate and timely.

In Australia, White (2008) discussed potential roles of ICT and future trends. He considered that the use of ICT in terms of access to free resources, social networking, collaboration opportunities, and availability of and access to information, would all influence the use of ICT. When these were considered, White stated the benefits of ICT in education could be great. Unfortunately, he concluded that there was a lack of detailed research in Australia that addressed how ICT was used in education and how ICT should be used in education to obtain the most benefits from its use.

ICT used

In their research conducted with 19 schools to investigate their proposed ecological metaphor framework, Zhao and Frank (2003) found the most frequent uses of the computer was for teachers to communicate with parents and preparing the lessons and the least frequently occurring uses involved students using the ICT. They proposed that the reason for this was that students using the ICT directly would involve more changes to the teachers' teaching than any of the other uses. Ainley, Banks, and Fleming (2002) analysed the use of ICT in five schools that were selected due to their innovative practices. They compared the cases in terms of how ICT was used and what teaching and learning practices were evident. Ainley et al. (2002) found that the schools all focused on ICT being used to improve learning, rather than focusing on ICT skills themselves. However, they stated that ICT competency was needed for ICT use in this way to be beneficial.

Hus (2011) investigated the use of ICT in lessons in grades 1 to 3 of Slovene primary schools through teacher completion of questionnaires and the recording of the ICT used during randomly selected lessons within the environmental studies subject. Results indicated that the least number of teachers used ICT in their lessons often (every day or at least three times per week) and, when added to the number of teachers who indicated they used ICT at least once a week, were the same numbers of teachers who indicated they used ICT rarely or one or two times each month (a total of 33 teachers). Hus (2011) found more than half of the teachers in the observed environmental classes did not use ICT, and of those that did, the most commonly used ICT were computers, then projectors, and then IWBs. It was found that the most frequently used ICT to access interactive materials were internet browsers, followed by computer programs, and CDs or DVDs.

Comparisons between teachers from different countries also showed similarities in how ICT was used, though differences were also noted. Suduc, Bizoi, Gorghiu, and Gorghiu (2011) compared the teacher-reported use of ICT in science classrooms in five European countries – Finland, Greece, Poland, Spain, and Romania. They used questionnaires delivered online to 363 teachers to ascertain access to ICT during science lessons and how ICT was used during science lessons. All science teachers from Finland reported having a computer in their classroom, where as 84% of Romanian science teachers, 70% of Polish science teachers, 60% of Spanish science teachers, and 36% of Greek science teachers reported having a computer in their classroom. When asked if they used computers in their science classroom, all Finnish teachers responded in the affirmative, whereas 85% of the Greek teachers, 78% of the Romanian teachers, 72% of the Polish teachers, and 57% of the Spanish teachers responded affirmatively. The majority of science teachers reported using powerpoint presentations with the computers in their classroom, with the second most frequent response to the students using the computers for autonomous work. When Suduc et al. looked at the student autonomous use of computers by country, only Finnish teachers reported this for the most frequent use of computers, with this occurring in less than half of the responses from the teachers from the other four countries.

The way in which the teacher chose to use ICT has been investigated and discussed. In their study of educational computer use with 352 teachers, Tondeur, van Braak, and Valcke (2007) developed a tool to measure the different ways computers were used by teachers in the classroom. Their study focused on computer use in the primary classroom and an instrument was developed that would measure the different ways the computer was used. They found that three types of educational use of the computer were identified – "'basic computer skills', 'computers as an information tool', and 'computers as a learning tool'" (p. 204). Tondeur, van Braak, and Valcke (2007) recommended the use of their instrument "to explore the determinants on the types of computer use in primary education, e.g. at teacher, classroom, and school levels." (p. 205).

Relationship between ICT purpose and use

Spring (2004) focused on ICT use and uses in his review of ICT in education in Australia. All education levels were considered and stakeholders in all sectors were invited to contribute. He outlined seven areas that were essential if ICT use in education was to be successful – the importance of setting priorities, the development of the educators who would use ICT in their teaching, provision of services for the users of ICT in education, providing support for the best use of ICT, ensuring access to the advantages of ICT were available to all, encouraging the provision of flexible online learning, and providing ways for the efficiencies possible through ICT to be evaluated.

In their paper presenting results from the Computers in Education study conducted in two stages during 1989 and 1992, Pelgrum and Schipper (1993) differentiated between learning about computers, which involved incorporating ICT-specific curriculum, and learning with computers, which involved using ICT within the other subjects of the curriculum. They found that the reason given by schools as to why they decided to use computers was related to how the computers were used, with schools who indicated improvement of educational outcomes as an aim integrating computers more than schools who did not specify the improvement of educational outcomes. In addition, the length of time computers had been used within the school and the availability of educational software suited for use within subjects were also found to be related to integrating computers.

Hennessy, Ruthven, and Brindley (2005) used focus group interview with teachers at six schools catering to students with ages from 11 years to 18 years, with a spotlight on teachers teaching English, science, and mathematics, to investigate what teachers perceived were the impact of ICT on pedagogy, how ICT were used, and the affordances and constraints generated by the use of ICT in the classroom. They noted that although there were some differences in ICT availabilities, there were strong similarities in what ICT were used in each of the subject areas, with document processors and publishers focused on in English, spreadsheets and graphing programs in Mathematics, and databases in Science, with all subjects using the internet and multi-media resources. Where resistance to using ICT was evident when resources were available, the resistance was attributed to a lack of expertise and less confidence in the use of ICT in the classroom with students. The lack of confidence was seen by Hennessy et al. (2005) to be particularly powerful as teachers referred to the need to overcome their lower confidence before ICT could change how they might teach. Another factor raised by teachers when ICT was used the impact ICT would have on their control of the learning processes, as teachers believed the use of ICT would result in a loss of control. Teachers also expressed difficulty in balancing between teaching how to use the ICT and using the ICT to teach the subject, with concern that the use of ICT could focus more on the ICT rather than the content of the subject being taught. In addition, teachers referred to the need for a fit between the learning objectives of the lesson and the ICT, particularly concerning the use of ICT to add value to the learning rather than to distract students.

ICT integration

Integration of ICT into teaching involves the use of ICT in all facets of teaching and learning. Shulman's (1986) introduction of his framework and Mishra and Koehler's (2006, 2009) incorporation of technology to create the technological pedagogical content knowledge framework reflect the complexities that are evident. In addition, many researchers have focused on the relationships between teaching and learning, considering how technology mediates between them (for example, see Peeraer & Van Petegem, 2012).

The Technological Pedagogical Content Knowledge (TPACK) framework

Shulman (1986) argued that the interplay between pedagogical knowledge and content knowledge needed to be foregrounded, along with both pedagogical knowledge and content knowledge, for effective teaching. His Pedagogical Content Knowledge (PCK) framework outlined the types of knowledge required by a teacher as well as with the forms that knowledge can take (that is, propositional, case, and strategic). He proposed that teachers needed both the types of knowledge and forms of knowledge to be effective. Furthermore, types of knowledge and forms of knowledge should be developed by teacher educators to ensure teachers could meet the requirements of their work.

In their paper introducing their conceptual framework Technological Pedagogical Content Knowledge (TPACK), Mishra and Koehler (2006) stated that ICT have become commonplace in the world and this had led to the provision of technology within education. They incorporated technology to reflect the overall ability teachers would need to effectively use changing and expanding technology in the classroom. The incorporation of technology as part of the conceptual framework also recognised the importance of the teacher knowing about ICT. Mishra and Koehler (2006) proposed that using technology within teaching involved attention to pedagogy, technology, and content. Koehler and Mishra (2009) described TPACK as a way to explain "a complex interaction among three bodies of knowledge" (p. 60) that they proposed teachers needed before they could integrate ICT into their teaching. The framework acknowledged knowledge of pedagogy, content, and ICT individually as well as the intersections – the spaces where they interact – and Koehler and Mishra (2009) stated that these have the potential to generate something more than if just considered as separate, non-related entities. In addition, they posited that the central emergent combination of all three is where teachers will be flexible in their teaching and will use ICT in ways that were nuanced and contextual.

Teaching and learning

When used in the classroom, Pegrum (2009) proposed that ICT, teaching, and learning become intertwined. He argued that ICT could not be viewed in isolation, that it must be viewed through multiple lenses. In addition, although many acknowledged that ICT impacts on education, few considered the reverse flow – that education will impact on ICT. However, he stated that teachers using ICT in and of itself would not drive their pedagogy from traditional to contemporary, as it was possible for teachers to use ICT as an add-on and to not change how they teach. In doing this, teachers could limit the affordances offered by technology.

Hughes (2005) described ICT as supporting pedagogy in three ways – by replacing another, non-technical aspect of the teaching and learning, without modification to how the lesson would have gone or the student learning involved; by amplifying an aspect of the lesson through greater efficiency that was unavailable via the non-technical process or product it was replacing, though the lesson and learning were unchanged; or, by transforming the lesson through changing how the lesson was conducted or the learning of the students. The transformational aspect may recognise the potential of ICT to interact with the participants in the classroom. Loveless (2007) examined the connections between ICT, Didaktik, and improvisation. Her description of Didaktik as the what, why, and how of teaching focused on the planning involved, and of improvisation as flexible and original teacher presentations within the classroom, placed both Didaktik and improvisation within the knowledge of subject content. However, ICT was seen as both subject knowledge and a resource, with Loveless (2007) describing the issues of the teacher being able to develop the skills in their students as well as being cognisant of the ways ICT could be used to generate affordances for learning. Loveless (2007) stated that when there was discord between Didaktik, improvisation, and ICT, student learning would suffer as the affordances for learning would not be supported.

Peeraer and Van Petegem (2012) developed and validated an instrument to measure how teacher educators in Vietnam integrated ICT into their teaching. The questionnaire collected self-reported data from 933 teacher educators on their use of ICT and how their students used ICT to determine the impact it would have on teaching and learning. Peeraer and Van Petegem created four levels that could describe how teachers incorporated ICT into their teaching and the impact the ICT would have on teaching and learning. The first level focused on using ICT as replacement or assimilating ICT into existing practices, which modified teaching practice slightly but not student learning. The second level used ICT as an enhancement to teaching, but again, did not change learning. The third level used ICT innovatively, which resulted in the teaching becoming more student-centred and with the ICT use impacting on student learning. The final level used ICT transformatively, with both teaching and learning changing accordingly.

Summary

The importance of ICT in education was raised as early as 1984 (Rushby, 1984) and this importance has now been recognised through the inclusion of ICT in the National Reports on Schooling in Australia by MCEETYA (2000, 2002, 2004, 2006, 2007, 2008). However, as with the changing ICT outlined earlier, the focus on ICT has changed over the 9 years National Reports on Schooling in Australia were published, going from student access (MCEETYA, 2000) to implications of teaching (MCEETYA, 2004) and finally to assessment of ICT literacy (MCEETYA, 2006, 2007, 2008). The move in focus was reflected in the views of Warschauer and Matuchniak (2010), who focused on student learning enabled by ICT, and Levy (2010), who discussed the continuation of international assessment of ICT skills into adulthood.

Types of ICT available in education mimic those available in the community (Martinovic & Zhang, 2012). When there was access to ICT in the classroom, the choice of ICT used depended on the teacher (Inan et al., 2010; Russell et al., 2003), with teachers determining whether it would be used for preparation outside of the classroom or within the classroom (Hus, 2011). Zucker (2008) agreed that ICT had the potential to transform schools, particularly with benefits such as opportunities for collaboration and information availability outlined by White (2008). Sudoc et al. (2011) described the opportunities for accessing information that became available via ICT, but teachers could weigh these opportunities against their perceived level of control, which Hennessy et al. (2005) stated could be seen as decreasing with ICT use.

When using ICT, ICT could be the focus of the learning or an enabler for learning (Hennessy et al., 2005; Pelgrum & Schipper, 1993). Ainley et al. (2002) reiterated that if ICT was to be used to improve learning, ICT skills needed to be present. ICT was also seen as having the potential to be incorporated into existing practices or to change these practices (Hughes, 2005; Peeraer & Van Petegem, 2012). How ICT could be incorporated into teaching was described by Mishra and Koehler's (2009) TPACK model that recognised the interaction between technology, pedagogy, and content knowledge. However, if there were discordances between the ICT use and teaching, it would be student learning that would suffer (Loveless, 2007). The next section explores the potential effects of ICT use in more detail.

EFFECT OF ICT USE

The impact of ICT use in educational contexts has generated expectations based on both the educational milieu and on the participants. Initial concerns about ICT in education focused on whether everyone would have access to ICT (OECD, 2010). After decades of funding, concern now focuses on how ICT is used by the two main participants in education – the student learner and the teacher (Ananiadou & Claro, 2009). The skills the learner brings with them need to be considered before new skills can be developed and it is the teacher who will be the main conduit for the development of these skills (Pineida, 2011). Although the impact of ICT on teaching and learning is still being investigated, initial research indicates positive impacts (for example, Fiorini, 2010).

Expectations

Expectations regarding the impact of ICT in education have been raised in terms of the digital divide and the anticipated skills for the future. Access to ICT has the capacity to impact on the potential of ICT (Hargittai, 2010). In addition, the use of ICT can impact on the skills of students and how they will use their skills in the future (Ananiadou & Claro, 2009).

The Digital Divide – Access and use

Hargittai (2010) argued that the original digital divide between people who have access to the internet and people who do not still exists, but there is now an additional divide created by how the internet is used. She added that, until recently, the assumption that having access equated to equal levels of use in terms of skills and benefits was prevalent, but she considered that this was not reflective of what was actually happening. Her research conducted with 1,060 first-year university students found that participants who were male, had parents with higher levels of education, and were from a higher socioeconomic background were more likely to use the internet more often for a greater range of activities. Hargittai considered that the homogenous nature of the participants could point to these effects being greater in the general population.

Skills for the 21st Century

In their paper that reported on research within the Organisation for Economic Development (OECD) New Millennium Learners (NML) project context, Ananiadou and Claro (2009) referred to the dual aims of the NML project, namely, the impact of ICT on the cognitive development of young people and how governmental and educational sectors have responded to ICT through both policy and practice. They stated that these two aims intersect via the recognition of the new skills and competencies that the proliferation of ICT both demanded and enabled, and referred to these skills as “21st century skills” (p. 6). Whilst they used the European Commission’s definition of a skill, “the ability to perform tasks and solve problems” (Cedefop, 2008, as cited in Ananiadou & Claro, 2009, p. 8, italics in cited text), they described competence as the application of skills, cognitions, interpersonal attributes, and ethics within a specified context. One of the consequences of identifying these 21st century skills, Ananiadou and Claro (2009) stated, was to determine if and how these skills were being taught and how student attainment could be assessed. They noted the incorporation of ICT in education saw ICT as both something to develop as a skill (in and of itself) and as a competence (for use with other learning). As a result, ICT had the capacity to impact on three levels – student skill and competency development, teacher pedagogies, and classroom (and wider) assessment practices. Ananiadou and Claro (2009) concluded that whether the potential of ICT in education is met or not will depend upon the teachers and students as they are the players who will determine the value and relevance of ICT to their teaching and learning experiences.

The results of the 2006 PISA conducted by the Centre for Educational Research and Innovation (CERI), part of the Organisation for Economic Co-operation and Development (OECD), were utilised as part of the OECD's New Millennium Learners (NML) project to investigate student development of 21st century skills (OECD, 2010). The study found that a second digital divide exists that differentiates on the basis of whether students have the competencies and skills to access the full potential possible through ICT. The second divide has arisen as a high proportion of students have access to ICT, but the benefits of the access are not realised without the requisite skills and competencies (OECD, 2009a). Students on the wrong side of the second digital divide gain less in educational terms when ICT is made available, when compared to those on the right side. However, it was proposed that the optimal conditions would require governments providing incentives for teachers to recognise the potential and adopt ICT for use within their teaching (OECD, 2009b).

Pineida (2011) discussed how ICT should be integrated into everyday lives, schooling, and the economic development of a country to ensure appropriate competencies were developed for the 21st century. He advised that for this to occur, teachers needed to address competences within their teaching, their learning, their profession, and their use of ICT, whereas students needed to focus on competencies concerning ICT and learning. To encourage students to accept the value of ICT in the classroom, Pineida stated, ICT use had to show the connections between the classroom and the real world. He recommended teachers and students be provided with opportunities to develop ICT competencies, connections be made between the classroom use of ICT and the students' worlds outside of the classroom, increase awareness of the importance of ICT competencies, improve ICT resources such as the internet, reiterate the ethics of using ICT, and accept that ICT is no longer "new".

Teaching

When teaching is focused on, the changes relating to ICT use can be viewed in terms of the teaching experience. This experience is comprised of the effect ICT has on teaching (Nikolova, 2001) as well as the effects upon and created by the beliefs of the teacher and the teaching skills they bring (Levin & Wadmany, 2008), as well as the interaction between the teacher and the use of ICT.

Changes to teaching

Nikolova (2001) proposed that the changes in education as a result of ICT will reflect not only the needs of a society with new technology, but also the change in how teachers teach due to the availability of ICT in education. She believes that how we learn will change, and that "teachers have to adapt to this change, even more – to act as 'change agents' and help shaping new school cultures" (p. 73). To do this, Nikolova believes teachers need to be able to use ICT themselves, but beyond that, they should be fluent in its use and flexible in their approach. In addition, teachers need to be able to recognise when ICT is the best resource for the task and when it is not, as this knowledge will empower the students to learn to their potential. Nikolova stated that teachers without this knowledge will risk disempowering students as they will be unable to learn with the ICT resources provided.

According to Beardon and Way (2003), ICT can enhance teaching and learning through its potential to cater to how children learn and how they learn differently from each other, but this potential was not possible without the teacher knowing how to use the ICT in a way to enable this. They believe that using ICT can greatly assist teachers in providing different learning experiences without adding to their work load. However, the teachers do need to learn how to use the ICT and how to use it for teaching and learning. As a result, Beardon and Way claim that ICT does not diminish the teacher's role, on the contrary, the teacher's role has evolved to be more crucial. As an example, Beardon and Way discussed how the internet could be incorporated into the classroom, particularly how it opens up the information available to the students and "promotes a learning culture that is characteristically open and constructivist" (p. 161). This required the teacher to be able to use the ICT that students would use, and to be able to show students different ways of using that ICT in a discriminating way.

Stevenson (2008) found there was an interaction between using ICT, the participants, and the lesson. He used the metaphors of resource, tutor, tool, and environment to describe the use of ICT by 48 teachers with 58 groups of students aged 5 to 18 years and then investigated how these different uses impacted on teaching and learning practices. He utilised two structures for describing teaching and learning – teacher-centred and student-centred – and these two had specific types of dialogues that the teachers and students engaged in. In addition, he had classified the teacher's level of ICT experience and the students' (when grouped) level of ICT experience. Stevenson found interactions between how the ICT was used, the lesson structure, and the teacher and student level of ICT experience. Specifically, as was most evident for when technology was used as a resource or tool (which were the majority of uses), who controlled the ICT, what ICT was used, the intended and achieved outcomes, the focus of the tasks, and the pedagogical structure of the session could be used to differentiate the observed sessions. Stevenson noted that when ICT was used as a resource, teaching was enhanced, whereas, when ICT was used as a tutor, tool, or environment, learning was enhanced.

Changes to teaching beliefs

Levin and Wadmany (2008) investigated teacher views on the incorporation of ICT into the classroom by following six teachers of Grades 4, 5 or 6 at one primary school over three years. Professional development was provided to the teachers in the form of workshops and assistance on request. Levin and Wadmany found three profiles were evident when the teachers' view of how ICT should be used in their teaching was considered with the changes in their behaviour. The first profile incorporated a view of ICT as a tool that would enable the transmission of knowledge from the teacher to the students. This profile did not change over the study. The second profile initially viewed ICT as a support for learning to an element that has the potential to empower students in their learning and teachers in their teaching, which Levin and Wadmany found was related to the teacher's move towards a more constructivist view. The final profile already integrated ICT in their classroom with an authoritative view of teaching, but by the end of the three years, the teacher with this profile teaching had changed to incorporate ICT with discovery learning strategies within a constructivist perspective. Levin and Wadmany concluded that teachers are always evolving and they need to be aware that a lack of confidence in ICT use is part of the process of learning new ICT. Levin and Wadmany considered the teacher changes essential as they the teacher was the pivotal factor for whether ICT would be incorporated into the classroom and how it would be incorporated.

Although ICT use can change beliefs and views, beliefs have been shown to also impact on the use of ICT. In their study of the impact of the educational beliefs of 525 primary school teachers on their use of computers in the classroom, Hermans, Tondeur, van Braak, and Valcke (2008) investigated whether there was an effect due to the teacher beliefs, when viewed in terms of whether the beliefs were traditional or constructivist. Hermans et al. stated that how ICT was used in the classroom was important as the incorporation of ICT has moved from learning the ICT skills themselves to become a tool that supports the teaching and learning in the classroom. They found that constructivist beliefs had a positive effect on computer use in the classroom (that is, it was used more) and traditional beliefs had a negative effect on computer use. In addition, the effects of these teacher beliefs were similar to the effects of technology variables (such as experience using computers), and demographic factors (for example, age and gender). Hermans et al. stated that the results indicate the mediating aspect of teacher educational beliefs concerning computer use in the classroom.

Learning

ICT can transform learning by impacting on the interaction between the learners and the learning opportunities provided (Jarvela, 2010; Sutherland, 2004, as well as creating positive attitudes within the learning environment (Balanskat, Blamire, & Kefala, 2006; Coates, Hamish, & Friedman, 2009). The outcomes of the learning opportunities (Fiorini, 2010) and the learning practices themselves (Crook, Harrison, Farrington-Flint, Tomás, & Underwood, 2010) can also be affected by ICT. This can occur due to ICT enabling learning beyond the classroom (Pegrum, 2010). In addition, the impact of the students themselves need to be considered (Ainley, 2010; Fraillon, 2012; Selwyn, 2009).

The learners

In his review of the literature concerning the view of younger people as expert ICT users, as evidenced by terms such as digital natives, Selwyn (2009) summarised the multitude of descriptions as creating the belief that the young generation assume ICT to be ever-present in their lives and are ICT capable and empowered – willing to use ICT and able to use it. When viewed positively, Selwyn (2009) states these capabilities weave through leisure and education, making the young generation able to pick and choose which ICT to use and when. When viewed negatively, Selwyn (2009) described the impact as compromising their higher level thinking skills and inhibiting their ability to critically evaluate the plethora of information available to them. Selwyn (2009) describes these views as “exaggeration and inconsistency” (p. 370) and states the more realistic and empirically based interpretation is one of a knowledge consumer who passively pulls information from any source but unable to truly create new knowledge or share collaboratively with others. In addition, rather than expecting to use ICT in all facets of their lives, they are more likely to make decisions on participating or not participating in ICT use. Selwyn (2009) proposes that the role for educators is to help this generation develop a critical understanding that will enable them to utilise ICT in an empowering way.

If learners actively make decisions on whether or not to use ICT, their attitudes towards ICT need to be measured as they could affect their decisions. Kubiatko and

Halakova (2009) used an instrument with Likert-style questions to investigate attitudes towards ICT use in biology classes of 518 students aged from 15 years to 19 years in nine high schools in Slovakia. Overall, their findings indicated that there were gender and age differences, with boys and younger students being more positive towards ICT use in biology classrooms. However, when the results were considered within the five categories of positive and negative ICT influence, advantages and disadvantages of ICT, and the use of ICT in biology lessons, only the first category (positive ICT influence) had gender differences. These differences involved females attaining higher responses, which was opposite to the overall findings. In their conclusion, Kubiatko and Halakova (2009) stated that it would be the teacher who determined how ICT would impact on students' learning in biology as it was the teacher who would decide how ICT was used.

Learning opportunities

As part of the InterActive project, Sutherland (2004) investigated how using specific ICT could transform the learning available to students and how the use of the tool could produce effects beyond the completion of the task using the tool. The research was conducted at both primary and secondary schools and the paper discussed preliminary findings for the project. It was found that there were several factors related to learning opportunities – the connections between the knowledge domain, how ICT and non-ICT tools were used, the context for the learning, the students' learning history, and how the teacher would work with the students were important. Another finding related to the teaching, with the discourses used by the teachers, becoming more authoritative when ICT was used. In addition, when using ICT, the teacher may focus on the ICT rather than the learning area content, which Sutherland (2004) proposed may have been due to a lack of integration of learning area content with ICT knowledge by the teacher. A final finding concerned the responsibility held by the teacher, with Sutherland stating some teachers had "devolved the responsibility for learning to the computer and have not worked with the class as a collective" (p. 14). In contrast, Sutherland (2004) described classes that successfully worked within a community of inquiry as noisy, with students moving around the classroom to discuss ideas with classmates.

Bidarian, Bidiarian, and Davoudi (2011) presented a model describing how ICT could improve teaching and learning. Their model proposed that ICT improved the effectiveness of learning through creating more opportunities for a student-centred focus through group work and collaboration, which provided better opportunities for problem solving and research-based learning. These opportunities helped students become creative and evaluative independent learners who could integrate their learning. Their model also recognised the social aspects evident in the interaction between the learner, education, school, and instructor. Jarvela (2010) discussed how ICT had the capacity to change how learning and teaching opportunities were designed, particularly in terms of the interactions between students and with the teacher and the way the structure of the learning environment can be less strict and confined. When ICT was used in this way, she proposed, the results could be an environment where students had choice in what they did and how they did it, both requiring and enabling them to control the tasks and their learning.

In their research in nine secondary schools, Crook, Harrison, Farrington-Flint, Tomás, and Underwood (2010) found that ICT had the potential to modify practices in the classroom and through the provision of a range of possible learning practices. Their study analysed two sources of data, the lesson logs that teachers used to track what they did when ICT was used and interviews with the teachers and the senior managers of the schools, to determine how ICT, student engagement, learning, and context of ICT use were related. Crook et al. found that practice could be modified in the classroom through changes to the classroom space, increasing flexibility presented via ICT, and the use of ICT to create activities that had, until recently, not been possible in the classroom. Furthermore, ICT could enable the creation of new learning practices through the opportunities for sharing visuals, students working independently on research, and creation of new products due to the availability of ICT.

Student experiences with ICT are not limited to school. ICT uses by students at school and at home were investigated by Selwyn, Potter, and Cranmer (2009). They surveyed 612 primary school students aged between 7 years and 11 years of age in England to examine how they engaged with ICT in these two environments. Selwyn et al. (2009) found that ICT use at school focused on learning activities and obtaining images, with the levels of engagement, ICT used, when used, and how used differing between the five schools. However, although all students expressed a level of dislike for the ICT activities at school, the majority indicated that ICT helped them learn. ICT use outside of school also differed by school, though Selwyn et al. (2009) proposed this difference could be attributed to the location or other factors rather than just the school. These differences included where students accessed the ICT (such as at home or a library), access to ICT, and how ICT was used. Differences in access to ICT and ICT use also occurred based on age, and older children perceiving greater learning from ICT than younger children. Selwyn et al. (2009) recommended that students be encouraged to engage more with ICT in schools by being given the opportunity to participate in how ICT can or should be used in schools, and that educators take the opportunity to introduce students to ICT with a focus more on exploration than on restriction.

Pegrum (2010) proposed that ICT created the potential for students "to be able to learn anytime, anywhere, linking their in-school to their out-of-school learning" (p. 351). In addition, he stated that the impact of ICT could occur via both the content (as many sources become available) and the curriculum (as the learner can access information at any time and in any order). Pegrum (2010) also noted that ICT could impact on how students learn, as they can choose to investigate themselves or to investigate as part of a group. These form part of the "challenges in moving from an early twentieth-century model of education to a twenty-first century one" (Pegrum, 2010, p. 352).

Outcomes

Trinidad (2002) reiterated that using ICT successfully involved more than "simply 'putting boxes on desks'" (p. 126), as incorporating ICT into the classroom required changes in how teachers taught. In her paper on the use of ICT in classrooms in Western Australia, she noted that these changes took time, though the provision of ICT in the classroom over several years could be a catalyst that would provoke changes in the teachers' approaches to teaching and learning and their beliefs concerning schooling. However, Trinidad stated that the teacher needed to be open to these changes and able to overcome barriers such as a lack of support, limited funding, inadequate directions or school policy regarding ICT, or out of date ICT. She proposed that one of the most significant changes would be when the generation of people who grew up with ICT become teachers, as the use of ICT will seem commonplace and natural. However, both existing teachers and new teachers from the ICT generation will need to establish ways to incorporate ICT into their classroom that will benefit teaching and learning.

In their review of research involving access to, use of, and outcomes of ICT use, Matuchniak and Warschaur (2010) discussed how traditionally disadvantaged groups, such as those of low socioeconomic status or from specific ethnic groups, were disadvantaged less in terms of access and more in terms of how ICT is used. They described the differences in ICT at schools as “less about whether computers are used and more about how they are used” (p. 96). With use at home mimicking this differentiation, Matuchniak and Warschaur proposed that the flow-on effect of potential skills and competencies that are or are not obtained due to how ICT is used, could additionally impact on academic outcomes. However, they stated that addressing this string of effects was hard as the provision of ICT to students who also were disadvantaged through lower literacy and ICT skills meant that these had to also be addressed for the full potential to be accessed. Matuchniak and Warschaur concluded that for ICT to benefit all, attention to how ICT was accessed by students, appropriate professional development for teachers, adequate support systems, and the development of curriculum that incorporated ICT were needed.

Cognitive and social skills could also be affected by ICT use. Fiorini (2010) used data from the Longitudinal Study of Australian Children (LSAC) to investigate the relationship between computer use at home and children’s cognitive and social skills. Social skills were measured in terms of consideration of and helpfulness to other, restlessness, and emotional problems. She found that the effect of the variable concerning the parents reporting the child as using the computer at home during the first data collection (when the children were aged 4 and 5 years) was significant and positive on both cognitive scores and their relationship index. The variable also positively affected cognitive scores for the children during the second data collection phase, when the children were aged 6 and 7 years. Interestingly, Fiornini did not find an effect from computer use when children were older, either on cognitive scores or the relationship index. When gender was considered, the cognitive and relationship effects were positive and larger for female children.

Being able to determine the effect of ICT on the development of student skills and learning is an important step to determine the impact of ICT. Quellmalz and Kozma (2003) examined how to assess the skills developed by students as they use ICT for complex problem solving with the aim of designing and testing a framework that was designed to meet the requirements. They initiated their examination by reiterating the importance of being able to assess the impact ICT has had on student skills and learning, particularly as this has not yet been successfully achieved. Quellmalz and Kozma proposed that “the measurement of students’ skills as they use technological tools to address problems” (p. 391) is the essential component of any assessment of ICT skills. Their assessment framework integrated knowledge of the content, use of ICT tools, strategies for and of using ICT, multiple levels of problem solving, and using ICT strategies to enable and support reasoning within domains.

Quellmalz and Kozma (2003) also discussed the results of the Second Information Technology in Education Study Module 2 (SITES M2, as cited in Quellmalz & Kozma, p. 396). A total of 174 cases from 28 countries covering grades in primary school and lower and upper secondary school contained data collected from interviews, classroom observations, and document analyses. The cases had been selected by panels in each country as exemplars of ICT use in schools in that country. In terms of ICT use and patterns of classroom practices, they found that the most frequent type of ICT used were productivity tools, web resources, and email, with the most common software packages being for presentation or product creation and information acquisition. In addition, when they conducted a cluster analysis to scrutinise patterns in how ICT was used by teachers and students, they found seven clusters. These clusters connected the ICT used and how it was used, the teaching practices of the teachers, and the behaviours and practices of the students.

The overall effect of ICT use in education has also been investigated. Underwood (2009) initiated her evaluation by outlining the importance of ICT integration, focusing on the learning opportunities it could present and how and if they are realised in the learning achievement. She found that the evidence showed two effects

– one on behaviours and one on academic performance. Integrating ICT changed behaviours in terms of all participants being prepared to learn within the learning environment (which include all members of the school community) and through the opportunities presented for all learners to participate and learn. Underwood (2009) found evidence of improvements in academic performance through ICT use at school and at home, though gender and ability interactions were sometimes apparent.

In their review of studies investigating the impact of ICT on schools in Europe, Balanskat, Blamire, and Kefala (2006) summarised the findings of 17 studies. They used the term "impact" to refer to "the overall achievement of an intervention on the education system … the end-point" (p. 24). They found that ICT benefited students and their learning by increasing engagement and motivation, providing more differentiation tailored to student needs, and generating greater opportunities for student collaboration on projects. The use of ICT benefited teachers and their students by increasing teacher positive attitudes towards ICT and teaching, making collaboration between teachers easier, creating the potential to use more efficient practices, and providing support or transforming existing pedagogies.

Ainley (2010) outlined the results of the 2008 National Assessment Program for ICT literacy (NAP – ICT literacy). This was the second iteration of the survey, following on from 2005. Over 10 000 Year 6 and Year 10 students participated in 2008 The assessment involved three sections, simulations, multiple choice, and short answers, that were delivered in a computer-based environment. Ainley reported differences between students based on socioeconomic status, Aboriginal status, and location, with a lower percentage of students from lower socioeconomic status or of Aboriginal status achieving the Proficiency Standard for Year 6 and Year 10. A higher percentage of Year 6 and Year 10 students in the metropolitan area achieved the Proficiency Standard than those in regional areas and a higher percentage of Year 6 and Year 10 students in the regional areaa achieved the Proficiency Standard than those in rural or remote areas. Gender differences were also noted, as a higher percentage of female students in Year 6 and Year 10 achieved the Proficiency Standard than male students in Year 6 and Year 10.

Overall, Ainley (2010) reported improvements in the achievement of the students from 2005 to 2008, with an increase in the percentage of Year 6 and Year 10 students achieving or surpassing the Proficient Standard, though the increase for Year 10 was small. In addition, a higher percentage of students reported using computers at home in 2008, (from 43% to 54% for Year 6 and from 58% to 73% for Year 10). Fraillon (2012) found the percentage of students in Year 6 and Year 10 who achieved the Proficient Standard in 2011 increased from 2008 and 2005, though the increases for Year 10 were slight. In addition, in 2011, Fraillon found similarities in the differences found in 2008. Specifically, a lower percentage of students of low socioeconomic status, who were Aboriginal, or lived further from metropolitan centres achieved the Proficient Standard. Likewise, a higher percentage of girls than boys achieved the Proficient Standard. The 2011 results showed that a higher percentage of students used ICT at home than at school, with an increase also noted over the three iterations of the NAP – ICT literacy. However, in 2011, ICT was still found to be used in limited ways by students.

Coates, Hamish, and Friedman (2009) reported on research conducted at ten primary and secondary schools in Australia with students, teachers, and principals that collected the attitudes towards ICT (focusing on ICT skills and ICT use at school and outside of school) and the quality of student engagement in general and with ICT. A total of 2223 students and 237 teachers participated in 2006 and 785 students, 72 teachers, and 21 principals (all participants in the Partners in Learning Project) in 2008. In 2006, the majority of students responded that they were interested in using ICT, used ICT more outside of school, considered themselves competent in ICT, and used ICT in ways that involved higher level thinking skills. The teachers reported more positively on student attitudes to ICT and overestimated student ICT use. Overall, students reported ICT engagement that was lower than general engagement. In 2008, the 785 students reported increases in ICT engagement and this was reflected in teacher reports of student ICT engagement. The type of work completed as part of Partners in Learning Project was related to student ICT engagement – when educationally focused, collaborative, student-driven, technologically supported, and delivered by a range of teachers (and often in primary schools), students reported more ICT engagement; when technologically focused, teacher driven, and lacking technological and staff support, students reported less ICT engagement. Coates et al. reported that there was evidence that "teachers appear to have become more sophisticated users of ICT over the two-and-a-half years of the Partners in Learning Project, and that they may feel more confident integrating ICT into their teaching practices" (p. 19).

Summary

The initial focus on access to ICT has changed to what ICT use can enable. Not all users of ICT use it in the same way (OECD, 2009a; Hargittai, 2010). ICT has the capacity to help users develop new skills and competencies (Ananiadou & Claro, 2009; OECD, 2010), but to affect students in this way, teachers need to be competent with ICT use in the classroom (Pineida, 2011) otherwise they could disempower their students (Nikolova, 2001). ICT use in the classroom has made the role of the teacher evolve (Beardon & Way, 2003), though there were risks that ICT could be used only as a tool by the teacher, which would generate teacher-centred rather than student-centred interactions (Stevenson, 2008). When used as a tool, knowledge was transmitted but when used to support learning, knowledge was constructed (Levin & Wadmany. 2008). Similarly, Hermans et al. (2008) found that teachers with constructivist beliefs used ICT in the classroom more than teachers with traditional beliefs.

Even though students may enter the classroom with ICT skills, it is up to the teacher to develop a critical application of ICT (Selwyn, 2009) rather than handing responsibility for learning to ICT (Sutherland, 2004). Collaborative learning opportunities can be provided via ICT (Bidarian et al., 2011). Students can develop further skills and use them to guide their choices in ICT use (Jarvela, 2010). New learning practices (Crook et al., 2010), more ICT capabilities (Selwyn et al., 2009), and greater flexibility in where learning would occur (Pegrum, 2010) were raised as opportunities that ICT use provided.

ICT use was also considered in terms of equity of access by Matuchniak and Warschaur (2010), with traditionally disadvantaged groups being disadvantaged through how ICT was used. This was crucial as ICT use could positively impact on social and cognitive skills (Fiorini, 2010). Although assessment tools to determine the effects on learning needed to be developed (Quellmalz & Kozma, 2003), there are indications that academic performances gained from ICT use at home and school (Underwood, 2009) and engagement and motivation improved (Blaanskat et al., 2006). Over time, ICT literacy has also improved (Ainley, 2010; Fraillon, 2012) and increases were noted in the occurrences of collaborative and student-driven activities (Coates et al., 2009).

FACTORS RELATED TO ICT USE IN EDUCATION

ICT use in education does not involve an insular insertion of ICT into education – it is affected by and affects other aspects around its use (for example, see Hayes, 2007). The school within which ICT is used, the teacher, the students, and the learning environment created by the interaction of the teacher, students, and learning environment are all factors that interact with ICT use.

School Factors

To investigate how school factors may affect ICT use, Hayes (2007) conducted observations and interviews with staff and teachers at a total of six primary and high schools in New South Wales, Australia. Teachers who were interviewed and had their classrooms observed had been identified by their school as confident in using ICT in their classrooms in innovative ways. Hayes asked the teachers questions regarding the impact ICT integration had on their classroom practices and found that, although teachers had difficulties answering, the majority believed the way they taught or designed learning experiences had not changed significantly. This was backed up by Hayes' observations of the use of ICT to supplement and replicate their usual practices. Hayes also investigated the school approaches to integrating ICT and found that the most successful format needed teachers to be given opportunities to learn how to use the technology before they used it with the students.

Guha (2003) interviewed 10 elementary school teachers in New York to examine the factors that the teachers' perceived as either hampering or helping their integration of ICT into their classroom teaching. The interviewed teachers had been identified via their scores on a questionnaire administered in a previous study, and were the five teachers whose scores indicated they were more comfortable using ICT for teaching and the five teachers whose scores indicated they were less comfortable using ICT for teaching. Guha (2003) found that, regardless of their comfort level with computers, all teachers supported the integration of the computer into the classroom and wanted to be competent in both using ICT and teaching with ICT as they stated it would encourage more cooperative learning opportunities for their students. However, school differences in resources and opportunities for professional development in using computers were found to be related to teacher comfort in using ICT. All teachers reported changes in how they teach due to the incorporation of computers. Guha (2003) proposed that all teachers in elementary schools should be proficient in both using the computer and incorporating the computer in their teaching. She proposed that the speed at which new technology became available emphasised the need for teachers to have access to professional development to ensure they could be proficient in both using the computer and using it when teaching.

The use of a school wide ICT plan and associated ICT leadership can affect ICT use. Baylor and Ritchie (2002) administered questionnaires to a total of 94 teachers at five elementary schools, five middle schools, and two high schools with an ICT plan and where ICT had been implemented for a minimum of two years in the majority or all classes. In addition, structured interviews were conducted with the teachers and administrators, and the school technology use plan was examined. They found the impact of technology on students' content acquisition was predicted by the level of ICT leadership evident at the school, the teachers' willingness to change, and the lack of teachers not using ICT at school. The impact of technology on the students' higher order thinking skills was predicted by the teachers' willingness to change to enable ICT integration, students not using technology by themselves when completing creative tasks, and the use of ICT within a constructivist approach. The integration of the ICT in the classroom was predicted by the teachers' willingness to change to enable ICT integration and the proportion of activities incorporating ICT where students used it with other students. The teacher's own ICT competency was predicted by the teachers' willingness to change to enable ICT integration. The teachers' morale was predicted by opportunities for professional development and using ICT in a constructivist manner. Baylor and Ritchie concluded that the most critical factor was the level of willingness to change to incorporate ICT. This factor seemed to have a flow-on effect to student learning and teacher competencies and morale.

The curriculum within the school can also interrelate with ICT use. In their paper considering the interaction of ICT and the curriculum in schools that cater to the learning needs of students (referred to as smart schools). Ghonoodi and Salimi (2011) proposed that ICT could be used in three ways – to provide information, to provide a way for information to be shared, and to generate discussion. They stated that the use of ICT in education and the classroom would impact on pedagogy, particularly in terms of how the curriculum was enacted, through these three ways. They suggested that ICT use could create a student-centred environment where students controlled their learning. Salimi and Ghonoodi (2011) used the descriptions of the interaction of ICT and the curriculum outlined in Ghonoodi and Salimi (2011) to compare traditional and smart schools. Whereas they described smart schools as ones that catered to the learning needs of the students, traditional schools were described as text-book reliant, with teaching and learning determined by the content and organisation of these text-books. Rather than the student-centred environment that Ghonoodi and Salimi (2011) stated was evident in smart schools, Salimi and Ghonoodi (2011) described the environment in traditional schools as being more likely to be teacher-centred, where the teacher determines the learning opportunities by controlling the teaching process within the classroom.

The school setting also includes the participants of that setting. Trinidad, Newhouse, and Clarkson (2005) proposed a framework for measuring teacher capabilities with ICT in the school setting. The framework was designed to be used within a cycle of improvement and would describe the teacher's progress whilst integrating ICT into their pedagogy and the learning environment. Three instruments were developed that could be utilised within the school setting. Trinidad et al. proposed that a school could improve the use of ICT via sets of processes, which could be focused on the school, all staff, individual teachers, and students. These incorporated policy and planning at the school level in terms of appropriate policy creation, effective support for teaching and learning, and meeting of system requirements; staff development of ICT skills; ICT choices made by teachers; and, student development of appropriate

ICT skills. Trinidad et al. stated that the use of this framework would assist teacher integration of ICT in a holistic manner that addressed both a pedagogical and a school-wide change.

Rather than initially focusing on the participants, Tondeur, Coopert, and Newhouse (2010) focused on the school. The changes resulting from the integration of ICT were considered as part of the changes at the whole school level, and this was the context within which they described the role of the ICT coordinator. This consideration of factors beyond the physicality of ICT enabled a more holistic approach, and a revisioning of the ICT coordinator to the "curriculum ICT (CICT) coordinator" (p. 298), which involved incorporating the curriculum and, therefore, pedagogy.

The school does not operate in isolation and external factors can have an impact on ICT use. Tearle (2003) conducted a case study of a secondary school to investigate how ICT was incorporated into a school context. The school had 1,880 students ranging from 11 years of age to18 years of age and 80 staff. Questionnaires were provided to all staff, with the data focusing on how ICT was used, the beliefs of the staff regarding how valuable ICT was for teaching and learning, and what aspects of the school were most beneficial to using ICT. A subset of staff were also interviewed, and meetings and informal discussions were also conducted. In addition, classroom observations and general observations of the school environment were utilised. She found that a range of external factors affected the school, with variety in the level of choice at the school level, with the strong leadership of the school and the positive culture (both whole-school factors) moderating the impact of these external factors. Overall, Tearle (2003) found that incorporating ICT has commonalities with other changes in education and this needed to be acknowledged for the successful implementation.

Teacher Factors

Teachers do not work in isolation within their classroom. They have experiences that they bring that have resulted from their educational experiences and life experiences. They also have attitudes, beliefs, and perceptions that all affect and are affected by their use of ICT and their role as a teacher. These potential teacher factors are discussed in this section.

Prior ICT experience

In her multiple case study involving four teachers, Hughes (2005) sought to answer questions regarding the learning experiences and use of technology by practicing teachers and the role of their prior knowledge and learning experiences in the incorporation of technology into their pedagogy. She found that informal learning experiences impacted on the access to technology and the use of technology as it provided opportunities to become aware of, familiar with, and to understand technology. Another finding concerned the importance of teacher exposure to technology learning experiences incorporating a focus on content as this resulted in content-based integration of technology, though, at times, the teacher initiated need for new ways of providing content encouraged them to seek new technologies. The third finding was that exposure to the educational value of technology motivated teachers to consider how they would use technology within their classroom. These findings all demonstrated the importance of the connections of the technology to either general education or to the content to be taught, with the final finding indicating that when teachers were exposed to technology without these connections, the technology was not incorporated in a way to support pedagogy.

ICT experience was part of Zhao and Frank's (2003) ecological perspective research conducted with 19 schools to investigate how technology was used. Zhao and Frank (2003) proposed that using an ecological perspective within their framework was essential as the school settings were seen as ecosystems within which computer use and teachers were species within that ecosystem and the potential innovations from and external policies in regard to using computers as an invasive species. They found that the success of an innovative use of technology was dependent on the teacher in terms of both using the technology themselves and having students use the technology. The teacher needed to interact with the technology. If the teacher had assistance and time to explore, students were more likely to use the technology. If the teacher was pressured to use technology, the teacher would use it. In addition, the teacher had to perceive that using technology would be advantageous for them, which Zhao and Frank (2003) referred to as the teacher's cost-benefit perceptions of incorporating technology.

Teacher prior ICT experience was also a factor in van Braak, Tondeur, and Valcke's (2004) research into the factors related to the use of computers, both to support teaching and within the classroom. Their survey of 468 teachers in primary schools found different factors were found to relate to these two uses of technology. Positive general computer attitudes had the strongest relationship to teachers using computers to support their teaching, followed by more experience with computers, using computers more frequently, and having had more training with computers. More experience with computers was most strongly related to class use, followed by the intensity of computer use, more training with computers, technological innovativeness, and positive attitudes towards computers in education.

To investigate what factors may be related to whether teachers integrated ICT into their teaching, Mueller, Wood, Willoughby, Ross, and Sprecht (2008) surveyed 185 elementary in-service teachers and 204 secondary in-service teachers using a questionnaire with Likert-style questions regarding the use and integration of computers together with attitudes towards and experiences with computers. They found that the teachers' positive experiences with ICT and their attitudes towards incorporating ICT into their classroom were most closely connected to whether elementary or secondary teachers would successfully integrate ICT. Mueller et al. (2006) proposed that their findings suggested it was the positive experience of using ICT within their classroom that was the most significant factor as this would contribute to how confident the teacher would feel when faced with the complexities of incorporating ICT into their teaching.

Attitudes towards ICT

The attitudes of teachers towards ICT were investigated by Rogers (2000). She focused on the technology adoption of 507 art teachers from kindergarten through to year 12 and of 28 technical coordinators in post-secondary institutions in the United States. She found that ICT use had the capacity to be profound but its use was dependent upon the attitudes of the teachers and technical coordinators who would be responsible for its use. This was particularly evident in the relationship between barriers reported by teachers and the adoption level of those teachers, with lower adoption related to the reporting of more barriers. However, these barriers focused on quality of support and services rather than the availability of them.

Tezci (2009) proposed that teachers were one of the driving factors that determine whether ICT was used in the classroom. He surveyed 1540 primary school teachers in Turkey to investigate teacher influence on ICT use at schools. He theorised that the teacher influence would feed through teacher attitudes towards ICT and their attitude would impact on their behaviours, both directly in terms of their attitude towards ICT but also indirectly via their willingness to embrace changes in teaching. His survey incorporated Likert-style questionnaires inquiring about the teachers' self-reported ICT knowledge, frequency of using ICT, attitude towards computers, and attitudes towards the internet. Significant positive correlations were found between all pairings of the four areas of inquiry. Teacher attitudes towards computers and towards the internet were both reported by Tezci as above the medium level, indicating positive results overall, with attitudes towards the internet slightly higher than attitudes towards computers. In addition, there were significant differences when gender and professional experience were taken into account, with males reporting higher levels than females regarding knowledge and use. The internet, email programs, word processing programs, graphics programs, and presentation software were the top four ICT used, and the top three were reflected in the top three uses - accessing the internet, communicating (such as through email), and processing texts (such as word processing programs). Tezci concluded that experience with ICT, attitudes towards ICT, and self-reported knowledge of ICT, and self-reported usage of ICT were interrelated, and that an important starting point for teachers was to ensure they had adequate and appropriate experiences with ICT.

As part of a larger project involving the use of the internet in Spanish schools that was conducted by Sigales, Momino, Menses, and Badia (2009, as cited in Menese, Fabregues, Rodriguez-Gomez, & Ion, 2012, para. 8), Menese et al. surveyed 1,405 teachers of primary and secondary schools in Spain to investigate how the teachers' attitudes towards using ICT in their out-of-classroom work was related to the teachers' self-reported professional use of the internet outside of the classroom. The questionnaire was a range of open-ended and Likert-style questions. Menese et al. found positive attitudes towards ICT were related to how often they accessed the internet, educational ICT training, and their self-reported competence. Likewise, negative attitudes were negatively related to these three variables. Teachers with more positive attitudes towards ICT who had participated in (reportedly useful) courses for using ICT in education, indicated a higher self-reported competence, and considered their school as more developed organisationally, were likely to use the internet more frequently (both within the school and outside of the school).

Beliefs and perceptions regarding ICT

Teacher beliefs are related to how they teach. Nespor (1987) created a framework of teacher beliefs that was based on research with eight teachers that involved interviews and video of the classrooms. Nespor considered beliefs in terms of their structure, their uses, and their function. The structure of beliefs incorporated six features that were sorted into two groups. Tthe first four – presumptive labels that incorporated a set of assumptions, alternative realities reflecting ideal renderings of the situation, emotional responses and associated value, and remembered critical experiences – described beliefs as separate to knowledge, and the last two – disparity in individuals' beliefs and the variability of connectedness to the world – described how beliefs could be structured. Nespor found these features influenced teachers when creating activities and tasks for the classroom and their remembrances of past activities and experiences. As a result of the nature of teaching, particularly the complexity and variety, Nespor stated that teachers have to rely on their beliefs and that researchers interested in finding out what happens in the classroom needed to accept the effect of teachers' beliefs.

In their discussion of teachers' visions and beliefs, and how these might impact on their actions regarding the incorporation of ICT within their teaching, Albion and Ertmer (2002) focused on the connections between experiences, beliefs, and behaviours as a way to increase ICT use in teaching. They proposed that teachers needed to experience using ICT as a precursor to changing their beliefs regarding the use of ICT in their teaching. This was seen by Albion and Ertmer (2002) as particularly important due to the resistance to change of teacher beliefs and visions.

However, they noted that these experiences with ICT needed to incorporate opportunities for teachers to try out technology in a way that did not jeopardise the learning of their students.

Teacher beliefs can also affect their perceptions regarding the use of ICT in education. Jimoyiannis and Komis (2007) conducted research into teacher beliefs and perceptions of ICT in education in Greece. One of the reasons for their study was their supposition that "teachers' attitudes towards ICT in education have a significant influence on ICT adoption and implementation behaviours in the classroom" (p. 151). For the 1,165 preschool, primary, and secondary teachers, Jimoyiannis and Komis found common beliefs and perceptions regarding ICT use in education. The survey research was conducted at the completion of basic ICT skills training that was conducted as part of the larger Teachers' Training on ICT in Education (TTICTE) project. Positive beliefs relating to the training program they had completed, integrating ICT in education, and the potential of ICT within education, were found. Personal factors were found to be related to the teachers' beliefs and perceptions, with the subject the teacher taught in and the length of time they had been teaching, having an effect on teacher beliefs. In addition, Jimoyiannis and Komis found that one aim of the TTICTE project, to increase awareness of ICT use in teaching, was not achieved as the survey indicated that the teachers did not change their view of ICT to encompass more than the technological aspect.

Research with eight teachers of elementary or secondary students who had been awarded for the quality of their teaching with ICT by Ottenbreit-Leftwich, Glazewki, Newby, and Ertmer (2010) investigated teacher value beliefs and how they were connected to teachers' use of ICT. Ottenbriet-Leftwich et al. used interviews, observations, and work samples collated via electronic portfolios to find out why and how ICT were used by teachers and what teaching and learning goals the teachers stated they would address with ICT (which Ottenbreit-Leftwich et al. used as a measure of the teachers' value beliefs). The findings showed links between the teachers' use of ICT and their value beliefs. ICT was used to benefit students – to improve student learning of difficult subject matter, to improve student engagement and motivation, and to develop student ICT skills. The teachers' value beliefs concerned the potential of ICT to enable the teacher to meet student needs.

Ottenbreit-Leftwich et al. proposed that these results indicated that ICT professional development for teachers should demonstrate how using ICT would achieve the value beliefs of the teacher in their classroom. Ottenbreit-Leftwich et al. referred to these two professional development foci as “translation activities” (p. 1332) and “application activity” (p. 1332).

In their investigation of the relationship between the educational beliefs of the teacher and their use of computers in their classroom, Tondeur, Hermans, van Braak, and Valcke (2008) surveyed 574 elementary school teachers. Four teacher profiles were identified via cluster analysis based on the teacher responses to two questionnaires concerning their educational beliefs. The resultant profiles were strongly both constructivist and traditional, strongly constructivist only, strongly traditional only, and weakly both constructivist and traditional. When the types of computer use reported by the teachers was compared by teacher profile, Tondeur et al. (2008) found that teachers within the both strongly constructivist and strongly traditional profile reported the most use of the computer to gather and present information, for practice and learning, and to develop basic computer skills. Teachers categorised as strongly constructivist had the next highest levels use of the computer to gather and present information, and for practice and learning, but the teachers within the both weakly constructivist and weakly traditional profile had higher mean scores for using the computer to develop basic skills. Significant differences were not evident in computer use for the teachers in the strongly both constructivist and traditional and strongly constructivist profiles, nor were they evident for the teachers in the strongly traditional and weakly both constructivist and traditional. Tondeur et al. (2008) suggested that the high mean scores for each of the computer use categories for the both strongly constructivist and strongly traditional profile may have been due to the relationship between a broad belief base and willingness to use ICT in a variety of ways.

Ertmer, Ottenbreit-Leftwich, and York (2006) surveyed 25 teachers who were identified as exemplary users of ICT through winning technology teacher awards in their state. The questionnaires enabled the investigation of factors that exemplary teachers considered most influential in their successful use of ICT, whether teachers identified critical factors that were intrinsic or extrinsic, and whether these exemplary teachers shared characteristics that were connected to their use of ICT. Ertmer et al. (2006) found the two factors that teachers rated most influential overall were inner drive and personal beliefs. This result was reflected in the finding that intrinsic factors were, on average, rated higher than the average for extrinsic factors. Other intrinsic factors that Ertmer et al. (2006) found included confidence and commitment, with commitment to helping their students' learning being the factor indicated as most influential for teachers to use ICT. In addition, Ertmer et al. (2006) found that teachers moved along an experience continuum, and that this experience was related to the number of factors that the teacher indicated were influential, though pre-service education had the lowest rating of all factors.

Teacher perceptions of the use and benefits of ICT in teaching can affect teacher intentions regarding ICT use. Teo (2011) used an online self-report questionnaire containing Likert-style questions to survey 592 primary and secondary teachers from 18 primary and 13 secondary schools in Singapore to investigate relationships between the teacher's intention to use ICT and teacher perceptions of the usefulness and ease of using ICT, attitudes towards ICT use, intention to use ICT, perceived expectation to use (incorporating subjective norms), and conditions that would facilitate the use of ICT. He found that the intention to use ICT was directly influenced by the teacher's perception of the usefulness of ICT, their attitude towards using ICT, and the conditions that would facilitate the use of ICT. Attitude towards using ICT was affected by the perceived usefulness of ICT, which was in turn affected by the perceived expectation to use ICT.

Teachers' perceptions can relate to their skills with ICT and the usefulness of ICT. Inan and Lowther (2010) investigated the factors related to teacher use of laptops in their classroom instruction with 379 teachers working in kindergarten to Year 12 classrooms at 76 schools receiving Freedom to Learn grants. Their research focused on teacher perceptions of teacher factors and school factors. These factors were grouped into teacher factors such as their perceptions of their own skills and their beliefs regarding the impact of laptops on student learning and achievement and school factors such as the technological support and resources within the school, opportunities for professional development and training within the school, and support from the school community. Inan and Lowther (2010) also considered the interaction of school factors and teacher factors. They found that the teacher factors had the most influence and that this influence was direct and considered critical to the teachers' integration of laptops in the classroom. School factors had an indirect effect that was moderated by the teacher factors.

Erixon (2010) used focus groups in his study of 23 Swedish teachers at a lower secondary school to investigate teachers' use of ICT in their teaching and the impact they believe the ICT use had on content, classroom interaction, pedagogy, and the teacher's role. He investigated how the use of ICT would change teaching in terms of the way the essential components of the subject, which in turn may be affected by how ICT impacted on the contextual possibilities by challenging what Bernstein (1996/2000, as cited in Erixon, 2010, p. 1213) referred to as classification and framing. He found that teachers' views on whether ICT was compatible with content of the subject, would benefit student engagement and interest in their school work, influenced teacher and student dialogue in a way that was beneficial to the subject, and impacted on who controlled the content and educational discourses affected teachers' views on whether ICT should and would be used in their lessons. If teachers considered that ICT was not compatible with the subject, did not positively influence teacher and student dialogue, or affected control of content and educational discourses in a way that was incompatible with the subject, then ICT would not be used by the teacher. However, Erixon (2010) found there was a contradictory relationship within teachers, where they generally viewed ICT positively but were opposed to incorporating ICT within their teaching.

Gialamas and Nikolopoulou (2010) surveyed 248 Greek pre-service and 240 in-service early childhood teachers to obtain their views of ICT and their intentions to use ICT in their teaching. They focused on the perceptions, beliefs, and views of the pre-service and in-service teachers as these impacted on intentions to use and on actual use. Gialamas and Nikolopoulou found that views about ICT use were strongly related to intentions to use ICT in the classroom and computer self-efficacy was positively related to intentions to use ICT. In addition, they found the pre-service teachers had higher computer self-efficacy and the in-service teachers had rated higher regarding views regarding and intentions for integrating ICT in the classroom.

Teacher perceptions can affect the potential effects ICT may have. Ma, Andersson, and Streith (2005) considered that if ICT was used to its potential, then it had the capacity to change school by enabling students to control their learning and become more proactive through using higher level thinking skills to assess and evaluate the information that they could access. In addition, Ma et al. proposed that students could be more competent with ICT than their teachers. However, the first point in ICT use in education was whether teachers would use ICT in their teaching. As a result, Ma et al. surveyed 84 pre-service teachers using Likert-style questions to gather information on the pre-service teachers' perceptions regarding ICT use. Ma et al. found that the perception of how easy the ICT was to use influenced the perceived usefulness of the ICT, which then influenced the intent to use ICT.

In her study of the use of ICT by early career secondary science teachers in Western Australia, Dawson (2008) investigated the teachers' perceptions of the impact of their pre-service teacher education, what factors contributed to or diminished the use of ICT, and which ICT were used more frequently or less frequently. A Likert-style questionnaire was completed by 33 teachers and telephone interviews were conducted with 12 teachers. The teachers' perceptions of which ICT university most prepared them to use were the same or shared components with four that they used most frequently – the ICT the teachers were most prepared to use were the internet, Word documents, email, and PowerPoint, and the most frequently used were Word documents, the internet for research, email, and PowerPoint with a projector. This link was also evident for the ICT teachers felt least prepared to use and, in turn, used least, with the four ICT that university least prepared them to use when teaching were four of the five ICT they used least when teaching. Most teachers responded positively to factors related to their ICT beliefs, skills, and confidence, school factors such as culture and support from technical staff and peers, student ICT skills, and access to resources such as the internet and computers. Other factors rating highly in terms of contributing to ICT use were teacher factors – their self-perceived ICT skill and confidence. Two of the other three factors rated highly in terms of diminishing ICT use were more student-related – ICT skills of the students and managing behaviour and the other was technical support.

Teacher perceptions also incorporate their perceptions of their abilities, and these have been found to relate to and affect actual ability. Bandura (1977) refers to the focus of self-efficacy as being not on the actual skills but on what the individual perceives their skills will enable them to do and the level of success they will achieve. As a result, self-efficacy incorporates the individual's perception of their skill and their perception of what they can do with their skill rather than a measure of the actual skill level. Although this research does not investigate self-efficacy, it does investigate what teachers and students perceive their competency in the use of specific ICT to be. It also investigates their confidence in their use of the specified ICT.

Teacher self-efficacy is related to the teacher's perceptions of their skills as a teacher. In their review of teacher self-efficacy, Tschannen-Moran, Hoy, and Hoy (1998) stated that teacher self-efficacy has the capacity to influence beyond the teacher themselves. In addition, it can change from task to task or learning area to learning area. Tschannen-Moran, et al. (1998) also stated that teacher self-efficacy is not a measure of a teacher's actual competence and is therefore not an indication of the teacher's actual skills. However, they consider teacher self-efficacy an important aspect when dealing with teacher skills as the teacher's perceptions could be an overestimate or underestimate their abilities, and, either way, this would then impact on what they decide to do.

Teacher views on integrating ICT into their teaching can be affected by self-efficacy, teaching self-efficacy, and computer self-efficacy. In their research investigating 727 pre-service teachers' teaching and self-efficacy beliefs and their computer self-efficacy and beliefs and the impact of self-efficacies and beliefs on prospective integration of ICT in China, Sang, Valcke, Braak, and Tondeur (2010) found that pre-service teachers who had stronger constructivist beliefs, higher teaching efficacy, higher self-efficacy in computers, and more positive attitudes regarding the use of computers in education, were more likely to indicate their intention to use computers in their teaching in the future. They did not find differences based on gender in pre-service teacher intentions to integrate computers into their teaching, which Sang et al. stated could reflect the intent of the teacher education program to ensure teachers could integrate ICT in their teaching.

Self-perceived ability in ICT can affect teacher use of ICT. Hsu (2010) described self-perceived ICT ability as the person's conception of their skills, knowledge, and competency regarding ICT and their ICT usage as how frequently something is completed, particularly in terms of behaviour or performance. This description was similar to computer self-efficacy but it incorporates a more cognitive aspect. Hsu (2010) constructed two instruments to measure self-perceived ICT ability and how often ICT was used to investigate the relationship between teachers' perceptions of their ability and the frequencies with which they used ICT in their classroom teaching. Teacher self-reported ICT integration competency focused on six areas regarding the ICT itself, using ICT appropriately (in terms of ethics and legalities), being professional and productive in ICT use, and using ICT in the preparation, teaching and assessment involved in classroom teaching. The instruments were administered to 3,729 Grade 1 to 9 teachers at 334 Taiwanese schools. Overall, Hsu (2010) found that the teachers' self-reported competency in ICT was related to the teacher's reported use of ICT, which she suggested was indicative of teachers with higher ICT abilities using ICT more in their classrooms.

Another teacher factor that is similar to computer self-efficacy and self-perceived ability in ICT involves teacher perceptions of their competence in ICT. In his investigation of the relationship between teacher perceptions of their competence, pedagogical beliefs, and classroom use of digital media, Petko (2012) surveyed 357 secondary school teachers in Switzerland. He used the framework of teachers having a positive attitude towards the use of ICT in the classroom, the skills to use ICT within the classroom, and appropriate access to ICT for use in the classroom to interpret the results from the online survey of 357 teachers at 15 schools. Petko found that the teachers access to and exposure to ICT that most related to using ICT in the classroom. Specifically, the use of ICT in the classroom was correlated with the number of computers the teacher had access to in the classroom, the teacher's self-reported competence for teaching with ICT, the teacher's self-reported personal use of ICT, the teacher's ability to engage in reflection concerning media use in teaching, agreement that students needed ICT knowledge, and the belief that ICT supports student learning. Weaker correlations were found with the teacher's reported estimation on how effective and practical it was to use ICT in the classroom, the teacher's constructivist beliefs, and how much the teacher used ICT in teaching.

Connections have been found between teacher perceptions of their confidence and competence and the ICT used in the classroom. Waite (2004) surveyed primary school teachers at West Country primary schools in 1998 and 2001 to determine if changes had occurred in the teachers' aim for using ICT in their literacy lessons. The questionnaire incorporated Liker-style questions and open-ended questions and received 312 responses. She found that the percentage of teachers reporting themselves as fairly confident or very confident increased in all age groups and both male and female teachers. Waite also found a change over time in the aims of computer use in the literacy class, with the top reported aim of computer use being practice in 1998 and the top reported aim of computer use was cooperative work for 2001. The most often reported software used for both 1998 and 2001 was document processing software, though Waite proposed that this similarity between the two years was due to the availability of the technology during both time frames. However, Waite stated that teachers found it difficult to create opportunities to incorporate and implement ICT initiatives into their teaching and classrooms and that success will be achieved when teachers will acknowledge the need to incorporate ICT as part of their job as teachers.

Teacher confidence in ICT was also related to their thoughts about ICT use in teaching. In her study of 10 pre-service teachers and 9 experienced teachers, Smarkola (2008) found that the pre-service teachers had a fairly high level of confidence and valued the role of ICT in education. However, when asked how they would incorporate ICT when teaching, their answers focused on the internet. The experienced teachers had a similar confidence rating to the pre-service teachers. They also specified a wider range of ICT rather than the internet and focused more on subject-specific software.

In their study of 578 teachers working in Cyprus public elementary schools Papanastasiou and Angeli (2008) used the survey of factors affecting teachers teaching with technology (SFA-T3) questionnaire to find out about teachers' use of and self-confidence in using ICT. All information was self-reported, and included questions regarding which ICT were used, how often the ICT was used, how well the ICT was known, and how confident they were in using ICT in the classroom. These questions were all Likert-style, with teachers providing responses on a five-point scale. Their findings indicated teacher reported knowledge and use of ICT in both their teaching and non-teaching lives, their attitude towards and confidence with ICT, their beliefs regarding ICT as a change agent, and the ICT resources and available support in their school all related to how successfully ICT was integrated.

Menese et al. (2012) surveyed 1,405 primary and secondary school teachers to assist with their testing of a model that could predict teacher ICT use. Questionnaires were used to collect the data, with data for the teachers' digital proficiency focused on the internet and utilising a self-reported measure of competence. Menese et al. (2012) found that, when school information and socio-demographic data were controlled, technology factors such as access frequency and access location, the teachers' ICT skills and attitudes, and organisational development factors such as the establishment of goals for improving teaching and learning and the creation of systems for monitoring and evaluation, were related to both the teacher using ICT with students in a supportive way and the teacher using ICT in their management.

The teacher's perceptions of their ICT skills and competence with ICT have been connected to the types of activities they use ICT for with their students. Hinostroza, Labbe, Brun, and Matamala (2011) surveyed between two and six teachers of grades 6 or 10 and 6 to 16 students in the same two grades at each of 8839 Chilean government and 198 private primary and high schools to find out what teaching and learning activities, with and without ICT, were engaged in and the level at which the teachers' and students' rated their perceptions of their ICT skills. They found that teacher ICT use was similar across schools and grades but the student activities in which ICT were used were different in primary and secondary schools, with students in primary school reporting greater use of activities involving contributions to the community and reflection of their own learning experiences and strategies. However, although teachers reported similar uses of ICT, the secondary school teachers and students had higher self-reported ICT skills than primary school teachers and students. When lower and higher performing schools were compared, there were differences in teacher ICT use and student use, with student presentation activities more frequently in higher performing schools and collaborating with students from outside of the school and evaluations (both tests and self or peer evaluations) more frequent in lower performing schools .

Pedagogy

Pedagogical beliefs held by teachers have been found to interact with other factors that influence teacher use of ICT in the classroom. Zhao, Pugh, Sheldon, and Beyers (2002) conducted multiple case studies of ten teachers of kindergarten to Year 12 classes to investigate the factors that affect the implementation of innovative ICT projects within their classrooms. Zhao et al. (2002) considered that the impact of integrating ICT in a classroom can vary from situation to situation for the one teacher, let alone a whole profession. Furthermore, the teacher's technological proficiency needs to incorporate an aspect of knowing what was required to *enable* the technology to work as the teacher desired. Factors that Zhao et al. (2002) linked to teachers successfully implementing new ICT into their classroom were strongly related to how the teacher saw the technology. Successful teachers were more likely to view technology "as the means to an end, rather than an end itself," (p. 493) and to see "an intimate connection between technology and the curriculum." (p. 493), rather than limiting technology to "peripheral functions, such as adding novelty to teaching," (p. 493). Zhao et al. (2002) also found that, although most teachers in their study reported to be proficient in basic computing applications, this proficiency decreased as the applications became more advanced.

Hennessy, Harrison, and Wamakote (2010) reviewed literature on primary and secondary teachers' use of ICT in sub-Saharan Africa to investigate factors that influenced teacher use of ICT. They found that teachers used ICT to improve teaching and learning but this use could be reduced or non-existent when there were issues regarding access, a lack of appropriate teacher ICT skills or the opportunity to develop them (such as collegial support or coverage in teacher education programs), or a lack of teacher confidence in using ICT. How ICT was used was also a factor, with a teacher focus on using ICT to present student work rather than to enhance student understanding or a lack of teacher recognition or willingness to adapt pedagogically to make the most of ICT for learning and teaching, being found to correspond to teachers not using ICT.

Compatibility between pedagogical beliefs and ICT use was discussed further by Underwood. In her review of the impact digital technologies have had on education, Underwood (2009) proposed that every ICT affects learning opportunities for students, and it is these opportunities that should determine whether an ICT should be used. In addition, Underwood (2009) stated that ICT had the capacity to change student behaviours. These changes were related to the way students could engage in the learning process and how students could share their learning with other students. However, Underwood stated there needed to be a coherency between the teacher's pedagogy and how the ICT was or could be used, with teachers more likely to use those ICT that can be incorporated into their existing practices. Underwood highlighted the consequence that this could bring – where teachers would not use ICT that would require changes in their teaching – particularly the potential stagnation of ICT use by teachers. She proposed that careful consideration was needed to ensure that teachers will use ICT that suits their pedagogy but also that they will change their pedagogy to use ICT.

Pedagogical beliefs have also been found to interact with other factors. Prestridge (2012) stated that that whether nor not teachers use ICT in the classroom will be dependent on the level of congruence between their pedagogical beliefs and their beliefs regarding how ICT can be used as a teaching tool, how it will help students achieve the learning outcomes, and the teacher's perceptions of their own competence and confidence. A total of 48 teachers at four Catholic schools in Australia completed the questionnaire. In addition, eight of the teachers who completed the questionnaire were also interviewed and had their curriculum documents analysed. Prestridge found there were connections between the level teachers were allocated regarding their use of ICT and their demonstration of their understandings and beliefs regarding ICT integration. The two teachers in the foundational level used ICT at either a basic level or when another teacher taught. The two teachers in the developing level used pre-existing activities that incorporated ICT, often as a tool, in a mostly teacher-directed way. The two teachers in the next level both considered themselves competent with ICT and expressed the desire to use ICT with their students to help them develop ICT skills for the real world, and were focused on developing their students' ICT skills. The two teachers in the final level merged ICT and learning to create an environment where the students worked collaboratively, with a focus on this learning rather than of learning how to use ICT. Overall, Prestridge stated that there were connections between the teachers' self-reported competence and confidence with ICT and how they used ICT in their classrooms. The teachers at the lower level of competence and confidence were less likely to use ICT in their classroom, and when they did, they were more likely to focus on learning the ICT itself rather than learning with the ICT.

Pedagogical practices have been connected to how ICT is incorporated into the classroom. As part of the SITES Modue 2, Kozma (2003) reviewed 174 case studies from 28 countries where each case study examined classrooms that incorporated technology using what Kozma termed innovative pedagogical practices. He found there were similarities between the cases, such as the teachers changing from holding all of the information to providing students with access and ways of using information. In addition, he found that the impact of ICT on student learning is greater when used for research projects than when technology was used as a tool or a tutee. However, he proposed that student learning has not been investigated thoroughly and that, together with how ICT is used in the classroom, these should be the focus of further research.

In examining the connection between teachers' pedagogical beliefs and their integration of ICT into their teaching and the impact of external barriers on these connections, Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012) conducted case studies with 12 teachers who were identified through their winning of technology awards and the level of student-centred approaches identified through an initial analysis of their websites. Ertmer et al. (2012) conducted semi-structured interviews with the teachers and analysed the teachers' websites, then compared these data to determine the relationship between teacher pedagogical beliefs and their integration of ICT into their teaching. Eleven teachers used ICT in ways congruent with their pedagogical beliefs. ICT was used in three ways - to help their students develop appropriate ICT skills and access content, to enrich the curriculum through using ICT to help students to learn and to demonstrate their learning, and to transform their teaching and learning through the use of ICT to engage with the learning and with the world they will move into. Although the twelfth teacher wished to use ICT to help her students develop appropriate ICT skills and to enrich the curriculum, she had limited access to ICT resources.

Specific ICT have been found to interact with pedagogical practices. In their research investigating the effect of interactive whiteboards on pedagogy in Australian primary school classrooms, Way, Lilley, Ruster, Johnco, Mauric, and Ochs (2009) discussed five studies that had been completed. All studies involved teachers who used the interactive whiteboards in their classrooms, with several also including other staff or professional development educators and two including students from the classroom. Several commonalities were noted for the results over the five studies – the use of the interactive whiteboards increased student enjoyment or engagement with the tasks being undertaken, the desire of teachers to learn more about how to use the interactive whiteboard in their classrooms, and the complexity of the relationship between the interactive whiteboards, the content of the lesson, and pedagogy.

Student Factors

Student factors can affect how ICT is used. Students experience the world beyond the classroom and bring these experiences into the classroom. These experiences interact with those within the classroom. This section considers these experiences, as well as the attitudes students have towards ICT, their perceptions of their skills and of ICT, and their confidence.

Prior ICT experience

Initial discussions focused on the expected differences between the ICT experiences of students and teachers. Prensky (2001) coined the phrase "digital natives" (p. 1) to describe the generation of students who have grown up with access to ICT. This access, Prensky stated, has resulted in differences in how students want to learn and what they want to be able to learn with, and this means how teachers communicate and what they communicate (ie. the content) needs to change accordingly. However, teachers who have grown up without the ready access to ICT are like "digital immigrants" (p. 3). As digital immigrants, Prensky believed they find it difficult to value the ways digital natives wish to learn and how to incorporate ICT to enable their learning preferences to be enacted. This creates a mismatch between the teacher and the learner, with ICT having the potential to be both an area of connection and disconnection between them.

In situations where students know more than teachers about the ICT used in the classroom, Beardon and Way (2003) proposed that ICT use in the classroom could encourage a more open-ended environment. However, this environment could both enable students to gain more control and result in the teacher having less control. This could result in students further developing their ICT skills, beyond those of the teacher, but also provide opportunities for students to achieve beyond what was expected. Goldman (2003) echoed Beardon and Way (2003), proposing that students may bring ICT skills and knowledge that are greater than that of the teacher in their classroom. This could result in teachers believing they did not have control of the classroom and the teaching and learning within it.

Attitudes towards ICT

Attitudes, practices, and self-reported ICT skills have been found to be connected. In their study of the self-reported ICT skills, practices, and attitudes of 515 Finnish students at 25 schools, Hakkarainen, Ilomaki, Lipponen, Muukkonen, Rahikainen, Tuominen, Lakkala, and Lehtinen (2000) found that although gender differences were evident in some ICT skills, all students had a positive disposition towards using ICT for collaborating with other students in tasks involving thinking and in their school work. They also found that younger female students had a strong positive attitude towards both ICT and, in particular, for using ICT as a tool in their learning. In addition, a large proportion of students (particularly male) rated themselves as mastering ICT and were involved in helping maintain ICT at their school or helping other students or their teachers in ICT tasks. However, students reported that they were not using ICT daily, though this may have been due to computers being within a laboratory and therefore not accessible for all teaching and learning activities in the classroom.

Attitudes towards ICT and perceptions of ICT were investigated to determine whether they were related to gender. In their examination of the attitudes and perceptions of Grade 6 students towards ICT to determine whether there would be a gender effect, Bain and Rice (2006/2007) conducted research with 59 students (29 boys and 30 girls) at one school. They administered surveys to the students and the students kept computer logs of their use of ICT at home (both the activities undertaken and time spent). In addition, Bain and Rice conducted classroom observations, created field notes, teacher checklists of observed student interactions, and collected student work. No significant gender differences were found for attitudes and perceptions of ICT or for how ICT was used. Overall, the students' attitudes towards ICT were positive and they reported enjoyment in using ICT at school and home and in learning how to use other ICT.

Volman, Eck, Heemskerk, and Kuiper (2005) studied four primary and three secondary Dutch schools to investigate whether student gender and ethnic differences would exist in their participation, the skills developed, achievement of learning outcomes, attitudes towards, and approaches to the specified ICT applications. Participants used the specified ICT applications and completed two questionnaires that asked questions on general ICT use and on the specific ICT applications used for the research. Interviews were also conducted with two teacher-selected male and female students from each class to investigate how students had used and worked with the application, as well as the twelve teachers, who provided information on how the applications had been used and what they perceived were any differences in the students who had worked with the specified ICT applications. Volman et al. found that, overall, students had a positive view of ICT and a third considered that ICT would improve their work opportunities in the future. Gender differences were not found but when considered in terms of their responses, boys were found to state higher interest in, to be more knowledgeable, and to know more than the teacher regarding ICT.

Perceptions regarding ICT

The usability of student perceptions of their ICT competence has been investigated for secondary school students. Lennon, Kirsch, Von Davier, Wagner, and Yamamoto

(2003) conducted a feasibility study on assessing secondary school student ICT skills and practices. The study was designed to provide both an analysis of the processes involved in creating the assessment and analyses of the data collected. The data collection incorporated both tasks that students completed and a follow-up questionnaire asking how the ICT used in the tasks reflected the ICT they normally used. They collected data via the software used by students for the task (that is, the software collected data related to what and how the student used the ICT), questionnaires to collect data on student demographics and familiarity with ICT, and observation of student behaviours. Overall, the use of tasks to determine student skills was deemed successful, particularly the multiple sources of evidence, but there were issues such as capturing and storing student actions and behaviours when using the ICT, developmental time, and functionality of the underlying ICT that was used as a platform for the simulations. Even though this study recognised the importance of, and recommended students work through a skills test as a measure of competence, a questionnaire requiring students to report their perceptions was still utilised. For the PISA 2006 ICT familiarity questionnaires, student perceptions of their use of ICT were also collected (OECD, 2009a).

The relationship between self-reported competence and access to ICT was investigated by Zhong (2011). In his study using ICT self-assessment data from the 2003 and 2006 Program for International Student Assessment (PISA) together with data on ICT penetration for each of the countries, Zhong (2011) investigated the relationships between self-reported competence, ICT penetration, and educational factors, and family factors to determine whether relationships exist between these factors. As Zhong explained, PISA is a standardized assessment conducted internationally and administered to 15 year old school students to assess reading (in the primary language of the country), mathematics, science, and ICT use. Due to the analysis used, only 16 countries with all country-level variables were included in the analysis. Overall, Zhong reported that ICT penetration was negatively associated with student self-reported competence with ICT, which Zhong proposed may be reflective of students perceiving that the adult competence was greater than theirs due to the adults' ability to master ICT skills. He also considered that the impact of culture, specifically collectivist cultures, could create a more modest response from students. Zhong found that 2003 data did not show significant interaction between

ICT penetration and access of ICT at school, whereas 2006 data did, while a significant interaction between ICT penetration and access to ICT at home was found for 2003 data but not for 2006. Zhong found that family factors have a greater impact than school factors on student self-reported competence in ICT, but that supportive social networks such as those available via the internet are needed for internet connectedness. However, in his final point, he expressed some reservations regarding the PISA 2003 and 2006 self-reported measures.

Student perceptions of their ICT skills was considered in terms of their use of ICT and their attitudes towards ICT. Tomte and Hatlevik (2011) analysed the Finnish and Norwegian data from both PISA 2006 and the ICT survey conducted as an additional part of PISA 2006 to determine whether there were relationships between student reported self-efficacy in using ICT (considered similarly to confidence), student use of and attitude towards ICT as indicated by their user profile for ICT (OECD, 2009a), gender, and nationality. User profiles considered whether students accessed ICT for either leisure or education rarely, monthly, or frequently, and from this, nine profiles were created (OECD, 2009a), of which Tomte and Hatlevik examined six. These six were the three levels of leisure access with rare educational access, monthly leisure and educational access, and frequent educational access with either frequent or rare leisure access. Student confidence in using ICT to complete tasks involving the internet and tasks involving programs (but not accessing the internet) was measured (OECD, 2009a). Tomte and Hatleyik (2012) used the data by viewing self-efficacy as evident when students indicated they had high confidence in tasks related to the internet or to using programs. They found that self-efficacy in tasks involving the internet increased with reported use of ICT for leisure and self-efficacy in tasks involving software increased with reported use of ICT for either leisure or education. Norwegian males in all profiles and Norwegian females in all but one profile (monthly access to ICT for educational and leisure purposes) had higher self-efficacy for both tasks than Finnish participants.

In Australia, Ainley, Fraillion, Gebhardt, and Shultz (2012) discussed the comparison of results of student perceptions of their ICT skills for completing a range of specified tasks and their actual achievement in the ICT simulation component in the NAP – ICT Literacy from the 2011 iteration. The students' perceptions of their skills were converted to an ICT self-efficacy scale, and when the students' placement on this scale was compared, gender differences were not evident. Differences were found when the Year 6 and Year 10 results for the total group and for males and females were compared, with the Year 10 students placing higher on the ICT self-efficacy scale. When the ICT self-efficacy scale was used to divide the Year 6 and Year 10 students into low, medium, or high placements, strong relationships were evident with the ICT simulation component measuring ICT skills. This relationship was positive, with students within the low group from the ICT self-efficacy scale not performing as well as those in the other groups from the ICT self-efficacy scale.

Research into the relationship between student self-efficacy, computer self-efficacy, and perceptions of locus of control has been conducted. Broos and Roe (2006) used questionnaires to investigate how self-efficacy and locus of control were related to how 1,145 Flemish students aged 13 to 17 year old from 29 secondary schools used or did not use ICT. The questionnaires collected demographic and family information and measured the students' general self-efficacy, their self-efficacy with the internet and computers, and their general and computer locus of control. Broos and Roe found that the strongest predictors in their final model for using computers were the students' anticipated occupations and the students' self-assessment of their computer skills and expectations of success when using computers. Likewise, they found that the strongest predictors in their final model for using the internet were the students' anticipated occupation and the students' self-assessment of their skills with the internet and expectations of success when using a computer, though students who had higher general self-efficacy were likely to use the internet less often. Although gender did not predict computer or internet use in their models, Broos and Roe found significant gender differences in self-efficacy for both computer and internet use, expected and perceived lack of computer control, and anticipated occupation status, with boys scoring higher for the first three and girls scoring higher for the last two variables.

Student attainment

Student use of ICT was connected to several student factors in a study by Waite, Wheeler, and Bromfield (2007). They focused on seven Year 6 students to investigate how student factors affected the use of computer programs. Observations of the students were conducted each week and the students were interviewed at the end of the school year. Assessments conducted by their teacher were obtained and the students were observed with ICT and asked to provide a report on their proficiency with ICT. Waite et al. found that there were gender differences in the most frequently used programs and that the students in the high attainment group used programs more than the other students. When learning gain (measured by comparing the end of Year 5 with the end of Year 6) was compared between the students, those classified as high attaining achieve greater gains than those students classified as medium attaining, who had greater gains than the students classified as low attaining. Waite et al. proposed that these higher-attaining students also used their home computers for a wider variety of tasks than the lower-attaining students and suggested that higher-attaining students could adapt better to different ways of using ICT and therefore could achieve more when using ICT than students who were lower-attaining.

The impact of ICT on student attainment is affected by how ICT is used by students. Kolikant (2010) discussed how there seems to be inconsistencies with how ICT is presented to students, with the risk that some educational authorities want students to be able to use it but ICT was not being sufficiently used in the classroom. This is juxtaposed with the high level of ICT use at home by these students, but these ways of using ICT were not valued at school. Kolikant saw this as creating the potential to disconnect students from the educational experience at school, particularly if the students believed their ICT enabled learning outside of the classroom was more valuable than non-ICT learning within the classroom. However, he stated that the research evidence so far was split between this view and the belief that students valued learning at school, regardless of ICT use. Kolikant conducted interviews with 25 students who had participated in a previous research project investigating student perceptions of their use of ICT and their own learning. The students were in Year 8, 10, and 11 classes that had participated in previous research that had classified the

Year 8 and 11 classes as teacher-centred and the Year 10 class as learner-centred. Kolikant found that the Year and class classification did not have an effect. He found that students saw the internet as a less legitimate source of information than books when the information was needed for serious work. The majority of students also considered that their generation was less able to learn than the pre-ICT generations, with one fifth of the students seeing schooling as the reason and the others seeing the reliance and use of ICT as the reason for the discrepancy. In addition, almost half of all of the students interviewed saw the internet as dis-empowering as it made school work less challenging through the ease of access to information decreasing the need to develop study skills.

ICT used

The availability of laptops and their potential to be used both within the classroom and outside of the classroom was investigated by Ilomaki and Rantanen (2007). They provided laptops to 18 lower secondary Finnish students over three years to investigate how access to the laptop at home and school would relate to their ICT skills and competence, their beliefs about their expertise in ICT, the participation in ICT tasks and activities, their classroom environment and their participation in the classroom activities. Semi-structured interviews, ICT skills tests, and questionnaires regarding their views on their ICT skills were used to obtain data to classify the student as either expert in ICT, advanced ICT users, or non-interested ICT users. Ilomaki and Randanen found that the students allocated to the expert in ICT group (6 students), half could be viewed as "technically oriented experts" (p. 130) as they were interested in the technology itself and three could be viewed as "socially oriented experts" (p. 130), as they were interested in using the ICT to create something. The advanced ICT users were more likely to use ICT as a tool rather than for using the ICT itself. The non-interested ICT users were only interested in developing basic ICT skills. When ICT skills, tasks, self-assessment of ICT skills, and intentions for using ICT in the future were compared across the three groups, the expert group was higher than both of the other groups in all measures, and the advanced ICT users were higher than the non-interested ICT users in all but the intentions for using ICT in the future.

Hsu (2011) administered a questionnaire to 3,729 teachers at elementary and junior high schools to obtain data on teacher use of ICT and the types of assessments utilising ICT that were given to students. When data concerning the types of ICT used by teachers were analysed, Hsu (2011) found that teachers used document processors and the internet regularly for such activities as creating materials, finding information and materials, and creating presentations to show students. The most frequent ICT utilised for student assignments were using the internet for information gathering or document processors for creating products. Overall, Hsu (2011) found that teachers who used ICT more also set more assessments with ICT, that teachers who used higher level ICT were more likely to set more student-centred assignments, and that more complex ICT was used less by teachers.

The possibilities of using different ICT were highlighted by Herrington and Kervin (2007) in their presentation of ten ways for incorporating ICT into authentic learning for learners ranging from lower primary school through to teachers. The potential of ICT to create authentic contexts and tasks was demonstrated with examples that showed how to give students access to expert opinions and multiple perspectives, to enable students to gain greater depth of understanding via collaboration and reflection, to provide students with appropriate support through effective scaffolding and assessment, and to enable students to share their learning through effective articulation. They reiterated the necessity of the teacher and students being fully aware of the rationale behind the task before the potential generated through the use of ICT as cognitive tools could be realised. However, Herrington and Kervin stated that the control of the ICT was likely to move from the teacher to the students, which could threaten the traditional roles and relationships between teachers and students.

Student perceptions of ICT

Just as teacher perceptions of ICT impact on ICT use, so do student perceptions of ICT impact on ICT use. Deaney, Ruthven, and Hennessy (2003) conducted 27 focus group interviews at six English secondary schools with students in years 8, 10, and 12 to investigate their views on ICT use within teaching and learning. The focus was to investigate their experiences with ICT, whether ICT was helpful for their learning, and how ICT use might change their learning. Deaney et al. found that students commented on the efficiencies created by ICT use (though this was impacted by the students' proficiencies), the ease of editing, the change to routine enabled by using ICT (though they realised that ICT would start to become routine), increased motivation and interest from using ICT in lessons (though proficiency in ICT use was needed for this to occur), the immediacy of being able to experiment and interact with content when learning, and a reduced interaction with the teacher due to more interaction with the ICT. Deaney et al. concluded that although the students' recognition of ICT as important in helping their "engagement with the processes of learning" (p. 162), the teacher's role in selecting the appropriate ICT for the lesson and learners was still central.

Goodison (2002) reported on the perceptions of how 15 Year 2 students and 15 Year 5 students (aged 7 and 10 respectively) from the same school in the UK learned with ICT. The semi-structured interviews were conducted by the classroom teacher in a group setting with the researcher observing. Goodison found that the students learned how to use computers at both home and school, and that they transferred learning from one location to the other. When faced with problems with ICT, the students reported that they would try to solve it if assistance wasn't available. Similarly, if they didn't know how to use a specific ICT that they needed or wanted to use, they would search for a way to find out how to use it. When students were questioned about the productivity using ICT would provide, comments focused on the difficulties that arose if they couldn't use the specific program but also that if they knew the program, they liked to use it to its full potential over completing the requirements of the task. Both groups of students considered that ICT could make lessons enjoyable in some instances and that, overall, they benefitted from using ICT. Goodison found students stated that when the Smartboard was used, the teacher became more of a facilitator, was appreciated by the students. In addition, the creation of a more collective learning experience when the Smartboard was used was also noted by students.

Student perceptions of ICT in education were seen by Gerjets and Hesse (2004) as having the potential to impact on the effectiveness of powerful learning environments. They highlighted the impact that expectations could have on the user's perceptions of the usefulness of ICT in education. These expectations applied to elements of the ICT itself, how users should use the ICT, and how these two combine to create efficiencies and learning affordances. As a result, Gerjets and Hesse concluded that student perceptions of ICT and its use in education, which included their expectations, would interact with the learner activities within a powerful learning environment. This interaction could influence and be moderated by the control given to the learner, as they would determine what ICT would be used and how it would be used within the activities.

Learning Environment

The learning environment can be considered in terms of its structure and type. This section will discuss research that investigates the relationships between the structure of the learning environment and ICT as well research that considers the relationship between the learning environment itself and ICT.

Structure

The physicality of ICT use stretches beyond the classroom. In their review of research concerning the use and adoption of technology and their relationships to physical and virtual locations, Leander, Phillips, and Hendrick Taylor (2010) viewed the classroom as both a container but also "not an isolated container, but positioned in a *nexus of relations* to other such locales (p. 336, italics in original). As a result, Leander et al. (2010) proposed that classrooms "are seen less as parking lots and more as intersections" (p. 336). However, Leander et al. (2010) stated that the learning space created by the classroom had the potential to become larger with the introduction of ICT, though this could be restricted by the control exerted by the teacher, the school, and the community. Similarly, in their research investigating how children aged 11 to 16 years used ICT in their everyday lives, Valentine and Holloway (2001) proposed that children's ICT use for online interactions was connected with their real world and vice-versa. These connections enable children to interact beyond their existing physical world and to apply and use their skills from each world into the other.

The use of structure within the learning environment has been found to affect ICT use. Rasmussen, Krange, and Ludvigsen (2003) investigated the impact of two environments, one highly structured and one open-ended, where secondary school students worked together in groups using ICT in a science class. The highly structured environment was characterised by Rasmussen et al. as where the teacher determined the resource to be used by the students and there were many teacher-student interactions where the teacher poses a question or makes a statement, the student responds, and then the teacher gives feedback. Rasmussen et al. described the open-ended environment as incorporating an open-ended task where the teacher introduced the resources and task and the students had choices in what to do and how to present it. They found that both environments involved the students clarifying the task, but that the students in the structured environment also sought teacher authorisation of their thinking and processes. The students in the open-ended environment also clarified the use of resources, and as a result, Rasmussen et al. proposed that this indicated differences in how the students gained an understanding of the content.

Type of learning environment

In their discussion of the Catalyst Initiative that addressed secondary and tertiary innovation in science, technology, engineering, and mathematics (STEM) education, Kärkkäinen and Vincent-Lancrin (2013) highlighted the irreplaceable nature of ICT when developing educational experiences that have the capacity to "improve not just traditional learning outcomes, but also motivation, social, behavioural, thinking and creativity skills and their assessment" (p. 23).

The use of ICT can affect the learning environment within which it was used. Smeets (2005) surveyed 331 teachers of students aged 11-12 years (corresponding to Grade 8) in primary schools in the Netherlands to investigate learning environments in the last year of primary school, how ICT was incorporated, and what factors contributed to the use of ICT. Three-quarters of the teachers rated their ICT skills as good or quite good and 93% of teachers reporting that ICT was used in their lessons, with students using it for an average of 55 minutes per week. Just over half of the teachers reported ICT was used often or quite often in their classroom. Smeets (2005) found that when ICT use was compared in terms of the type of applications used, open-ended applications were used more than skill-based applications. Skills-based application use was related to teachers who rated themselves more confident with ICT and affirmed that ICT contributed to both curriculum differentiation and independent learning. Open-ended application use was related to teacher-created powerful learning environments, access to more computers, higher teacher self-reported confidence, when the teacher believed ICT would help create active and autonomous learning, and the teacher being male. Smeets described the powerful learning environment as those where authentic tasks with rich contexts are presented in a way to encourage autonomous, active, cooperative learning that can support an adapted curriculum to cater to individual students.

Iiyoshi, Hannafin, and Wang (2006) described the interaction of cognitive tools and student-centred learning in their framework. Their focus was on how the use of the cognitive tool would affect the classification of that tool. The classification of how tools were used included gathering information, presenting information in a way that assists the learner in their understanding, organising and managing knowledge to impose structure, integrating the new knowledge with their prior knowledge, and generating new ways of interpreting or representing their knowledge. Iiyoshi et al. proposed that the use of cognitive tools would assist student-centred learning as it would help by supporting the students, but that these tools would also benefit in other learning such as teacher-directed. However, the provision of these tools needed to be made with forethought to ensure the tool was appropriate for the context, content, and other lesson-specific requirements.

The level of interaction (that is, whether the interaction is with all students or a subset of students) can affect the exchanges between the participants within the lesson. Beauchamp and Kennewell (2010) discussed the relationship between interactive technology and interactive pedagogies when lessons were conducted at the whole-class level, with students working in groups, and with students working individually. They proposed a framework to analyse interactivity when ICT was used in these three groupings, which incorporated the actions of the teacher and students, how teachers and students interacted with each other, interactions between students, and interactions between teachers or students and the ICT. If the ICT is interacted with by the student, Beauchamp and Kennewell proposed categories to describe the interactivity, with the level of control of the student increasing over the four. Beauchamp and Kennewell also noted that student ICT skills needed to increase over these four categories, and the type of questioning employed by the teacher would change due to the nature of the interactions between the teacher, student, and ICT. They concluded that for ICT to be used at the highest categories of interactivity, students needed to be skilled ICT users and teachers needed to be able to let the students have more control.

The types of learning opportunities, and the potential learning enabled within those opportunities, could also be affected by ICT use and student perceptions of that use. Gerjets and Hesse (2004) described powerful learning environments as environments that "at least in principle enables, elicits or affords effective learning activities and, second, that learners use the opportunities provided by the environment and actually engage in these activities" (p. 447, italics in original). In their review of research investigating the impact of learner activities and student perceptions of ICT in education on powerful learning environments, Gerjets and Hesse stated that these environments required activities that were "(1) constructive and cumulative, (2) authentic and understanding-based, (3) cooperative, and (4) self-controlled and goal-oriented" (p. 448, italics in original), and although ICT was considered well-placed to provide these activities, it was not an essential aspect of the activities. However, Gerjets and Hesse stated that as cognitive load is incorporated into powerful learning environments, ICT could be used to decrease or reduce cognitive load, with risks that ICT could increase cognitive load if not used well. Another aspect of powerful learning environments was the high level of learner control that enables choices in how the resources (including ICT, when incorporated) were used and the activities are completed. These two factors together indicate the importance of ensuring that when ICT was incorporated into the activities, that they are used to improve learning rather than to embellish learning with unnecessary flourishes.

Maher (2012) investigated how the interactive whiteboard impacted on the interactions within two primary school classrooms at an Australian primary school. The focus of the investigation was the teacher-student and student-student interactions when the interactive whiteboard was used in literacy lessons for the

Grade 3 and Grade 4 classes. The ages of the students ranged from 8 years old to 11 years old. Maher compared two of the six lesson observations and two of the four where the electronic whiteboard was used. The first observation was described by Mayer as being more traditional, with the teacher at the front of the class next to the electronic whiteboard and fulfilling a role as the driver and centre of the dialogue and no student to student interaction. During the second observation, the teacher sat within the class and a student stood at the front with the electronic whiteboard. Both the teacher and the student had control of the electronic whiteboard via a keyboard. Maher described the students as interacting with each other without the teacher mediating the interactions or ideas. In addition, he noted that during the first observation, the teacher asked mostly clarifying questions that required limited responses, whereas during the second observation, the teacher asked questions to get them to think about their responses. Mayer also reviewed student responses from the questionnaires and noted that students referred to the use of the electronic whiteboard encouraged discussion amongst the students and encouraged them to share their ideas.

Hennessy and London (2013) proposed that electronic whiteboards were a powerful tool that could be used with the whole class, for group work, and for intensive remedial work. The potential interactive nature of electronic whiteboards was highlighted as one of the features that made it a valuable resource. However, the speed at which they were placed in classrooms resulted in their incorporation before professional development could be created and conducted. Hennessy and London stated that the use of electronic whiteboards fitted into the teachers' existing pedagogical approaches or beliefs, unless professional development had been provided that enabled new approaches to be taken. This resulted in some uses involving more constructivist approaches whereas others maintained a "transmission style of whole class teaching in which the contents of the board multiply and go faster, whilst students are increasingly reduced to a largely spectator role" (p. 12).

Summary

The school environment has been found to be related to the use of ICT in classrooms. Strong school leadership (Baylor & Ritchie, 2002) and positive school culture

(Tearle, 2003) were identified as impacting on the success of ICT use in classrooms, with traditional schools more likely to use ICT in teacher-centred ways Salimi & Ghonoodi, 2011). Appropriate policy and support were required for ICT to be incorporated as part of pedagogical change (Trinidad et al., 2005), with support incorporating expertise from a curriculum ICT coordinator (Tondeur et al., 2010) and opportunities to learn how to use ICT as a precursor to using ICT successfully in their classroom (Guha, 2003; Hayes, 2007).

Teacher exposure to ICT (Hughes, 2005), positive experiences with ICT (van Braak et al., 2004; Mueller et al., 2008), and positive perceptions of the benefits of incorporating ICT (Zhao & Frank, 2003) all increased the likelihood of teachers using ICT in their classrooms. Teacher attitudes towards ICT, both in terms of using it in their classroom (Rogers, 2000; Tezci, 2009) or outside of their classroom (Menese et al., 2012), were also found to relate to their use of ICT in their classrooms. Teachers also had to have beliefs congruent with ICT use in the classroom (Albion & Ertmer, 2002). Believing that ICT had potential in education (Jimoyiannis & Komis, 2007) and that using ICT was part of teaching and benefitted students (Ottenbreit-Leftwich et al., 2010) were also related to teachers using ICT in their classroom. Stronger teacher pedagogical beliefs, whether constructivist or traditional, positively affected ICT use (Tondeur et al., 2008) Ertmer et al. (2006) found inner drive, personal beliefs, confidence, and commitment all positively related to ICT use in the classroom. Teachers needed to see ICT use in the classroom as useful (Teo, 2011) and links had to exist between using ICT and the content being taught (Erixon, 2010). Teachers needed to believe they had the skills to use ICT (Gialamas & Nikolopoulou, 2010; Inan & Lowther, 2010), to perceive their skills with ICT as sufficient for use ICT in the classroom (Dawson, 2008; Hsu, 2010; Ma et al., 2005; Petko, 2012; Sang et al., 2010), and were confident with ICT (Hinostroza et al., 2011; Papanastasiou & Angeli, 2008; Smarkola, 2008; Waite, 2004) before they would use it. The use of ICT also needed to be congruent with their pedagogical beliefs (Ertmer et al., 2012; Prestridge, 2012; Zhao et al., 2002) or to be willing to change their pedagogy (Hennessy et al., 2010; Kozma, 2003; Underwood, 2009; Way et al., 2009).

Prensky (2001) proposed students would be more familiar with ICT than their teachers, which Beardon and Way (2003) and Goldman (2003) agreed with. However, Kolikant (2010) found students considered their generation were less able to learn than pre-ICT generations. Students were likely to have a positive view of ICT (Bain & Rice, 2006/2007; Hakkarainen et al., 2000) and be interested in using ICT (Volman et al., 2005). Student perceptions of their ICT skills have been used as indicators of skill (Lennon et al., 2003; Tomte & Hatlevik, 2011; OECD, 2009a), with strong relationships found between their perceptions and their tested skills (Ainley et al., 2012). Student ICT skills affect how much they use ICT (Ilomaki & Rantanen, 2007) and use of ICT impacts on the potential learning benefits, with skills in ICT needed before gains are found (Waite et al., 2007). Students perceive ICT as beneficial if they knew how to use the ICT (Deaney et al., 2003) or used the ICT (Goodison, 2002), though their expectations of what ICT could be used for could impact within the learning environment (Gerjets & Hess, 2004). However, it was the teacher's decision regarding how ICT would be used, and this then impacted on student use of ICT (Herrington & Kervin, 2007; Hsu, 2011).

The classroom within which ICT is used are part of the learning environment and the learning space can be expanded through ICT use (Leander et al., 2010). Open-ended environments, where students had choice in aspects of their tasks result in students interacting differently with the teacher when ICT was used as they sought less authorisation but clarified ICT use (Rasmussen et al., 2003). Kärkkäinen and Vincent-Lancrin (2013) proposed that ICT use enabled improved thinking and creativity, with Smeets (2005) finding that more teachers with higher confidence in ICT provided more open-ended environments. This could contribute to more student-centred environments, particularly when cognitive ICT tools were used (Iiyoshi et al. 2006).When students were skilled ICT users, if teachers gave them more control in the lesson, a greater level of interactivity between the students and ICT was obtained (Beauchamp & Kennewell, 2010). Gerjets and Hesse (2004) proposed that effective use of ICT was to reduce the cognitive load for students as this would enable more powerful learning environments with more constructive and authentic activities to be created. However, this could be affected by the physical environment, such as the positioning of the ICT and the teacher (Maher, 2012), which could impact on the interactivity of the environment (Hennessy & London, 2013).

CONCLUSION

There were two ways that ICT use in classrooms was viewed. The first was whether the focus was on learning the ICT itself. Tondeur et al. (2007) described these as for basic skills, to obtain information, or for learning. This theme was evident with Pelgrum and Schipper (1993), who referred to learning about computers and learning with computers. Ananiadou and Claro (2009) distinguished these as ICT skills and ICT competencies. The second was whether ICT was used to replace another non-ICT resource, to amplify an aspect of the lesson, or to transform the lesson (Hughes, 2005). Peeraer and Van Petegem (2012) used a similar framework, with their first level involving replacement or assimilation, the second level enhancing teaching, the third level incorporating innovation and changes to more student-centred teaching, and the last level transforming teaching and learning.

Whether ICT was used in the classroom and how it was used in the classroom was related to teacher and student factors. Teacher factors included their perceptions of the benefits of ICT (Jimoyiannis & Komis, 2007), their beliefs about their skills with ICT and particularly their skills to use ICT in the classroom (Inan & Lowther, 2010; Petko, 2012), and their confidence in using ICT (Hinostroza et al., 2011; Smarkola, 2008). Student perceptions about the usefulness of ICT in education (Deaney et al., 2003) and their perceptions of their skills (Tomte & Hatlevik, 2011) were affected by how ICT was used (Ilomaki & Rantanen, 2007). The classroom environment was related to the teacher perceptions and student perceptions, with open-ended environments more likely with confident teachers (Smeets, 2005) and teachers giving control in the classroom when students were more skilled in ICT (Beauchamp & Kennewell, 2010).

The next chapter will discuss the research methodology used to investigate how teacher and student perceptions of ICT and their competence and confidence with ICT relate to ICT use in primary school classrooms. The chapter will outline the ontological and epistemological approaches within which the research is grounded.

In addition, the theoretical perspective from which the methodology, method, and data collection methods are drawn and how the data will be analysed will be provided.

CHAPTER 3

METHODOLOGY

INTRODUCTION

This chapter describes the methodology used to investigate the factors related to the use of ICT in upper primary classrooms. Specifically, the research aims to answer questions regarding the frequency of behaviours observed when ICT is used and when it is not used, the teacher and student perceptions of ICT use in the classroom, the teachers' self-reported competence and confidence in ICT use, and the students' self-reported competence and confidence in ICT use. As shown in Figure 3.1, the description connects the ontology and epistemology and provides the theoretical perspective in which the methodology, method, and data collection methods are drawn. How the data are analysed is then discussed in terms of the research questions and data collection methods.

Ontology
Epistemology
Theoretical perspective
Methodology
Method
Data Collection Methods
Analysis

Figure 3.1. The framework for situating the research, based on Burrel and Morgan (1979, as cited in Cohen, Manion, & Morrison, 2002, p. 7), Crotty (1998, p. 4), Punch (2004, p. 67), and Creswell (2009, p. 68).

The research is situated within a framework that combines Burrel and Morgan's scheme for analysing assumptions about the nature of social science (1979, as cited in Cohen, Manion, & Morrison, 2002, p. 7), Crotty's four elements model (1998, p.

4), and Punch's (2004, p. 67) final stage of research (split into the two final parts in a similar way to Creswell (2009, p. 68)) to provide an examination of the ontological, epistemological, theoretical, and methodological perspectives that drive the methods used (see Figure 3.1). However, although Crotty (1998) viewed ontology and epistemology as likely to "sit alongside" each other (p. 10), they will be considered in terms of a hierarchical relationship such as proposed by Burrel and Morgan (1979). This is in contrast to the worldview that Creswell (2009) and Heron and Reason (1997) used as a combination of ontologies and epistemologies, though the reason behind the use of both ontologies and epistemologies will become apparent later. Additionally, as Greene and Caracelli (1997, as cited in Creswell, Plano Clark, Gutmann, & Hanson, 2003, p. 232), stated beliefs behind research should be explicitly stated. Nonetheless, as Rowbottom and Aiston (2007) proposed, it is a complicated interrelationship that exists between ontologies and epistemologies.

RESEARCH APPROACH

Punch (1998) stated that there should be a confluence between "the paradigm, the research questions, perhaps also the conceptual framework, the study design, the data collection procedures and the data analysis procedures" (p. 22). Furthermore, methodological choices should be driven by a combination of "what we are trying to find out, considered against the background of the context, circumstances and practical aspects of the particular research project" (Punch, 1998, p. 61). However, how we view what is being investigated is influenced by our view of reality (Heron & Reason, 1997) and thus is determined by our ontological position (Lincoln & Guba, 1994), in a similar way to what is "evidence" is predicated by our epistemological perspective (Sandberg, 2005). These need to "arise together" (Crotty, 1998, p. 11) and govern the theoretical perspective that is taken, and through this, the methodology and methods undertaken to gather the evidence.

The purpose of the research was to investigate the teacher and student perceptions of ICT use in the classroom, the teachers' self-reported competence and confidence in ICT use, the students' self-reported competence and confidence in ICT use, and the frequency of behaviours observed when ICT is used and when it is not used. For this to be considered worthy of investigation, the actions and beliefs of the individuals need to be seen as both part of the environment and apart from the environment – with individuals capable of determining their own behaviours and beliefs whilst existing in a world external to themselves. The contemplation of individuals as both creating their view of the world (that is, their perception of reality) and being part of an existing world (the reality at the time their perceptions are obtained) is based on the constructivism ontology (Crotty, 1998; Guba & Lincoln, 1994; Healy & Perry, 2000; Sale, Lohfeld, & Brazil, 2002). The interaction of the teachers and students within the classroom reflect the "interaction among individuals … within the specific context" that Creswell (2009, p. 8) stated is an aspect of constructivism. This suits the view of the classroom and ICT existing beyond the interaction of the teachers and students within the classroom and with ICT. The reliance on this ontology, and the later embedding within the social constructionist epistemology, reflects the fluidity that Bryman (2004) allocated to research methods.

The decision to situate the research within the social constructionist epistemology within the constructivism ontology can be argued (Sandberg, 2005). Crotty's (1998) discussion of the differences between constructivism and social constructionism reflected how the ontology and epistemology are viewed within this research. He sees constructivism as "the unique experience of each of us" (p, 58), suggesting "each one's way of making sense of the world is as valid and worthy of respect as any other" (p. 58). Social constructionism, however, "emphasises the hold our culture has on us: it shapes the way in which we see things (even the way in which we feel things!) and gives us quite a definite view of the world" (Crotty, 1998, p. 58). This distinction is significant for this research as it situates the move away from the individual perception to the interaction of the individual and the world in which they exist. Although Heron and Reason's (1997) participatory inquiry paradigm promoted "a worldview based on participation and participative realities" (p. 275), this research is within the constructivism ontology and social constructionism epistemology, rather than Heron and Reason's (1997) subjective-objective ontology and critical subjectivity and four ways of knowing epistemology, as the chosen ontology and epistemology have a greater emphasis on the individual.

Willig (2001) stated social constructionism proposes "human experience, including perception, is mediated historically, culturally, and linguistically … what we perceive and experience is never a direct reflection of environmental conditions but must be understood as a specific reading of these conditions" (p. 7). Furthermore, social constructionism investigates "implications for human experience and social practice" (Willig, 2001, p. 7). The investigation of the relationship between teacher and student ICT self-reported competence and confidence with ICT, perceptions of the importance of ICT in the primary classroom, and the observations of students' behaviour during lessons using ICT is in congruence with Creswell's (2009) discussion of social constructionism and pragmatic epistemologies.

Crotty (1998) identified several assumptions underlying social constructionism – "meanings are constructed by human beings as they engage with the world they are interpreting" (p. 43), "engaging in reality and making sense of it … in quite different ways" (p. 47). However, "no object can be adequately described in isolation from the conscious being experiencing it, nor can any experience be adequately described in isolation from its object" (p. 45), even though "the object may be meaningless in itself but it has a vital part to play in the generation of meaning" (p. 48) as "the meanings emerge from the … interaction" (p. 48). The internalising of the "what, why, and how" of ICT use by teachers and students, their self-reported confidence and competence, and their views on ICT use in teaching and the classroom is embedded in this epistemology.

Merriam (2009) proposed that social constructivism informs interpretive research and "interpretive research, which is where qualitative research is most often located, assumes that reality is socially constructed, that is, there is no single, observable reality. Rather, there are multiple realities" (p. 8). The interpretivist approach, as described by Crotty (1998), "*looks for culturally derived and historically situated interpretations of the social life-world*" (p. 67, italics in original) demonstrates the connection to social constructivism. Cohen, Manion, and Morrison (2002) stated interpretive approaches "focus on action" (p. 22), which "may be thought of as behaviour-with-meaning; it is intentional behaviour" (p. 23). An interpretive perspective provides "multi-faceted images of human behaviour as varied as the situations and contexts supporting them" (Cohen et al., 2002, p. 23).

The collection of sufficient evidence "with what works" (Creswell, Plano Clark, Gutmann, & Hanson, 2003, p. 231) via "many approaches for collecting and analysing data" (Creswell, 2009, p. 11) is necessary to enable the interpretation of the behaviours of the participants. Specifically, this research observed participants within their classroom and asked participants questions about how they behave in their environment, rather than removing them from their environment. The research also incorporated the observation of the behaviour of the participants within their environments as well as questionnaires and interviews to gain insight into the reasons for their behaviours. Additionally, documentation regarding the context was obtained to help situate participant responses. As discussed later, the sequence of the different data collection methods was established to ensure the greatest opportunity that the participants were fully cognisant of their environment. Patton's (2002) proposal that "it is possible, using empirical evidence, to distinguish between more and less plausible claims … getting as close as possible to what is really going on in whatever setting you are studying" (p. 93) supports multiple data collection to examine what is occurring, and Patton's (2002) proposal was echoed by Merriam (2009).

RESEARCH DESIGN

Anderson and Arsenault (2004) proposed that educational research "is a disciplined attempt to address questions or solve problems through the collection and analysis of primary data" (p. 6). As shown in Figure 2, the ontologies, epistemologies and theoretical perspective lead to the selected methodology and the methodology drives the data collection and analytical choices (Bryman, 2004). Punch (2004) outlined the two main approaches for research – qualitative and quantitative – with Bryman (2004) affirming qualitative data enables "access to the perspectives of the people they are studying" (p. 459) whilst quantitative data enables researchers "to explore specific issues in which they are interested" (p. 459). The methodology for this research is neither and both qualitative and quantitative, rather it is what Johnson and Onwuegbuzie (2004) described as mixed methods research, "*where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study*" (p. 18, italics in original). The use of multiple ways of collecting and analysing data without being limited to only using qualitative methods or only using quantitative methods is also reflective of what Creswell describes as within the pragmatic worldview as the research "draws liberally from both quantitative and qualitative assumptions" (Creswell, 2009, p. 10).

Even though the methodology was conducted to reflect what Johnson and Onwuegbuzie (2004) called "*across-stage mixed-model designs*" (p. 20, italics in original), the terminology mixed methods was used as it is more prominent in the later literature (for example, Creswell, 2008, 2009; Lincoln & Denzin, 2011) and reflected the use of quantitative and qualitative data collection methods individually or mixed within different stages of the research. This research situates the mixed methods methodology within the constructivism ontology and social constructionist epistemology (as shown in Figure 3.2), coinciding with Lincoln and Denzin's (2011) recommendation of the use of a single paradigm, to create a "coherent and resonant" (p. 716) connection with the purpose of the research.

There were challenges associated with the research design. The initial challenge involved the finding of a methodology that would "recognise" the capacity of individuals to construct their own view of the world from their participation within it whilst recognising the context in which the individual exists. As discussed above, this statement reflects constructivism (Crotty, 1998; Guba & Lincoln, 1994; Healy & Perry, 2000; Sale, Lohfeld, & Brazil, 2002) and social constructionism (Crotty, 1998). The interpretive approach also suited the beliefs behind the research as it recognised the situated-ness of individual interpretations of the social life-world (Crotty, 1998) as well as "behaviour-with-meaning" (Cohen, et al., 2002, p. 23). Additionally, the importance of removing or reducing researcher influence on the data collected restricted the protocol to one well-ordered contact with each class. However, whilst the protocol was strict, the potential variability increased due to the intentional lack of direction from the researcher. This necessitated the use of multiple case studies to fully understand the data and to give credence to the interpretation (Merriam, 2009). As shown in Figure 3.2, mixed methods were selected as the method for this research as it suited the purpose of the research by allowing a range of data collections to be used.

The second challenge was gaining access to an appropriate sample of participants (Cohen et al., 2002), which involved obtaining agreement from participants to take part in the research. As discussed in the Participants section (on page 99), just over one third of the schools approached were able to participate in the research. Principals needed to agree, then the teachers needed to agree, which added to the difficulties due to time constraints (Cohen et al., 2002). For a variety of reasons, not all students in the classrooms of the participating teachers were involved in the research, with as few as seven students in one class participating (this is discussed further in the Sample section on page 97).

Ontology	Constructivism (Crotty, 1998; Creswell, 2009)			
Epistemology	Social constructionist (Crotty, 1998; Merriam, 2009; Willig, 2001)			
Theoretical perspective	Interpretive (Cohen, Manion, and Morrison (2002); Crotty, 1998; Johnson & Onwuegbuzie, 2004; Merriam, 2009; Willig, 2001)			
Methodology	Multiple Case Studies (Ary, Jacobs, & Sorensen, 2010; Merriam, 2009; Yin, 2009)			
Method	Mixed Methods (Ary, Jacobs, & Sorensen, 2010; Creswell, 2009; Creswell, 2011; Creswell & Plano Clark, 2011; Johnson & Onwuegbuzie, 2004; Merriam, 2009; Yin, 2009)			
Data collection methods	Likert-style questionnaires (Ary, Jacobs, & Sorensen, 2010; Bryman, 2004; Creswell & Plano Clark, 2011; Johnson & Onwuegbuzie, 2004)	Open-ended questionnaires (Ary, Jacobs, & Sorensen, 2010; Creswell & Plano Clark, 2011; Marriam, 2009)	Interviews (Anderson, 1998; Liamputtong, 2009; Marriam, 2009; Yin, 2009)	Observations (Ary, Jacobs, & Sorensen, 2010; Creswell, 2009; Cohen, Manion, & Morrison, 2002; Creswell & Plano Clark, 2011; Johnson & Turner, 2003; Marriam, 2009; Yin, 2009)
Analysis	Case studies (Merriam, 2009; Yin, 2009)	Cross case (Ary, Jacobs, & Sorensen, 2010; Yin, 2009)	Correlations and comparisons (Creswell, 2008; Ary, Jacobs, & Sorensen, 2010; Creswell, 2008)	

Figure 3.2. Ontology, epistemology, theoretical perspective, methodology, methods and analysis and the literature that significantly informed discussions and decisions.

Multiple Case Studies

Creswell (2007, as cited in Liamputtong, 2010, p. 191) considered case study research as both a methodology or design in qualitative research and a product of the investigation. In this research, two forms outlined by Patton (2002) - interviews and observations – together with questionnaires, were used to collect data. Data from these were combined to create each case at the classroom level as this provided a physical and social context with which to delineate each case and to provide clear operational definitions (Yin, 2009, p. 33). However, Yin (2009, p. 19) stated “case studies need not always include the direct and detailed observational evidence”. The eleven cases were then compared as it would enable greater understanding as “multiple units can provide better illumination” (Ary et al., 2010, p. 456).

Merriam (2009, p. 40) stated “a *case study* is an in-depth description and analysis of a bounded system … (and is) … both the unit of study (the case) and the product of this type of investigation” (italics in original). Multiple case studies are beneficial as “the more cases included in a study, and the greater the variation across the cases, the more compelling an interpretation is likely to be” (Merriam, 2009, p. 49). As stated previously, the case is defined at the classroom level as data were collected and analysed for each classroom.

Yin (2009, p. 18) provided a two-part definition of a case study that situates the investigation:

> within its real-life context, especially when … the boundaries between phenomenon and context are not clearly evident … (where) … there will be many more variables of interest than data points, … relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, … (and) benefits from the prior development of theoretical propositions to guide data collection and analysis”

Each classroom was a real-life context with the observed behaviours and ICT use both the phenomenon of interest and part of the context (Creswell, 2009; Liamputtong; 2009; Merriam, 2009; Olsen, 2004; Willig, 2001). More variables were present than those observed or collected and multiple data collection procedures were used to collect data from multiple sources (Creswell, 2009; Patton, 2002). The choice of data collected, the data collection method, and the analysis that was conducted were determined before the data collection phase. The consideration of data from both qualitative and quantitative data collection methods "goes beyond being a type of qualitative research, by using a mix of qualitative and quantitative evidence" (Yin, 2009, p. 19).

As well as discussing each individual case, the cases are compared to determine "the lessons from all of them" (Yin, 2009, p. 173). The multiple case studies were direct replications (Yin, 2009). The multiple case studies were conducted to compare the results of each of the case studies to determine similarities and differences in the case studies (Yin, 2009). Furthermore, themes across cases were investigated (Stake, 2006). Themes that emerged during the analysis of the cases were also used as comparison points for the case studies. The flexibility to explore these themes was possible due to the interpretive theoretical perspective, with the "theory arising" (Cohen et al., 2002, p. 23) from the analyses. The importance placed on maintaining a balance between "underanticipating and overanticipating" (Stark, 2006, p. 13) was evident from the structured questionnaires, the semi-structured interviews, and the unstructured observations. The use of multiple case studies enables the "collection of situated case activities in a binding of larger research questions" (Stark, 2006, p. 90). The factors interacting with the identified themes may emerge due to differences in the results of the cases or due to similarities in the cases.

Mixed Methods

The research has not "relegated qualitative inquiry to a secondary role" (Creswell, 2011, p. 277), it has determinedly and fully utilised mixed methods to provide the best opportunity to answer to the research questions (Creswell & Plano Clark, 2007). The use of mixed methods was situated with the interpretive theoretical perspective as it "utilized the strengths" (Ary, Jacobs, & Sorensen, 2010, p. 559) of both qualitative and quantitative approaches within "blends of paradigms, philosophical assumptions, and theoretical perspectives directly driven by the purpose of the study" (Ary et al., 2010, p. 561). Rather than the situation Alexander (2007) described where "the logic of illustration in education research precedes the logic of generalisation" (p. 128), which emphasises that the researcher will "understand ideals first through detailed examples of concrete cases, and only secondarily by means of abstract and universal covering laws" (Alexander, 2007, p. 128), this research was a fully mixed design defined by Ary et al. (2010), as it involved "mixing of the qualitative and quantitative approaches in an interactive way throughout the study" (Ary et al., 2010, p. 563). Even though quantitative approaches are not traditionally included within the interpretive perspective (Merriam, 2009), the insertion of the results of the qualitative data collection methods into the quantitative analysis and vice-versa slides the quantitative data collection method into the interpretive perspective as this was "what works" (Creswell, Plano Clark, Gutmann, & Hanson, 2003, p. 231). It also forges the fully mixed design, as described by Ary, et al. (2007).

The purpose of the research was to investigate the teacher and student perceptions of ICT use in the classroom, the teachers' self-reported competence and confidence in ICT use, the students' self-reported competence and confidence in ICT use, and the frequency of behaviours exhibited by students when ICT is used and when it is not used. The research is, as Ary et al. (2010) stated, studying both relationships and phenomenon. Relationships between self-reported teacher and student competence and confidence in specified ICT, students' behaviour during lessons with and without ICT, how the teachers use ICT in their lessons, the importance teachers and students place on ICT in the lesson observed, and the importance teachers and students place on teacher ICT skills as part of the role of a teacher were investigated, as was the use of ICT in the classroom by both the teacher and the students. Firmly embedded in this is an aspect of what Healy and Perry (2000) referred to as the perceptions "being studied for their own sake" (p. 120). The mixed method design fully utilised both qualitative and quantitative research methodology (Creswell, 2009), with data collected via observations, questionnaires, and interviews concurrently, thus meeting the criteria proposed by Creswell and Plano Clark (2011, p. 5):

- the research design combines procedures;
- the procedures are within one study;
- the different forms of data are mixed; and

- the research questions are answered through the use of both qualitative and quantitative data.

Qualitative

Merriam (2009) stated "the overall purposes of qualitative research are to achieve an *understanding* of how people make sense out of their lives, delineate the process (rather than the outcome or product) of meaning-making, and describe how people interpret what they experience" (p. 14, italics in original). Liamputtong (2009) described qualitative research as producing "data that are well grounded and provide 'thick' and rich descriptions and explanations of processes situated within particular contexts" (p. xiii). Of the eight reasons Liamputtong (2009) listed for conducting qualitative research, the following five are applicable for this research:

- exploration of the issue is needed;
- detailed understanding is required;
- settings or contexts are important;
- there is uniqueness about the situation or individual; and
- to help explain quantitative data.

Creswell (2009) stated "in many qualitative studies, inquirers collect multiple forms of data" (p. 178). He lists observations, interviews, documents, and audio-visual materials as data collection types. Patton (2002, p. 4) described the data available from three of these forms of data collection

> *Interviews* yield direct quotations from people about their experiences, opinions, feelings, and knowledge. The data from *observations* consists of detailed descriptions of people's activities, behaviors, actions, and the full range of interpersonal interactions and organizational processes that are part of observable human experience. *Document analysis* includes studying excerpts, quotations, or entire passages from organizational, clinical, or program records; memoranda and correspondence; official

> publications and reports; personal diaries; and open-ended written responses to questionnaires and surveys (italics in original).

The use of qualitative methods within the fully mixed methods design fits the specified ontological and epistemological views and the interpretive perspective. The interaction of the teachers and students within the classroom reflected the aspect of individuals' interactions within a context evident in the constructivism ontology (Creswell, 2009). The recognition of the fact that the teachers and students were "engaging in reality and making sense of it" (Crotty, 1998, p. 47) was embedded in the social constructionism epistemology. The use of observations recognised what Cohen et al. (2002) considered as the interpretive perspective of "behaviour-with-meaning … intentional behaviour" (p. 23).

Quantitative

Newman, Ridenour, Newman, and DeMarco (2003) defined quantitative research as "designed to address questions that hypothesize relationships among variables that are measured frequently in numerical and objective ways" (p. 170). Creswell (2008) listed the characteristics of quantitative research as "collecting and analysing information in the form of numbers … [by] … collecting scores that measure distinct attributes … [with] … an emphasis on the procedures of comparing groups or relating factors … in … correlational studies, and surveys" (p. 48). Quantitative research can involve the creation of theory around which data are collected (Bryman, 2004). Ary et al. (2010) saw the purpose of quantitative research as investigating "relationships, cause and effect" (p. 25) by either experimental research or non-experimental research (Ary et al., 2010).

Quantitative methods were used in this fully mixed methods design in the non-experimental research as outlined by Ary et al. (2010), specifically, the investigation of relationships between non-manipulated variables that have occurred naturally and have been gathered from data collected from the teachers and students through the use of questionnaires. The self-reported competence and confidence of teachers and students will be correlated to investigate whether there is a relationship between the competence and confidence within each participant and also between the confidence reported by the teacher and students and the competence reported by the teachers and students. Additionally, participants will be categorised on two variables collected via the questionnaires – whether they believe teachers should have skills in ICT and whether ICT was important to the lesson in which it was used – and this will be compared to their self-reported confidence and competence.

The investigation of the attitudes and beliefs of the participants sits within Creswell's (2009) description of constructivism and the questioning of what ICT was used for in the lesson with ICT was within Olsen's (2004) discussion of realism. Questioning participants about the ICT skills required of teachers demonstrated their perceptions of reality, an aspect of the social constructionism epistemology (Willig, 2001). Using survey questionnaires enabled participants to share "the reality of and influence of the inner world of human experience" (Johnson & Onwuegbuzie, 2004, p. 18). The collection of a range of data enabled the "multi-faceted images" that Cohen et al. (2002, p. 23) prescribed to the interpretive perspective.

Sample

The quality of the data increases with the number of responses, however, practicalities mean that a sample was used rather than a census (Punch, 1998). As discussed previously, the research is both qualitative and quantitative and, as Creswell (2005, p. 178) described, used "*purposefully selected* sites or individuals for the proposed study" (italics in original). Additionally, the use of multiple case studies using purposeful samples ascribes to the importance of what Sale et al. (2002) referred to as "small, purposeful samples" (p. 45). In this research, purposeful sampling was used to "intentionally select individuals and sites to learn or understand the central phenomenon" (Creswell, 2009, p. 204). The individuals were selected to meet specific criteria (as outlined in the next paragraph). It is also expected that principals, teachers, and students who respond will be those who are more highly motivated to answer questions about the topic.

The Catholic Education Office of Western Australia (CEO WA) was approached to enable the researcher to access schools within the Catholic sector, which is Western Australia's second largest education sector, "educating some 18% of all school-aged children in Western Australia" (*About Us*, n.d., para. 2). The Catholic education sector is a single, state-based system and, as such, "is unique to Catholic education in Australia" (*Our History*, n.d., para. 2), due to the four dioceses of Western Australia being overseen by the CEOWA, the administrative arm of the Catholic Education Commission of Western Australia (CECWA), and the CECWA itself (*Our History*, n.d.). Catholic schools in Western Australia have legal or mandated accountabilities to the Bishops of Western Australia, the Government of Western Australia, the Australian Government, and their local community (*Governance*, n.d.).

Advice was sought from a colleague within the sector to provide assistance in selecting schools that fit the profile below and on determining a school that could be approached to participate in the pilot study. The profile of the targeted schools involved the schools having:

- A computer lab or set of laptops with a ratio of 1 computer to 2 students or less. The ratio was used as it has the potential to impact in terms of access to resources (Akbulut, 2009) and how ICT is used (Smeets, 2005).
- Year 5 and 6 teachers who use ICT, particularly computers, in their lessons. This criteria was used as attitude to technology could impact results (Mueller, Wood, Willoughby, Ross, & Specht, 2008)
- Primary grades only on campus (rather than a combined campus with both primary and secondary classes) to reduce the potential impact of catering to a cohort with possible access to resources aimed at older students (Akbulut, 2009).
- A metropolitan location to reduce the potential impact of rural location on the data as this could impact on access (Hew & Brush, 2007).
- A school where only one class for each grade provided (referred to as "single stream") was taught in the school. The aim of this criteria was to maintain coherence between school sizes as schools with two or more streams would have a larger cohort and this could affect infrastructure (Akbulut, 2009).

Interestingly enough, several considerations used in allocating these criteria were borne out in later research. With regards to access to resources and a difference in access between primary and high school settings, Hinostroza, Labbe, Brun, and Matamala (2011) found there was a difference in access between cohorts on campuses catering to primary grades as opposed to secondary grades, as well as an impact of access on "students' self-perception of their ICT skills" (p. 1366). Matuchniak and Warschauer (2010) found that some rural locations had lower access to the Internet and to computers themselves.

Participants

All schools were single-stream schools in the Catholic Sector of Western Australia, that is, they only had one class in each grade. They were all located in the metropolitan area and had both grade 5 and grade 6 classes (where students were aged between 9 and 12 years). As part of the approval process for conducting research, the Catholic Education Office of Western Australia (CEO WA) required a list of schools that would be approached as locations for the research. Advice was sought from a colleague within the sector to provide advice on schools that fit the profile outlined above. Thirty schools were identified as fitting the profile and this list was submitted to CEO WA. Once approval was given by CEO WA, a pilot school was selected from the list provided. This school was selected as it fitted the profile and the principal was a former colleague of the researcher and was agreeable to having the research conducted in their school.

Table 3.1.

Summary of Cases

Case (school)	ICSEA	Students (Observed) Males	Students (Observed) Females	Students (Questionnaires) Males	Students (Questionnaires) Females	Location/s	Length of observation (mins)
				Grade 5			
A (1)	1006	13	14	7	9	Classroom	28
D (2)	950	4	4	4	4	Classroom	35
F (3)	1154	9	14	5	6	Classroom	73
G (4)	1047	14 (no ICT) 13 (ICT)	14 (no ICT) 15 (ICT)	14	13	Library, Laboratory	27
J (5)	1156	15 (no ICT) 18 (ICT)	9 (no ICT) 8 (ICT)	3	4	Classroom, Laboratory	62
Total		55 (57)	55 (51)	33	36		
				Grade 6			
B (1)	1006	9	11	5	3	Classroom	70
E (2)	950	14	10	14	10	Classroom	30
H (4)	1047	8	10 (no ICT) 11 (ICT)	8	11	Library, Laboratory	48
I (6)	1052	16	13	16	13	Classroom	26
K (5)	1156	11 (no ICT) 13 (ICT)	14 (no ICT) 1 (ICT)	6	6	Classroom, Laboratory	42
Total		58 (60 ICT)	57 (46 ICT)	49	43		
			Split Grades (grades 6 and 7)				
C (7)	1138	7	3	7	3	Classroom, Laboratory	82
Total		**120 (124 ICT)**	**115 (104 ICT)**	**89**	**82**		

Of the remaining 29 schools, 27 were emailed and asked to participate in the research (two schools were not contacted as relatives of the researcher either attended or had recently attended the schools). Of the 27 that were emailed, ten indicated that they may be able to participate, either during the last term of the 2009 school year or during the first term of the 2010 school year. Of the ten schools that indicated they may be able to participate, seven were able to do so – four with both year 5 and year 6 classes, one with only year 5, and two with only year 6 (note that the split grade class was incorporated into the year 6 data, changing the age range from 11 to 12 to 12 to 13). Table 3.1 provides a summary of the cases.

The number of students per school ranged from 181 (Case C) to 200 (Cases F, J, and K) (ACARA, n.d.). Four cases were in schools where the ICSEA was more than one standard deviation (ACARA, 2011) above average (Cases C [School 7], F [School 3], J [School 5], and K [School 5]). Cases D and E (both School 2) had the lowest ICSEA and the highest percentage of students in the lowest quartile (78%) (ACARA, n.d.). There were 5 cases for each grade and one case of a split grade (Case C) with both Grade 6 and Grade 7 students. All but one school (Case I) had a computer laboratory or area or trolley with laptops (Cases A and B, both School 1) in sufficient numbers for one computer between 2 student for the class (apart from Case C which was a small class). All observed classes had an electronic whiteboard (EWB) and classroom desktop computers (ranging between 2 and 6 per classroom).

Pilot Study

A pilot study was conducted to assess data collection methods before the main data collection phase was started. This was particularly important with the questionnaires, as the respondents would include 9 – 12 year old children and it was essential to test construct validity by verifying the students understood the language used and the processes involved in administering the questionnaires (de Leeuw, Borgers, & Smits, 2004). Another aspect of the trialling of the questionnaires was to determine whether the ICT items were appropriate in both language used to describe and the coverage of possible ICT that students and teachers might use (de Leeuw et al., 2009).

The overall process for data collection (that is, pre-observation interview with the teacher, observation of lesson using ICT, administration of student questionnaires, post-observation interview with the teacher, and administration of teacher questionnaires) was also investigated to establish if it was suitable and sufficient for the research questions under investigation (Patton, 2002).

The pilot test was conducted in third term of 2009 (see Cooke & Dawson (2012) for a discussion of the results). The class was a year six class with twenty students. The teacher was interviewed then one lesson where students used ICT was observed. When the observation was concluded, the students completed their two questionnaires.

<u>Observations</u>

As the teacher was asked to use ICT for the observation, the opportunities to explore differences between behaviours when ICT was used and when ICT was not used were not available. Consequently, it was not possible to look for the relationships between the behaviours exhibited by the students when ICT was used nor to look for relationships between the behaviours exhibited by the students when ICT was not used. As a result of this lack of comparison that became apparent from the pilot study, it was decided that for the main data collection phase teachers would be asked to use ICT for part of the observations and to not use ICT for part of the observation.

<u>Questionnaires</u>

Cronbach's alpha for the Likert-style Competence questionnaire for students was 0.87 and for the Likert-style Confidence questionnaire for students was 0.87. The scores provided for each item were averaged to provide a single Competence and a single Confidence rating. Respondents had been advised to not provide a rating for the ICT they did not use. Minor modifications were made to the questionnaires after the pilot study to improve the respondents' understanding of the terminology used for the specified ICT. The first modification involved including a section for the respondent to indicate whether they were male or female and the grade they were in. The second modification involved changing some of the ICT items, whilst maintaining the same response categories (Satisfactory, Competent, and Expert for competence and Highly Anxious, Confident, and Highly Confident for confidence). Table 3.2 below provides the list of specified ICT that were included in the pilot and final versions of the Likert-style questionnaire and the changes that were made.

Table 3.2

The Specified ICT Used in the Pilot Likert-Style Questionnaire and Final Likert-style Questionnaire

Pilot Questionnaire	**Final Questionnaire**	**Changes**
Desktop or Laptop	Desktop or Laptop	No change.
Electronic Whiteboard	Electronic Whiteboard	No change.
Palm computers	Mobile telephones	Changed to mobile telephones due to the similarity of palm computers and newer mobile telephones.
Overhead Projector		Removed.
Internet browsers (such as Explorer or Safari)	Internet browsers (such as Explorer or Safari)	No change.
Document Processors (such as Word, AppleWorks or Text Edit) programs	Document Processors (such as Word, AppleWorks or Text Edit) programs	No change.
Presentation software (such as PowerPoint or KeyNote)	Presentation software (such as PowerPoint or KeyNote)	No change.
Statistical Software or Database Software (such as Excel)	Statistical Software or Database Software (such as Excel)	No change.
Email or messaging programs (such as MSN)	Email or messaging programs (such as Microsoft Outlook, iChat, or MSN)	Expanded to include the examples Microsoft Outlook and iChat.
Photograph importing software Photograph or image software (such as PhotoShop)	Photograph and image software (such as importing software or Photoshop)	Combined.
Movie or DVD editing programs	Movie or DVD editing programs	No change.
	Social Networking programs (such as Facebook or MySpace)	New item added.
	Digital cameras or video recorders	New item added.
	Wikis, Blogs or Twitter	New item added.
	Vodcast, Podcast, video conferencing, or webinars	New item added.

Interviews

As both the pre and post interviews worked effectively in the pilot, the pre and post interview structure and the interview questions did not change for the main data collection phase.

DATA COLLECTION METHODS

The data collection methods used to investigate the factors related to the use of ICT in upper primary classrooms, specifically the teacher and student perceptions of ICT use in the classrooms, the teachers' self-reported competence and confidence in ICT use, the students' self-reported competence and confidence in ICT use, and the frequency of behaviours exhibited by students when ICT was used and when it was not used, are addressed below. Although there are multiple forms of data that can be collected (Creswell, 2009), not all were utilised for this research. For example, Patton (2002) stated the use of documents is beneficial, and certainly, a classroom environment has a plethora of documents, such as lesson plans, assessment rubrics, and work samples. However, the decision was made not to include these forms of data in this research as the focus was on the observed behaviours within the classroom and the self-reported confidence and competence, attitudes, and beliefs expressed by the participants. Therefore, three forms of data collection methods were utilised in this research – interviews, observations, and questionnaires. The data collection method, participants from which data were collected, and the aspect of the research question answered by the data, is outline in Table 3.3.

Table 3.3

Data Collection Method by Participant and Research Question Addressed

Data Collection Method		**Participant**	**Research Question**
Teacher Interview	Pre-observation	Teacher	RQ 2. Preference for using ICT. How ICT was intended to be used in the lesson.
	Post-observation	Teacher	RQ 2. Whether the students behaved as they usually do in a lesson with ICT. What the teacher believed the students learned from using ICT.

	Observed environment	Teacher and student	RQ 1. Student organisation when using ICT and when not using ICT
	How ICT was used	Teacher and student	RQ 1., RQ 2. How ICT was used during the observation.
Classroom Observation	Observed behaviours when ICT was used	Teacher and student	RQ 1. Student and teacher behaviour. RQ 1. The manner in which ICT is used in the classroom.
	Observed behaviours when ICT was not used	Teacher and student	RQ 1. Student and teacher behaviour.
	Likert-style questions	Teacher	RQ 3. Self-reported competence in the use of ICT. Self-reported confidence in the use of ICT.
Teacher Question-naires	Open-ended questions	Teacher	RQ 2. Whether primary school teachers should be able to use ICT in their lessons. Whether ICT skills are part of the role of the teacher: • The main ICT skills required for primary teachers. • The importance of ICT in their role as a primary school teacher.
	Likert-style questions	Student	RQ 4. Self-reported competence in the use of ICT. Self-reported confidence in the use of ICT.
Student Question-naires	Open-ended questions	Student	RQ 2. How important ICT was for the lesson. What the most important part of using ICT in the lesson was. Whether primary school teachers should be able to use ICT in their lessons.

Overview of Data Collection Process

Teachers and students were observed in the classroom and the physical organisation of the classroom during the observation was noted. Questionnaires were used to collect data from teachers and students on their self-reported competence and confidence with specified ICT. Students were also asked open-ended questions regarding ICT use in the classroom and whether they considered it important for teachers to be able to use ICT. Teachers were asked open-ended questions regarding which ICT skills they considered important for teachers, how important ICT was in the classroom, and factors that should be considered when teacher ICT skills were being assessed. Pre and post-observation interviews were conducted with the teacher to explore reasons behind the choices teachers' make in their use of ICT in the lesson and to determine their perceptions on how the lesson went.

The protocol used for data collection was sequenced to obtain all data in close temporal proximity and in specific order. The close temporal proximity was considered important due to the potential variability of responses the further students were from the lesson (Hannula, 2002), particularly when the aim of the research is to investigate the responses of the students and teachers towards ICT and the intent for the lessons themselves to enact a recency effect (Reis & Gable, 2000). Additionally, conducting more observations or administering more interviews was decided against due to the potential impact of different aspects of the research on the results of the data collected. The reality in which the research is situated exists only as the research is being conducted (Sale et al., 2002). Extending the research over distinct time periods could result in multiple realities for each case that have been influenced outside of the research and by the initial research itself. Furthermore, the results could be affected by the Hawthorne effect (Anderson & Arsenault, 2004) or the exposure to the items in the interviews and questionnaires altering the behaviours of the teachers and students in the observation and in their responses to subsequent interviews and questionnaires due to priming, increased awareness, or carryover effects (Bargh & Chartrand, 2000; Ottati, 1997; Tourangeau, Rasinski, Bradburn, & D'Andrade, 1989).

The sequence of the data collection was established and adhered to. This protocol was created to reduce the potential effects of supraliminal and subliminal priming, the conscious and unconscious awareness of stimuli (Bargh & Chartrand, 2000), and artificial salience (Ottati, 1997) due to the information participants would be exposed to in the other data collection methods. The set sequence involved conducting the teacher pre-observation interview just before the observation; the administration of the student questionnaires just after the conclusion of the observation (and with the Likert-style competence questionnaire first, followed by the Likert-style confidence questionnaire, then the open-ended questionnaire); the teacher post-observation interview just after the administration of the student questionnaires; and the questionnaires for the teachers (first the Likert-style competence then the Likert-style confidence, then the open-ended questionnaire) last of all.

Several areas related to the research questions were investigated using questionnaires for the students and the teachers (see Appendix A). The students completed questions regarding their own competence in using ICT, their confidence in using ICT, how ICT was used in the lesson, and whether teachers should be able to use ICT in the classroom. Teachers completed questionnaires about their own competence in using ICT, their confidence in using ICT (efficacy), how ICT was used in the lesson, what ICT teachers should be able to use in the classroom, the importance of ICT in their role as a primary teacher, and other factors that affect teacher ICT use.

Interviews

Yin (2009) stated "interviews are an essential source … (however) … responses are subject to the common problems of bias, poor recall, and poor or inaccurate articulation … a reasonable approach is to corroborate interview data with information from other sources" (pp. 108-109). Interviews were conducted with the teachers who were teaching the classrooms that were observed whilst incorporating ICT in some part of the observation. Interviews were necessary in this research as "the behaviour, feelings, or how people interpret the world around them" (Merriam, 2009, p. 88) could not be directly observed.

Semi-structured teacher interviews were used to collect data as they provide three advantages: respondents are more engaged in the interview process than the questionnaire; respondent answers to questions can be clarified; and non-verbal responses or gestures can also be collected (Anderson, 1998, p. 190). Both interviews used open-ended structuring questions and, depending on the type of clarification required, follow-up questions that were probing, specifying, direct, indirect, or interpreting were used to clarify answers (Liamputtong, 2009, pp.48-49).

The interviews with the teachers enabled them to provide information on ICT availability and were of use to clarify what was observed in the classroom (see Appendix B). This was an integral aspect of the constructivism ontology on which the research was based, with participants being able to share their perception of the world within the context of the existing worlds within which they taught (Crotty, 1998; Guba & Lincoln, 1994; Healy & Perry, 2000; Sale, Lohfeld, & Brazil, 2002). Additionally, how participants made sense of reality in a way that works satisfied aspects of social constructionism (Crotty, 1998) and pragmatism (Creswell et al., 2000). The interviews contained information on:

- factors considered when planning to use ICT;
- preference for using ICT;
- whether ICT in the lesson is planned as part of the learning outcomes;
- what ICT is available in the school;
- whether the students stayed on task during the lesson;
- whether there were other factors that affected the lesson;
- whether the behaviour of students when using ICT was typical of their behaviour when using ICT in other lessons;
- whether the students behaved in the same way as other students during a lesson with ICT; and
- what the students learnt by using ICT in the lesson.

The teacher interviews were conducted before and after the observations. The first interview was conducted just after the researcher was introduced to the teacher and occurred in the staffroom, the teacher's office, or the teacher's classroom. The second interview was conducted after the observations and administration of the student interviews. These were conducted in a wider variety of settings, usually due to the requirements of the teacher to be elsewhere (such as on-duty in the playground). These settings include the teacher's classroom, the playground, and the staffroom. The teacher questionnaires were administered after the second interview. In most cases, they were completed in the presence of the researcher. In four cases, the questionnaires were emailed to the teachers and, in three of these cases, the teachers completed the questionnaires electronically and returned them to the researcher as attachments to emails.

Observations

Yin (2009, p. 110) considered observations "useful in providing additional information about the topic being studied … (as) … observations of the technology … are invaluable aids for understanding the actual uses of the technology". One observation was conducted for each classroom – with the requirement that ICT was used during the observation. The researcher did not stipulate what ICT should be used, who should use it, or how it should be used. The physical classroom environment, student behaviours, and teacher behaviours were the focus of the observations. The aims of the observations were to

> notice things that have become routine to the participants themselves, things that may lead to understanding the context … to triangulate emerging findings … to record behavior as it is happening … (and) … to provide some knowledge of the context or to provide specific incidents, behaviors, and so on (Merriam, 2009, p. 119).

Classroom observations were used to collect data on the behaviours of the students and the teachers during the session when ICT was used and when ICT was not used. Cohen et al. (2002) stated that observations enable researchers "to see things that might otherwise be unconsciously missed, to discover things that participants might not freely talk about in interview situations, to move beyond perception-based data (e.g. opinions in interviews), and to access personal knowledge" (p. 305). Furthermore, Johnson and Turner (2003) stated "people do not always do what they say they do" (p. 312). Johnson and Turner (2003) sounded a warning regarding observations, specifically "Goffman's (1959) point that most social behavior is *frontstage behavior* (i.e., what people want or allow us to see) rather than *back-stage behavior* (i.e., what people say and do with their closest friends or when acting naturally)" (p. 312). These are all issues that may be present in this research.

Naturalistic observations were conducted within the participants' natural environment (Johnson & Turner, 2003). However, due to the classroom environment, even though the aims of the research required the researcher to act as a "complete observer" (Cohen et al., 2002, p. 310), the researcher had to be within the classroom and was therefore visible to the participants. This created aspects of "observer-as-participant" (Cohen et al., 2002, p. 310). The researcher did maintain a separation from the observed interactions by "standing aloof from the group activities" (Cohen et al., 2002, p. 187) to remain a non-participant observer. In terms of the Cohen et al. (2002) typology of observation studies, the research involved unstructured observations in a natural setting. This resulted in many variations in the observed sessions, such as the topics taught, the types of ICT used, the organisation of the activities, and the length of the observed session. However, as the research aim was to investigate factors that related to the use of ICT, the imposition of restrictions via the research design or researcher expectations could have impinged the full exploration of potential factors. This consideration was primary in the use of natural and unstructured observations (Cohen et al., 2002).

The routine of the classroom was seen as a constant environment that would be a suitable setting (Merriam, 2009, p. 127) less likely to be disrupted by an observer than by a video camera with an observer controlling it. Even though the presence of the researcher would "contaminate" (Merriam, 2009, p. 127), the inclusion of a video was seen as providing a higher level of disruption to the observed phenomena within the classroom. This disruption would be due to the presence of the device itself, the potential of the device would have to affect the behaviours of the participants, and the disruptive nature of the researcher interacting with the device. In addition, if the researcher had to interact with the video recorder, they would not be observing the classroom. Finally, as Merriam (2009, p. 128) discussed, the use of a video camera can be disruptive and costly.

As previously stated, the observations were conducted to determine what was actually happening in the classroom (Hinostroza, Labbe, Brun, & Matamala, 2011). This was possible due to the strengths of natural unstructured observations – the observed sessions were determined by the environment and the (logical) participants in the environment and not the researcher. The observations of the interaction of the teachers and students within the classroom reflect Creswell's (2009) description of constructivism, where there is "interaction among individuals … within the specific context" (p. 8), although the external existence of the classroom within which the observations satisfies an aspect of realism as described by Olsen (2004). Observations enabled the investigation of both the social constructionist and pragmatic beliefs as it involved participants "engaging in reality" (Crotty, 1998) and "human experience in action" (Johnson & Onwuegbuzie, 2004, p. 18), respectively. As the research was situated in a mixed methods design as described by Ary et al. (2010) and discussed by Creswell and Plano Clark (2011), the data from the observations were combined with data from other results to address the research questions (see the Analysis section for a discussion of these), as well as addressing:

- the physical environment;
- the behaviours students engaged in;
- verbal and non-verbal communication;
- how the teacher used ICT during the observed session; and
- how the students used ICT during the observed session.

One observation session was conducted where ICT was used. In instances where the teacher emailed the research regarding what ICT could be used, the researcher advised the teacher that it was fully their choice and decision. The researcher did not engage in discussions with the teacher regarding the format, content, or lesson topic. This resulted in observations covering a range of topics in different learning areas, with a variety of ways of incorporating ICT.

When the researcher arrived at the school appropriate processes were followed (such as signing in to the school as a visitor and meeting with the principal). The teacher participant was met before the researcher went to the classroom as the pre-

observation interview was conducted before the observations. When the researcher went to the classroom, the teacher introduced the researcher as a visitor or guest to the students in the classroom. The introduction process usually involved a welcome from the students and a reply from the researcher. The researcher maintained an external relationship with the observed teacher, students, and classrooms.
After being introduced to the students (to address why the researcher was in the classroom), the researcher did not interact with the participants of the research. Diagrams of the classroom that incorporated the locations of student desks, the teacher's desk, resources (ICT and non-ICT), and other architectural features (such as windows and doors) were sketched. The student desks were labelled on the diagram to indicate the short-hand label used to identify the student occupant of the desk and, if the desks were grouped, identify the group by the group identifier.

The researcher started the session by drawing a diagram of the classroom (as discussed in the Methods section). To enable quicker noting of observations (Cohen et al., 2002) the researcher used short-hand labels to identify the participants and were used to note teacher and student movements, behaviours, and interactions with other students and the classroom environment. As Ary et al. (2010) state, decisions were made on what to observe. Participant behaviour, that is, both the teacher and the students, were noted. The types of behaviour included interactions with other participants and classroom resources, movement around the classroom, and classroom management issues. Instances of observed behaviours were recorded, with the researcher "waiting for something to happen and then recording what follows from it" (Bryman, 2004, p. 170). After the data were collected, the researcher discussed the observations with teaching colleagues to identify ways of describing and categorising the data. These discussions incorporated aspects of ensuring the observations were interpreted consistently. Appropriate literature known to the researcher (due to the researcher being a qualified teacher), were consulted and observations were classified and categorised (see the Data Collection section for further information). This demonstrated an aspect of the fully mixed methods approach (Ary et al., 2010) as it mixed "the qualitative and quantitative approaches in an interactive way" (p. 563).

Questionnaires

Questionnaires enable many variables to be considered. Punch (1998, p. 102) considers survey questionnaires as capable of addressing multiple variables. They are capable of obtaining demographic information about the respondent as well as independent, dependent and control variables. Consequently, questionnaires collect two types of information - demographic data and data regarding what the respondent knows or the behaviours they engage in as well as measures the respondent's "attitudes, values, opinions or beliefs" (Punch, p. 103) about a topic or issue. The use of questionnaires satisfied the constructivist ontology (Crotty, 1998) as the use of questionnaires was to obtain the ideas and views participants had constructed regarding the use of ICT, though the situating of this within the classroom reflected the realism perspective of the participants' position within the existing world (Olsen, 2004). Questionnaires also suit Willig's (2001) recognition of the social constructionist aspect of human experience as mediated by the environment. The use of questionnaires to obtain information from participants regarding their "experienced world" (Sandberg, 2005) reflects the interpretive perspective.

Four questionnaires were administered to the teachers and two questionnaires were administered to their students, partly due to the efficiency of questionnaires for collecting large amounts of data (Anderson, 1998), but also due to their frequent use in research on teacher ICT skills and teacher efficacy (for example, Davies, 2005; Zhao et al., 2002). Many studies on teacher efficacy or self-efficacy use modifications or variations of existing teacher efficacy scales, such as Gibson and Dembo's 1984 Teacher Efficacy Scale (see Davies, 2005; Riggs & Enochs, 1990) or Friedman and Kass' 2002 Teacher Self-efficacy Scale (see Labone, 2002). All questionnaires were designed to be self-administered (Babbie, 2020). However, as younger children were participants, the researcher read and discussed the questions to increase the likelihood of students understanding what they were being asked (Schwarz, 1995). This procedure is discussed in more detail in the Data Collection section (on page 104).

To achieve the purpose of this research, both Likert-style questions and open-ended question were used, at times with both types within the one questionnaire, reflecting what Johnson and Onwuegbuzie (2004) describe as "the use of a questionnaire that includes a summated rating scale (quantitative data collection) and one or more open-ended questions (qualitative data collection" (p. 20). Likert-style questions were used as it enabled "the intensity of feelings about the area in question" (Bryman, 2004, p. 68). This contrasts with a self-report inventory, which provides the option of three choices - yes, no, and uncertain (Ary et al., 2010). This research required participants to give an indication of the level or intensity (Bryman, 2004), hence the use of Likert-style scales for the closed questions. In this research, participants were asked to indicate the level of competence in and confidence with specified ICT (and with space for participants to provide additional ICT). Both scales were five point scales, with 1 reflecting the lowest measure of competence or confidence and 5 representing the highest measure of competence or confidence. Specifically, the scale for competence for students had the values of 1 for satisfactory, 3 for competence, and 5 for expert, and the scale for competence for teachers had the values of 1 for beginner, 3 for competence, and 5 for expert. The scale for confidence for both students and teachers had the values of 1 for highly anxious, 3 for confident, and 5 for highly confident. The mid-point for both scales corresponded to the existence of competence or confidence. Data from the Likert-style questionnaires were used to address the following aspects of the research as well as being combined with other data to satisfy the criteria specified by Creswell and Plano Clark (2011) and Ary et al. (2010) for mixed methods designs (see the Analysis section on page 119 for more detail):

- how confident teachers and students report they were in the use of 14 specified ICT;
- how competent teachers and students report they were in the use of 14 specified ICT; and
- whether there was a relationship between the self-reported competence and confidence of teachers and students in the use of the 14 specified ICT.

The open-ended questions contained in the questionnaires that were completed by both teacher and student participants as part of the research, referred to as "researcher-generated documents" by Merriam (2009, p. 149). These were used as they provide information that enabled “more about the situation, person, or event being investigated” (Merriam, 2009, p. 149) to be obtained. In line with the mixed methods design (Ary et al., 2010; Creswell & Plano Clark, 2011), the open-ended questions were combined with data from the other data collection methods to address aspects of the research (see the Analysis section on page 119 for further information on this), as well as being used by itself to address the following aspects of the research:

- the ICT skills that respondents stated teachers should have;
- how ICT was used in the lesson;
- the importance of ICT as used in the classroom; and
- for the teachers, factors affecting ICT use in the classroom and the main ICT skills a primary school teacher should have.

The following procedures were used for each class before students started to complete the questionnaires. The definition for ICT at the top of the open-ended questionnaire was read out and students were asked if they understood the definition. The definition incorporated aspects from Hew and Brush (2007) and states that ICT includes desktop computers, laptop computers, and handheld computers that can run software and can enable access to the Internet, along with software and using the Internet itself. The instructions at the top of the Competent section of the Likert style questionnaire were read out to the class and the researcher asked the question – “At home, if your mum or dad asks you to help whenever they have a problem with the computer, which box do you think you would tick?”. The researcher waited until a student or students answered that they would tick the box under Expert or the box to the left of Expert. This process was used to provide opportunities for students to clarify the meaning of the questions (Schwarz, 1995).

The instructions at the top of the Confident section of the Likert style questionnaire were read out to the class and the researcher asked the question – “At home, if your mum or dad asks you to help whenever they have a problem with the computer, and you don’t feel comfortable or able to help properly, which box do you think you would tick?”. Again, the researcher waited until a student or students answered that they would tick the box under Highly Anxious or the box to the right of Highly Anxious. Additionally, the researcher asked the question – "At home, if your mum or dad asks you to help whenever they have a problem with the computer, and you were happy to help and felt you were able to help properly, which box do you think you would tick?". The researcher waited until a student or students answered that they would tick the box under Highly Confident or the box to the left of Highly Confident.

Students were finally asked if they had any further questions and the researcher waited for them to indicate that they didn't. Students were then advised that they could ask questions whilst completing the questionnaire, and the example was given that they should ask a question if they were not sure what a word meant, for example, one of the types of ICT. Whilst the students were completing the questionnaire, the researcher walked around the desks to monitor progress and answer any questions. After the students completed the questionnaires, the questionnaires were collected.

Triangulation, Validity, and Reliability

According to Yin (2009, p. 132), the use of both qualitative and quantitative data "can yield appreciable benefits" as using three different data collection methods enabled triangulation of data. Lincoln and Guba (1985) considered triangulation a means of increasing the credibility of the findings. Mathison (1988, p. 13) viewed triangulation as an important methodological issue, as "naturalistic and qualitative approaches to evaluation have demanded attention to controlling bias and establishing valid propositions because traditional scientific techniques are incompatible". Triangulation has been achieved in two ways described by Denzin (1970, as cited in Cohen et al., 2002, p. 113) – by combining the levels over individuals and cases and through data collection methods.

An additional benefit of data triangulation is that "problems of *construct validity* can also be addressed because the multiple sources of evidence essentially provide multiple measures of the same phenomenon" (Yin, 2009, pp. 116-117, italics in original). As a result of this, the data from the different data collection methods were used to strengthen interpretation of the data. As stated above, however, this research is a fully mixed method and not a triangulation mixed methods design (as described by Creswell, 2008) as data collected from the different data collection methods were analysed together and not, as Creswell (2008) stated, analysed separately. The research considers both "variables and relationships between them" (Punch, 2004, p. 242) as well as being "sensitive to context and process, to lived experience" (Punch, 2004, p. 243).

If triangulation can address construct validity (Yin, 2009), internal validity, external validity, and reliability need to be addressed to ensure "the quality of any empirical social research" (Yin, 2009, p. 40). Cohen et al. (2002) stated "both qualitative and quantitative methods can address internal and external validity" (p. 107). The question of whether the research design "is a true reflection of the reality studied" (Punch, 2004, p. 30) is dependent upon how reality is viewed. As previously stated, the aim of the research is to investigate the actions and beliefs of the individuals as both part of the environment and apart from the environment – with individuals capable of determining their own behaviours and beliefs whilst existing in a world external to themselves. To obtain information on these, the research needed to access the internal thoughts and external behaviours whilst situating these within the environment. The research demonstrated internal validity by maintaining the connection between the data obtained and the reality outlined by the aim of the research (Punch, 2004). In addition, peer reviews of coding, categories, and classifications by colleagues who were qualified teachers were utilised to assess the appropriateness of the codes, categories, and classifications to ensure these would "capture what is really there" (Merriam, 2009, p. 213) in terms of the reality of the classroom setting. The conditions for external validity are addressed to the extent that the data from the questionnaires can be generalised to the population that matches the theoretical criteria or settings (Punch, 2004) on which the participants were selected (these criteria are outlined in the Sample section on page 97).

The issue, however, is whether the traditional forms of internal validity, external validity, and reliability are the only measures of rigour (Tobin & Begley, 2004) appropriate for this research. Tobin and Begley (2004) state "it is argued that the transference of terms across paradigms is inappropriate, however, if we reject the concepts of validity and reliability, we reject the concept of rigour" (p. 388). Instead of using the terms outlined by Yin (2009) above, they use the terms proposed by Lincoln and Guba (1985, cited Tobin & Begley, 2004, p. 391). They align these terms to three of those proposed by Yin, specifically the term credibility to be analogous to internal validity, transferability analogous to external validity, dependability analogous to reliability, and confirmability analogous to neutrality or objectivity (pp. 391-392). As this research is fully mixed methods, both forms of approaches, together with the strategies outlined by Creswell and Plano Clark (2011) below, were also used to address validity and reliability.

In this research, credibility was achieved via the use of a variety of data collection methods (Tobin & Begley, 2004, p. 392; Yin, 2009, pp. 42-43), principally both open-ended questions and Likert-style questions within the questionnaires for the students and the additional use of interviews for the teachers. Observations of the classroom were used as a third verification of data, whether as "convergent, complementary, or dissonant" (Sands & Roer-Strier, 2006, p. 239, as cited in Liamputtong, 2009, p. 27). These multiple sources provided the researcher with several locations where the student or teacher could respond when providing information, increasing the likelihood of the assigned meaning coinciding with the intended meaning. Transferability of the results to other classes with similar contexts was improved via the use of multiple case studies (Yin, 2009, pp. 44, 61), particularly where the results were replicated between cases. In the use of case studies, it is interesting to note that Evers and Wu (2007) stated that classrooms are a particular case

> The reason why classrooms are so similar the world over is not only due to the empirical conditions of collective instruction converge on a particular form. It is also a matter of the similarity of the constitutive rules under which the pedagogy of mass education is defined. (p. 206)

Dependability was addressed via the consistent use of the same well-documented procedures within the research and the opportunity this created for the research to be replicated in the future (Tobin & Begley, 2004, p. 392; Yin, 2009, p. 45). Confirmability has been attended to via the researcher's referral to colleagues and existing literature (see the discussion under Case Studies and Multiple Case Studies in the Analysis section below) when interpreting the data and findings (Tobin & Begley, 2004, p. 392).

As the research was mixed methods, Creswell and Plano Clark's (2011) discussion of threats to validity when merging or connecting data was relevant and their strategies for reducing these threats were considered as appropriate. Several of these strategies were utilised within this research, for example, using the questionnaires in a pilot test (see Cooke & Dawson, 2011); using the same participants for both the qualitative and quantitative data with good size samples from both perspectives; analysing and interpreting both qualitative and quantitative data; connecting the components of the research; using procedures to ensure the reliability and validity of coding, categories, classifications, and themes; conducting appropriate exploratory analysis of data to determine whether parametric or nonparametric statistics should be used; and, giving equal weight to both forms of data.

Analysis

The purpose of the research was to investigate the teacher and student perceptions of ICT use in the classroom, self-reported competence and self-reported confidence of teachers and grade 5 and 6 students in their use of ICT, and the frequency of behaviours in the classroom when ICT is used and when it is not used. The purpose was addressed using data collected via the three data collection methods discussed in the Data collection methods section above (see page 104). Data are combined to consider each classroom as a case (Merriam, 2009; Yin, 2009) and considered separately (outside of the case) to strengthen the analysis (Lincoln & Guba, 1985; Mathison, 1988; Tobin & Begley, 2004). The research incorporates multiple case studies at the class level since each class would, as Yin (2009) stated, "share the same research questions, to collect complementary data, and to conduct counterpart analyses" (p. 63), though "case studies need not always include the direct and detailed observational evidence" (Yin, 2009, p. 19). The research also collates the results of the questionnaires for the teachers and the results of the questionnaires for the students to enable generalisation of findings (Creswell & Plano Clark, 2011, p. 9) as well as being incorporated into the analysis of the case studies, reflecting the mixed method design in the data analysis (Ary et al., 2010).

Qualitative

Several types of analysis were conducted with the data from the teacher post-observation interviews, the teacher and student answers to open-ended questions from the post-observation questionnaires, and the observed behaviours. The simplest analysis involved the creation of themes based on the presence of words in the responses. The next level occurred for only one question from the teacher post-observation interview and considered overall response to determine which category the answer belonged to. The final level looked at coding the behaviours, then creating categories that could be used to describe the session.

The allocation of themes, codes, and categories, enabled both descriptive statistics and inferential statistics to be conducted on the data (Creswell, 2008). In line with the fully mixed methods methodology, particularly the "mixing of the qualitative and quantitative approaches in an interactive way" (Ary et al., 2010, p. 563), statistical analysis of the data resulting from the Likert-style questionnaires in conjunction with data from the open-ended questionnaires, teacher pre and post-observation interviews, and observed behaviour, were conducted. Data from the Likert-style questionnaires were entered into the statistical program PASW Statistics GradPack 18 SPSS. The results of the Likert-style questionnaires were entered by allocating the numerical value that was provided on the questionnaires (that is, 1 for the lowest response and 5 for the highest response). Missing data were left blank and were not included in any calculations. Totals for each class were checked against the data forms and random checks were made to compare the data files with the data forms.

Quantitative

Cronbach's alpha was used to determine the reliability for the Likert-style questionnaires. There were four Likert-style questionnaires administered in the research – the Competence and Confidence questionnaires for the Teachers and the Competence and Confidence questionnaires for the Students. The assumption of normality was assessed prior to conducting the statistical analyses to determine whether the data were approximately normally distributed. Skewness and kurtosis statistics were conducted to determine whether the data were normally distributed

(Allen & Bennett, 2010). Two tests of normality (the Sharpiro-Wilk test and the Kolmogorov-Smirnov test for the larger data sets) were conducted (Allen & Bennett, 2010). In addition, visual inspections of the histogram, normal Q-Q plot, detrended Q-Q plot, and boxplot were also made (Allen & Bennett, 2010). As a result, the *t* test, one-way between groups analysis of variance (ANOVA) was conducted to analyse the data in all but one situation, where Kruskal-Wallis one-way ANOVA was utilised. Before correlations were conducted with the results of the teachers' self-reported competence and confidence and the students' self-reported competence and confidence, as well as the aforementioned tests, the data were plotted and the scatterplot examined to determine whether the relationship between the variables was linear and heteroscedastic. If the assumptions were not violated, a bivariate Pearson's product-movement correlation coefficient (r) was calculated. If the assumptions were violated, Kendall's τ_b was calculated.

Ethical Issues

Ethical approval was sought from the Human Research Ethics Committee at the Office of Research and Development at Curtin University. As minors would be asked to participate, a higher level of ethical approval was required. The application process involved the review of the relevant sections of the National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council [NHMRC], 2007a) and the Australian Code for the Responsible conduct of Research (National Health and Medical Research Council [NHMRC], 2007b). Particular care was taken when reviewing Chapter 4.2 and Chapter 4.3 of the National Statement on Ethical Conduct in Human Research as these concerned research with minors and research involving persons in dependent or unequal relationships.

The interactions between the researcher and the minor participants were conducted to meet the requirements of Chapter 4.2 of the National Statement on Ethical Conduct in Human Research. Before the research was conducted in the classroom, the Information Sheet and Consent Form were sent home with the student and both the parent/guardian and the student needed to sign the Consent Form for consent to be given (see Appendix C). When the researcher went in to the classroom to conduct the observations, the classroom teacher introduced the researcher to the class and explained the purpose of the visit. The language used by the researcher suited the developmental level of the students, whether in written form on the Information Sheet and Consent Form or on questionnaires or through verbal dialogue when interacting with the students in person. The behaviour of the researcher was appropriate for the school environment and for discourse with students of the age of the participants, particularly as the researcher is a qualified teacher and a member of the Western Australian College of Teachers (WACOT) and had appropriate clearances for working in a school.

Compliance with Chapter 4.3 of the National Statement on Ethical Conduct in Human Research was demonstrated through the detailed and specific information provided to participants via the Information Sheet. The Consent Form reiterated the significant points from the Information Sheet, particularly that participation was voluntary and would not benefit the participant and their consent could be withdrawn at any time without penalty. As the students were minors, parents or guardians were also required to sign Consent Forms.

Approval to conduct research in Catholic Primary schools in Western Australia was obtained from the Catholic Education Office of Western Australia (CEO WA). The granting of this permission and the ethical approval provided by the Human Research Ethics Committee at the Office of Research and Development at Curtin University was included on the Information Sheet. Written permission was obtained from the principal of schools used for data collection, as well as the teachers (as both teachers of student participants and participants themselves) and parents or guardians of students in the classrooms involved in the research. Participants were informed that they could withdraw from the study at any time and were given information on how to withdraw.

Anderson (1998) described two aspects of confidentiality – a clear understanding by the participant of how the data will be used by the researcher and the right of the participant to remain anonymous and not be identified from their data. Schools were identified by a researcher-constructed ID code and participants were assigned an ID number that incorporated their school code. Once data were collated, the results were checked to ensure identifying data could not be reconstructed.

To minimise the impact of the data collection on participants and their schools, advice was sought from principals and teachers to enable data to be collected from students and teachers in a way that was minimally intrusive. Specifically, this involved:

- asking principals how and when to approach teachers regarding obtaining consent and agreement to conduct research;
- asking teachers to specify when would be the most suitable time to observe two lessons;
- asking principals and teachers to specify when and where to collect data via questionnaires for students and teachers;
- asking principals and teachers to specify when and where to collect data via interview for teachers; and
- being flexible in how teachers returned their questionnaires.

The steps outlined above ameliorated the potential risks associated with the data collection, particularly for the teachers. These risks included teacher reactions to their own responses to the questions, possible negative connotations that may be made by principals on viewing the results of the research, and the reaction of teachers to having an observer in their classroom.

CONCLUSION

This chapter outlined the placement of this research in terms of the ontology, epistemology, and theoretical perspective. The adoption of the interpretive theoretical perspective provided strong connections between the research questions, the constructivism ontology and social constructionist epistemology, and both the multiple case studies methodology and mixed methods. The next two chapters, Chapter 4: Case Studies and Chapter 5: Cross Case and Quantitative Analysis, present the findings of the research.

CHAPTER 4

CASE STUDIES

INTRODUCTION

This chapter presents the research findings from each of the case studies to investigate factors that are related to the use of ICT in upper primary classrooms (that is, the behaviours observed when ICT is used and when it is not used, the teacher and students' perceptions of ICT use, teachers' and students' competence and confidence in using ICT). The cases are presented grouped by what the teacher described the students as learning from the ICT being included in the observed session – either to support learning, as a focus of learning, or to both support learning and as a focus of learning. Each case is described in terms of the context in which the observation occurred, the classroom observations, teacher and students' perceptions of ICT used, and the competence and confidence of the teacher and students, as shown in Figure 4.1.

Context
Teacher and Student Observed Behaviours
Teacher and student perceptions of ICT use in the classroom
Teacher competence and confidence
Student competence and confidence
Comparison of teacher and student competence and confidence
Summary

Figure 4.1. The framework for the presentation of the results of the case studies.

Overview of cases

As described in Chapter 3: Methodology, there were 11 case studies that met the criteria for the research design. The researcher observed each class for one session during which ICT was used for at least part of the session (see Table 4.1). The teacher determined the structure of the session, subject, content, student activities, and ICT used. Prior to the start of the session, the teacher was interviewed. At the end of the session, the students completed a questionnaire and the teacher was interviewed again and completed a questionnaire (see Chapter 3 pages 20-30 ** for more details).

The introduction with the teacher was conducted via email, when an appropriate time for the researcher to visit the school was negotiated. Once the researcher was at the school and introductions were made, the teacher took the researcher to a quiet place for the interviews. Depending on the teacher and the school, this was either the staff room or the classroom. If the interviews were conducted in the staff room, if other staff were present they were not close enough to hear the interview. If the interviews were conducted in the classroom, it was when the students were not present. Two interviews were conducted, one prior to the observation and one after the observation and administration of the student questionnaires. The first interview was designed to ascertain the planning and preferences for ICT use in lessons and what ICT was available in the school. The post-observation interview was designed to investigate the teacher's appraisal of the just-completed lesson with ICT in terms of student behaviour and the impact of using ICT in the lesson.

The observations were conducted where the teacher was teaching the class (diagrams of the sites are provided in Appendix D). As described in the Chapter 3 (p. 109 **), the researcher observed the types of behaviours exhibited by both teachers and students. A form of "progressive problem solving" (Erickson, 2012, p. 1460) was used to analyse the behaviours. This involved using open coding (Corbin & Strauss, 1990) to allocate a code to reoccurring behaviours (Ryan & Bernard, 2003) to reflect who initiated the behaviour, whether another individual was involved, and what was done. Once codes were allocated, the behaviours were reviewed again to ensure gaps were not evident (Corbin & Strauss, 1990). This occurred for all cases. Codes were then grouped into categories that were based on the individual initiating the behaviour (see Appendix E for the categories and codes and Appendix F for an example of the coding). Reflecting Merriam's (2009) peer review, discussions with teaching colleagues were held when codes were created, allocated to behaviours, and grouped into categories to ensure validity (Ryan & Bernard, 2003).

The teacher and student answers to the open-ended questions from the post-observation questionnaires and the teacher responses to the interview questions were examined for themes and categories. Themes were created around words used by the participants in their responses, with each response examined and reoccurring (meaningful) words highlighted to generate the themes. This process enabled multiple themes to be allocated to one response. Themes were created in response to six questions, two from the teacher responses to the post-observation open-ended questionnaire, one from the teacher responses to the post-observation interview, and three from the student responses to the open-ended questions in their questionnaires. For the teachers, the questionnaire responses involved the main ICT skills they considered a primary school teacher required (see Appendix G) and how important they considered ICT in their role as a primary school teacher (see Appendix H) and the interview responses concerned what they believed the students learned from using ICT during the observation (see Appendix I). Students were asked whether and why teachers should be able to use ICT in their role (see Appendix J), what they used ICT for in the lesson (see Appendix K), and what the most important part of using ICT during the lesson was (see Appendix L).

The responses to the open ended questions were analysed by comparing the responses to each other to look for common words or phrases (Patton, 2002). When commonalities were found, these were highlighted and noted. When new commonalities emerged, the previous responses were reviewed to search for the new phrases or words. This process continued until no new commonalities arose. The one instance where categories were created to analyse teacher responses were for a question in the post-observation interview. The use of categories instead of themes reflected the consideration of the overall response, rather than a search for words used in the response (Corbin & Strauss, 1990). This analysis was used as the interview enabled probing questions to be asked (Yin, 2009). The responses to the question “What do you think the students learnt by using ICT in this lesson?” were categorised as using ICT to support learning or learning the ICT itself. The results were used to organise the presentation of the cases in this chapter (see Table 4.1).

Table 4.1

Structure of ICT use

Case	Competence			Confidence			ICT	ICT used by
	Average T	Average S	Correlation τ_b	Average T	Average S	Correlation τ_b		
ICT used to support learning								
A	3.21	3.58	.50*	2.93	4.10	.08	EWB, laptop, internet, program	Students
B	3.27	3.80	.46	3.27	3.89	.84**	EWB, document processor	Teacher
							ICT not used	-
							Laptop, internet, program	Students
D	3.18	3.99	.72**	3.33	4.12	.73**	EWB, internet, program	Teacher
							EWB, internet, program	Students
F	3.14	3.43	.42	3.14	3.54	.53*	ICT not used	-
							EWB, internet	Teacher
							ICT not used	-
E	3.92	3.47	.00	4.07	3.47	.46*	ICT not used	-
							EWB, document processor	Both
I	3.43	3.65	.53*	3.71	3.74	.41	ICT not used	-
							EWB, document processor	Both
ICT itself was learned								
K	3.43	4.13	.21	3.50	4.24	.05	EWB, document processor	Teacher
							Desktop, document processor, presentation software	Students
H	3.00	3.59	.28	2.79	3.82	.52*	ICT not used	-
							Desktop, document processor, presentation software	Students
G	2.71	3.32	.42	3.00	3.51	.06	ICT not used	-
							Desktop, statistical or database software	Students
ICT itself was both learned and used to support learning								
C	3.79	4.06	.45*	3.79	4.33	.20	ICT not used	-
							Desktop, statistical or database software	Students
J	3.09	2.59	.46	3.25	2.75	.45	ICT not used	-
							Desktop, document processor, presentation software	Students

Note. T = Teacher; S = Students; * = significant at .05; ** significant at .01.

As can be seen from Table 4.1, six cases involved teachers who considered ICT supported the student learning, three cases involved teachers who considered the students learned the ICT itself, and two cases involved teachers who considered both the ICT itself was learned and also provided support for learning. Also included in Table 4.1 are the teacher average self-reported competence and confidence and student average self-reported competence and confidence. The method used to calculate the averages is outlined in the Questionnaire section in the Methodology chapter (p. 106). Correlations between the teacher self-reported competence and confidence and the student average self-reported competence and confidence are also provided (see the *Quantitative* section in Chapter 3 on page 113). The data provided in Table 4.1 will be considered in detail with the other factors regarding observed behaviours and teacher and student perceptions of ICT for each of the cases.

CASE A

Context

The female teacher and her 27 Year 5 students were observed over a 28 minute session. There were 13 males and 14 females sitting in six groups based on mathematics ability (see Figure D1, p. 260). Four teacher-selected groups comprising 17 students (8 males and 9 females) used ICT (see Table 4.2). Group 1 (n=5) was working together on an internet-based mathematics program on solving angles on the electronic whiteboard. Group 2 (n=4) was working individually on a mathematics program on time and place on laptop computers. Group 3 (n=4) was working individually on a mathematics program converting Roman numerals on laptop computers. Group 4 (n=4) was working individually on a mathematics program on Australian time zones on laptop computers. Group 5 (n=5) was working with calculators (as they were not able to access the internet, they were outside of the definition for ICT for this research). Group 6 (n=5) was working with protractors and measuring angles.

Table 4.2

Case A results

Behaviours	
ICT used by whom	Laptop computers, electronic whiteboard, internet, program used by the students.
Class organisation when ICT used	In groups of 4 or 5 students
Most frequently occurring behaviours when ICT used	• Teacher initiated interactions with the students, including students responding (24 occurrences) • Teacher talking to the students or giving directions where a response was not required (16 occurrences) • Individual student behaviours (15 occurrences) • Students interacting with other students (14 occurrences) • Student initiated interactions with the teacher that involved the teacher responding (10 occurrences)
Most frequently occurring behaviours when ICT not used	ICT was used for the full observation.
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *the changing world* and *the curriculum*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT, experience with or exposure to ICT, using ICT outside of teaching.
Student responses – should teachers be able to use ICT in their lessons	15 of 16 responding students affirmed teachers should be able to use ICT in their lessons.
Student responses – why should teachers be able to use ICT in their lessons	Themes of *learning and teaching* (n=12), *being beneficial for students* (n=12), and *the ICT itself* (n=11).
ICT use in the observed session	
Teacher response –what the students learned by using ICT	Category of *learning from using the ICT*.
Student responses – was ICT important in the lesson	14 of 16 responding students stated ICT was important to the lesson.
Student responses –what ICT was used for in the lesson	Most frequent response incorporated the subject area, mathematics (n=6).
Student responses – most important part of ICT being used in the lesson	Themes of *learning and teaching* (n=5) and *the activity* (n=3).

Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.21	3.58
Average Confidence	2.93	4.10

Research Question 1 – Teacher and Student Observed Behaviours

As shown in Table 4.2, the most frequently occurring behaviours were teacher initiated with the students, either requiring or not requiring a response. The teacher-led aspect of these behaviours and the teacher selection of ICT for the lesson indicated a more teacher focused lesson. Her use of questioning and directions may have been a response to the off-task behaviour of previous lessons, as the teacher stated in the post-observation interview that the students were "better behaved more focused" (Teacher A, 12/11/ 2009).

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The increasing presence of ICT skills as part of the curriculum was reflected in the teacher's response indicating that "(ICT) has now become an integral part of the curriculum" (Teacher A, 12/11/ 2009). During the post-observation interview, the teacher stated that by using ICT, the students learned to use different strategies, for example, "visual clues … kinaesthetic intelligence" (Teacher A, 12/11/ 2009). ICT also enabled the lesson to be student centred and organised by abilities. The teacher's responses indicated a focus on learning from using the ICT (see Table 4.2).

The student responses regarding ICT use in the lesson referred to the learning area, mathematics, with the most important part of using ICT indicating the themes *learning and teaching*, for example, "we learned stuff" (Student A10, 12/11/ 2009), and *the activity*, for example, "finding out the angles" (Student A02, 12/11/ 2009). As shown in Table 4.2, the first theme was also present as one of the three themes from students responses to why teachers should be able to use ICT in the classroom – *learning and teaching*, for example, "it is more easier to explain with and learn with" (Student A16, 12/11/ 2009), *being beneficial for students*, for example, "it is fun and exciting for the children and it is good to interact with" (Student A09, 12/11/ 2009), and *the ICT itself*, for example, "teacher can help us how (sic) to use ICT if we don't know how" (Student A15, 12/11/ 2009). The student focus on learning and teaching reflected the teacher's belief that the students learned from using the ICT.

Research Question 3 – Teacher self-reported competence and confidence

Table 4.2 shows that although the teacher had an average self-reported competence of slightly more than competent, her average confidence was below confident. The teacher rated herself competent to expert for nine ICT and rated herself as confident to highly confident for eight ICT (see Table M1, p. 284), five of which matched the competence ratings. The teacher rated herself competent or higher and confident or higher for all three ICT used during the observation, with her competence matching her confidence.

Research Question 4 – Student self-reported competence and confidence

As shown in Table 4.2, the student average competence was lower than the average confidence. The ICT with the highest student average competence was *internet browsers* (4.19) and the ICT with the lowest student average competence was *wikis, blogs or twitter* (2.86) (see Table M1, p. 284). The ICT with the highest student average confidence was also *internet browsers* (4.75) and the ICT with the lowest student average confidence was *statistical or database software* (3.10). Most variance in student competence occurred for *wikis, blogs or twitter*, and for *statistical or database software* for student confidence, which both had the lowest student average ratings. The lowest variation in student competence occurred for *desktop or laptop computers*, and for *internet browsers* for student confidence. These were two of the ICT used during the observation.

Comparison of teacher and student average competence and confidence

The Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was strong and positive, $\tau_b = .50$, $p<.05$, two-tailed, $N = 14$, indicating similar responses to the specified ICT. However, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was not significant, $\tau_b = .08$, $p>.05$, two-tailed, $N = 14$. The lack of correlation may be due to the students' higher average ratings and the teacher's lower ratings. Overall, these results were reflected in the effect size for the difference in average competence and competence, with the difference in average competence being small, *d* = .29 but the difference in average competence being large, *d* = .97.

Summary of Case A

The teacher's lower average confidence ratings may have contributed to her indecisiveness in her responses to the questions concerning the use of ICT in the lesson – prior to the lesson she described it as an aspect of the learning outcomes but after she focused on the opportunities generated from using the ICT. In addition, her lack of confidence using ICT (as evidenced by her lower average confidence) and the disparity between her confidence and the student average confidence may be why she maintained tight control in the lesson, demonstrated in her choosing of both the ICT and who used it in the lesson, and in her behaviours. Likewise, the teacher's stated concern with the off-task behaviours in previous mathematics lessons may have added to the teacher directed nature of the lesson. The teacher's reference to the learning generated by using ICT in the lesson corresponded to the students referring to learning and teaching as both why teachers should be able to use ICT and the most important part of using ICT in the lesson.

CASE B

Context

The female teacher and her 18 Year 6 students were observed over a 70 minute session. There were 9 males and 11 females sitting in four groups (see Figure D2, p. 261). The session involved the English subject area and the activity focused on writing shape poems. The teacher explained what students were to do during the first 20 minutes and she used the electronic whiteboard to illustrate her explanation with examples of shape poems. The students used the laptop computers and the internet or a resource program individually (though while sitting in groups) during the 30 minutes they researched their poem topic, though they had choice over whether they used ICT and for how long they would use it. ICT was not used for the final 20 minutes when the students moved to the mat area and shared their poems with the class.

Table 4.3

Case B results

Behaviours	
ICT used by whom	Electronic whiteboard and document processor used by the teacher. Laptop computers and software used by the students.
Class organisation when ICT used	In four groups of students
Most frequently occurring behaviours when ICT used by the teacher	• Teacher initiated interactions with the students, including students responding (28 occurrences) • Student initiated interactions with the teacher that involved the teacher responding (19 occurrences) • Teacher talking to the students or giving directions where a response was not required (16 occurrences)
Most frequently occurring behaviours when ICT used by the students	• Students interacting with other students (33 occurrences) • Individual student behaviours (30 occurrences) • Student initiated interactions with the teacher that involved the teacher responding (25 occurrences)
Most frequently occurring behaviours when ICT not used	• Teacher initiated interactions with the students, including students responding (20 occurrences) • Student initiated interactions with the teacher that involved the teacher responding (8 occurrences) • Whole class interactions (8 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *role modelling ICT* and *specific ICT*.
Teacher response – main ICT skills required in the role of primary school teacher	Using ICT in pedagogy, using ICT outside of teaching, skills related to ICT use.
Student responses – should teachers be able to use ICT in their lessons	All 8 responding students affirmed teachers should be able to use ICT in their lessons.
Student responses – why should teachers be able to use ICT in their lessons	Theme of *being beneficial for students* (n=6).

ICT use in the observed session	
Teacher response –what the students learned by using ICT	Category of *learning from using the ICT*.
Student responses – was ICT important in the lesson	Three of eight responding students stated ICT was important to the lesson.
Student responses –what ICT was used for in the lesson	Most frequent responses referred to *obtaining information or facts* (n=6) and *the ICT itself* (n=4).
Student responses – most important part of ICT being used in the lesson	Theme of *obtaining information or facts* (n=8).

Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.27	3.80
Average Confidence	3.27	3.89

Research Question 1 – Teacher and Student Observed Behaviours

As shown in Table 4.3, the most frequently observed behaviours when the teacher used the ICT and when ICT was not used involved teacher initiated interactions with students including the students answering or student initiated interaction with the teacher including teacher answering. These behaviours indicated the teacher and students interacting, though most interactions were directed by the teacher. When students used the ICT, the most frequently observed behaviours involved students interacting with other students or individual student behaviours. These behaviours indicated the session was more student focused. These behaviours may have been possible as the teacher gave control to the students in terms of whether to use ICT. This intention was reflected in the teacher's description of the students as responsible and self-sufficient, who knew how to "log on and stay on task" (Teacher B, 12/11/2009).

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher's responses focused on role modelling ICT use and specific ICT – with the aim to "provide examples and role model different ways with both the laptops and electronic whiteboards" (Teacher B, 12/11/2009). Her focus on using ICT within and around her pedagogy as well as having skills and attributes to effectively apply

ICT skills was demonstrated with her response "to research effectively ... use critical judgement ... provide stimulating and creative activities … use for planning programming and assessing" (Teacher B, 12/11/2009). All eight out of the 18 students who completed the questionnaire responded that a teacher *should* be able to use ICT in their lessons, with the most prevalent theme for why *being beneficial for students* (see Table 4.3).

The teacher stated in the pre-observation interview that she preferred using ICT with the whole class or using the electronic whiteboard with students in groups, which was evident in the observation. The teacher stated ICT was used as part of the learning outcomes but stated it "promotes understanding of what [it] might look like - visual" (Teacher B, 12/11/2009). During the post-observation interview, the teacher stated using ICT meant the students would be "enthusiastic and will participate when [they] may not in discussion" (Teacher B, 12/11/2009). Her response indicated she used ICT to improve learning opportunities. Less than half of the students affirmed that ICT was important in the lesson, as shown in Table 4.3. The student focus on the theme of *obtaining information and facts* did not reflect either of the teacher's responses regarding what she thought the students learned by using ICT or what students would learn from using ICT in the lesson, but it did reflect the teacher's statement regarding role modelling effective research.

Research Question 3 – Teacher self-reported competence and confidence

As shown in Table 4.3, the teacher's average competence and confidence were both 3.27. Teacher B did not rate herself as expert or highly confident in any of the ICT items but she rated herself as more than competent in seven items (see Table M2, p. 285). She rated herself as confident and higher (but not highly confident) for all ICT apart from the three ICT – *electronic whiteboard*, *statistical or database software*, and *social networking programs*. The teacher did not rate herself for competence or confidence on three ICT items (*movie or DVD editing programs*; *wikis, blogs or twitter*; and *vodcast, podcast, video conferencing or webinars*), indicating she did not use them. The teacher rated herself competent or higher and confident or higher for three of the ICT used during the observation, with her competence matching her confidence, however, she rated herself less than competent and less than confident for electronic whiteboards.

Research Question 4 – Student self-reported competence and confidence

As shown in Table 4.3, the student average competence was slightly lower than the average confidence. The ICT with the highest student average competence was *email or messaging programs*, which was one of seven ICT with an average 4.00 or above (see Table M2, p. 285). In addition, student average competence ratings for all 14 ICT were 3.00 or above. The ICT with the highest student average confidence was *mobile telephones*, which was one of eight ICT with ratings of 4.00 or above. The ICT with the lowest student average confidence was *social networking programs*, which was one of two below 3.00. When comparing student average competence and confidence, the student average competence was lower than the average confidence for seven ICT and the same for two ICT.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated to investigate whether there was a relationship between the teacher's competence and confidence and the students' competence and confidence. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was not significant, $\tau_b = .46$, $p>.05$, two-tailed, $N = 11$. However, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was significant, $\tau_b = .84$, $p<.001$, two-tailed, $N = 11$. This would indicate similarities in which ICT the teacher and students rated themselves as confident and dissimilarities in the ICT the teacher and students rated themselves competent. The teacher's competence and confidence were lower that the student average competence and confidence for the four ICT used during the observation (*desktop or laptop computers*, *electronic whiteboard*, *internet browsers*, and *document processors*). The effect size for the difference in overall averages for teachers and students for competence was small, $d = .48$ but the effect size for the difference in overall averages for teachers and students for confidence was medium, $d = .64$.

Summary of Case B

The teacher's stated preference in using ICT was reflected in how ICT was used in the session. When the teacher used ICT and when ICT was not used, the most frequently observed behaviours involved the teacher initiating interactions with the students and the students responding or the students initiating interactions with the teacher and the teacher responding. However, when the students used the ICT, the most frequently observed behaviours involved students interacting with other students or individual student behaviours. Although the teacher stated the ICT was used as part of the learning outcomes before the observation, she referred to the improved learning ICT would enable after the observation. The majority of students responded that ICT was not important in the lesson, which may indicate they felt it was not needed during the lesson, reflecting the teacher's focus on trusting students to use ICT discriminatingly. The teacher's indication of modelling using ICT for research was reflected in the students' responses regarding using ICT for obtaining information. The significant correlation between the teacher and average student reported confidence and the medium effect size in the average confidence could reflect the teacher's role modelling ICT use.

CASE D

Context

The female teacher and her eight Year 5 students were observed over a 35 minute session. There were four male and four female students sitting in two groups in front of the electronic whiteboard throughout the session (see Figure D3, p. 262). The observed session involved mathematics, with the electronic whiteboard, time program, and internet used by the teacher for the first 27 minutes and then used by the students for the last 8 minutes.

Table 4.4

Case D results

Behaviours	
ICT used by whom	Electronic whiteboard, time program, and internet used by the teacher. Electronic whiteboard, time program, and internet used by the students.
Class organisation when ICT used	In two groups of students
Most frequently occurring behaviours when ICT used by the teacher	• Teacher initiated interactions with the students, including students responding (42 occurrences) • Students interacting with other students (11 occurrences)
Most frequently occurring behaviours when ICT used by the students	• Students interacting with other students (7 occurrences) • Individual student behaviours (4 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *role modelling ICT* and *student learning*
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT, using ICT in pedagogy, using ICT outside of teaching
Student responses – should teachers be able to use ICT in their lessons	All 8 responding students affirmed teachers should be able to use ICT in their lessons
Student responses – why should teachers be able to use ICT in their lessons	Themes of *being beneficial for students* (n=5) and *learning and teaching* (n=5)
ICT use in the observed session	
Teacher response –what the students learned by using ICT	Category of *learning from using the ICT*
Student responses – was ICT important in the lesson	7 of 8 responding students stated ICT was important to the lesson
Student responses –what ICT was used for in the lesson	All students referred to the *ICT itself* (n=8).
Student responses – most important part of ICT being used in the lesson	Themes of *the activity* (n=5) and *learning and teaching* (n=4)

Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.18	3.99
Average Confidence	3.33	4.12

Research Question 1 – Teacher and Student Observed Behaviours

The teacher selected the hardware and software when ICT was used, but different behaviours were observed when the teacher used the ICT and when the students used the ICT. When the teacher used the ICT, the most frequently occurring behaviours were initiated by the teacher, whereas when the students used the ICT, the most frequently occurring behaviours involved student initiated interactions.

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher responses to the post-observation questionnaire regarding the importance of ICT focused on role modelling ICT use and student learning, while her responses regarding the main ICT skills required in her role as a primary school teacher focused on knowledge of ICT and using ICT in her pedagogy as well as outside of her teaching. Role modelling ICT use and student learning were reflected in the example, "[the children] look to us as a guide … respond more to learning that incorporates ICT" (Teacher D, 01/12/2009). All eight students completed the questionnaire and all responded that a teacher *should* be able to use ICT in their lessons, with responses for *why* teachers should be able to use ICT in the classroom reflecting the themes *being beneficial for students* and *learning and teaching* (see Table 4.4).

The teacher stated ICT was not used as part of the learning outcomes, more that it was "used to support Maths outcomes" (Teacher D, 01/12/2009). During the post-observation interview, the teacher stated using ICT meant the students would be "More focussed. Respond better than chalk and talk" (Teacher D, 01/12/2009). Her responses indicated she used ICT to improve learning opportunities. Seven of the eight students wrote that using ICT was important in the lesson, with student responses regarding ICT use in the lesson referring to the ICT itself, which would be at odds with the teacher intention to use ICT to improve learning opportunities. As shown in Table 4.4, the students' responses to the question regarding the most important part of using ICT during the observation resulted in different themes, with the two main themes referring to *the activity* and *learning and teaching*. This reflected the teacher's focus on ICT to support learning.

Research Question 3 – Teacher self-reported competence and confidence

As shown in Table 4.4, the teacher's average competence was less than the average confidence. Teacher D rated herself expert and highly confident for *internet browsers* and *document processors* but did not rate her competence or confidence for *mobile telephones*, *social networking programs* or *wikis, blogs or twitter* (see Table M3, p. 286), indicating she did not use these ICT. Her rating for *statistical or database software* and *vodcast, podcast, video conferencing, or webinars* was less than competent. The teacher also did not rate herself for *digital cameras or video recorders* and *vodcast, podcast, video conferencing, or webinars*. She rated herself as less than confident for one of the items she rated herself as less than competent (*statistical or database software*) as well as *photograph and image software* (which she rated herself higher in competence than confidence) and *movie or DVD editing programs*. She rated herself higher in competence than confidence for *internet browsers* and more than confident for *desktop or laptop computers* and *email or messaging programs*.

Research Question 4 – Student self-reported competence and confidence

Table 4.4 shows that the student average competence was slightly lower than the average confidence. The ICT *email or messaging programs* had both the highest student average competence and the highest student average confidence, with both at the highest rating of 5.00 (see Table M3, p. 286). In addition, all students who responded regarding this ICT selected this rating. The ICT with the lowest student average competence was *wikis, blogs or twitter*, and the ICT with the lowest student average confidence was *movie or DVD editing programs*. Most variance in student competence occurred for *social networking programs* and occurred for *movie or DVD editing programs* for student confidence (which had the lowest student average confidence). When comparing student average competence and confidence, the student average competence was lower than the average confidence for seven ICT and the same for three.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. In both instances, the correlation was significant. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was strong and positive, $\tau_b = .72$, $p<.01$, two-tailed, $N = 11$. In addition, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was strong and positive, $\tau_b = .73$, $p<.01$, two-tailed, $N = 9$. This would indicate similarities in which ICT the teacher and students rated themselves as competent and confident. The teacher's competence and confidence for one of the ICT used during the observation (*electronic whiteboard*, as the program was not one of the specified ICT) was lower than the student average competence and confidence. The effect size for the difference in overall averages for teachers and students for both competence and confidence was medium, $d = .64$ and $d = .63$, respectively.

Summary of Case D

The teacher's stated preferences for using ICT were not evident in the observation. Whoever used the ICT initiated the most behaviours during the observations. Although the teacher referred to the ICT as being used to help students learn, the students focused on the ICT itself in their answers regarding the importance of ICT in the lesson. However, the teacher's view of ICT in the teacher role in terms of students responding more to learning incorporating ICT corresponded with the students' focus on ICT use during the lesson being beneficial to them and helping them learn. The student average competence and confidence for all ICT were greater that the teacher average competence and confidence, with a medium effect size for the difference between the student averages and the teacher averages. In addition, there were strong and positive correlations between teacher's average competence and confidence and the student average competence and confidence for all ICT.

CASE F

Context

The female teacher and her 23 Year 5 students were observed over a 70 minute session. There were 9 male and 14 female students observed sitting in seven groups in the classroom (see Figure D4, p. 263). The session involved the English learning area and focused on advertisements. The first 7 minutes did not involve ICT as the students individually completed a worksheet on advertisements. For the next 35 minutes, the teacher used the electronic whiteboard and the internet to show advertisements that the class discussed. The final 31 minutes involved the students working in their groups to interpret paper advertisements and to then create their own.

Table 4.5

Case F results

Behaviours	
ICT used by whom	Electronic whiteboard and internet used by the teacher.
Class organisation when ICT used	In five groups and one student by himself.
Most frequently occurring behaviours when ICT not used (first session)	• Teacher initiated interactions with the students, including students responding (14 occurrences)
Most frequently occurring behaviours when ICT used by the teacher	• Teacher initiated interactions with the students, including students responding (74 occurrences) • Student initiated interactions with the teacher that involved the teacher responding (16 occurrences) • Individual student behaviours (13 occurrences)
Most frequently occurring behaviours when ICT not used (second session)	• Teacher initiated interactions with the students, including students responding (39 occurrences) • Individual student behaviours (24 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *specific ICT* and *teaching skills*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT and skills related to ICT use
Student responses – should teachers be able to use ICT in their lessons	Ten out of 11 responding students affirmed teachers should be able to use ICT in their lessons
Student responses – why should teachers be able to use ICT in their lessons	Theme of *learning and teaching* (n=7) and *the ICT itself* (n=6).

ICT use in the observed session		
Teacher response –what the students learned by using ICT	Category of *learning from using the ICT*	
Student responses – was ICT important in the lesson	Ten out of 11 responding students stated ICT was important to the lesson	
Student responses –what ICT was used for in the lesson	Most frequent responses referred to *the activity* (n=8) and *the ICT itself* (n=2).	
Student responses – most important part of ICT being used in the lesson	Themes of *the activity* (n=9) and *the ICT itself* (n=7)	
Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.14	3.43
Average Confidence	3.14	3.54

Research Question 1 – Teacher and Student Observed Behaviours

The most frequently observed behaviours when ICT was not used and when the teacher used the electronic whiteboard and internet involved teacher initiated interactions with students including the students answering, as shown in Table 4.5. The question-answer format of the observed session, with the teacher asking most questions for the students to answer, may have resulted in the teacher directed nature of the sessions. This intention was reflected in the teacher's description of the lesson as being different to how she usually taught with ICT as it was "teacher directed" (Teacher F, 09/12/2009).

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher's focus on specific ICT and teaching skills were reflected in the her response "I use it [ICT] every day. PP (*sic*), internet, interactive maths activities research, teaching tools, prayer reflection - email" (Teacher F, 09/12/2009). Her focus on the knowledge of ICT and skills related to ICT use was demonstrated with her response "know how to set up laptop data projector etc. … know the software … be able to critique resources/web pages … ask for help … type" (Teacher F, 09/12/2009). The teacher's preference of using the electronic whiteboard or computers with the students in groups was reflected in the observation. The teacher stated ICT was used "to get interest level and for students to see that advertising and stereotypes and bias" (Teacher F, 09/12/2009) and that although the students didn't use it as she used it "as a tool" (Teacher F, 09/12/2009) as using ICT meant the students "got to see something that can't be explained, discuss power of advertising" (Teacher F, 09/12/2009). Her responses indicated she used ICT to improve learning opportunities. Of the 11 who completed the questionnaire, 10 responded that the teacher *should* be able to use ICT in their lessons, with the most prevalent themes for why being *learning and teaching* and *the ICT itself*. The theme of learning and teaching reflected the teacher's response regarding using ICT to get students interested.

As shown in Table 4.5, there were commonalities between the student responses regarding why ICT was important in the lesson and what the most important part of using ICT during the observation was, with both focusing on the themes *the activity* and *the ICT itself*. The students focused on the themes of the activity itself reflected the teacher responses, but the inclusion of the theme of the ICT itself contrasted, particularly as the teacher pointed out specifically that the students did not use ICT. However, this could be interpreted as the students indicating that without the ICT, the videos could not have been watched. The use of the ICT reflected the teacher's focus on ICT being used to improve the learning opportunities for the students.

Research Question 3 – Teacher self-reported competence and confidence

Table 4.5 shows the teacher's average <u>competence</u> and <u>confidence</u> were both 3.14. Teacher F rated herself as competent or higher but not expert and as more than confident but not highly confident in all ICT except for *statistical or database software*, *email or messaging programs*, *movie or DVD editing programs* and *social networking programs* (see Table M4, p. 287).

Research Question 4 – Student self-reported competence and confidence

Overall, the student average competence was slightly lower than the average confidence (see Table 4.5) and the student average competence was lower than the average confidence for 11 ICT. The two ICT with the highest student average <u>competence</u> were *desktop or laptop computers* and *presentation software*, which were the only ICT with an average 4.00 or above (see Table M4, p. 287). The ICT with the lowest student average competence was *social networking programs*, which was one of three below 3.00. One of the ICT with the highest student average confidence was also *desktop or laptop computers*, which, together with *document processors* (the other ICT with the same average), was one of three ICT with an average 4.00 or above. The ICT with the lowest student average confidence was *statistical or database software*, one of three below 3.00. Most variance in student competence occurred for *movie or DVD editing programs*, and for *digital cameras or video recorders* for student confidence.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was not significant, τ_b = .42, p>.05, two-tailed, N = 14. However, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was moderately strong and positive, τ_b = .53, p<.05, two-tailed, N = 14.

The teacher's competence and confidence were higher that the student average competence and confidence for the one of the two ICT used during the observation (*electronic whiteboard*) and lower for the other (*internet browsers*). The effect size for the difference in overall means for teachers and students for competence was small, d = .48 but the effect size for the difference in overall means for teachers and students for competence was medium, d = .64.

Summary of Case F

When ICT was used and used by the teacher and when ICT was not used, the most frequently occurring behaviours were teacher initiated interactions with the students, including the students responding. The teacher's description of the lesson as teacher directed reflected this. How ICT was used in the lesson also reflected the teacher's preferred way. In addition, using the electronic whiteboard with the internet enabled students to view videos from the internet. The teacher described the use of ICT in the lesson as focusing on improving learning opportunities that may not otherwise have been possible. The student responses regarding the importance of ICT focused on the activity – reflecting both the teacher's perceptions and the observed use of the ICT. In addition, the inclusion of learning and teaching as a theme in student responses regarding why teachers should be able to use ICT corresponded to the teacher's perceptions of ICT use in the lesson. The teacher's average competence and confidence were lower than the student average competence and confidence.

CASE E

Context

The female teacher and her 24 Year 6 students were observed over a 30 minute session. There were 14 male and 10 female students sitting in two groups when ICT was not used and when it was used (see Figure D5, p. 264). The first 15 minutes of the session was a literacy lesson that involved a range of activities for the students to work through – a comic strip regarding the parts of speech, suffixes and prefixes, spelling tied to suffixes, and working with the teacher. The second part of the session was also a 15 minute long literacy lesson that involved identifying grammatical terms in written texts using the electronic whiteboard and a document processor. Although the teacher and students used the ICT interchangeably when it was used, the teacher selected who would access the ICT and when.

Table 4.6

Case E results

Behaviours	
ICT used by whom	Electronic whiteboard and document processor used by both the teacher and students interchangeably.
Class organisation when ICT used	In two large groups of 11 and 13 students
Most frequently occurring behaviours when ICT not used	• Teacher initiated interactions with the students, including students responding (22 occurrences) • Individual student behaviours (7 occurrences)
Most frequently occurring behaviours when ICT used by both the teacher and students interchangeably	• Student interacting with other student/s (12 occurrences) • Individual student behaviours (10 occurrences)

Perceptions of ICT use in the classroom		
Teachers using ICT in the classroom		
Teacher response – importance of teacher using ICT	Theme of *teaching skills*.	
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT and using ICT in pedagogy.	
Student responses – should teachers be able to use ICT in their lessons	20 out of 24 responding students affirmed teachers should be able to use ICT in their lessons	
Student responses – why should teachers be able to use ICT in their lessons	Theme of *learning and teaching* (n=12), *being beneficial for students* (n=9), and *the ICT itself* (n=6).	
ICT use in the observed session		
Teacher response –what the students learned by using ICT	Category of *learning from using the ICT*	
Student responses – was ICT important in the lesson	16 out of 24 responding students stated ICT was important to the lesson	
Student responses –what ICT was used for in the lesson	Most frequent responses referred to *the activity* (n=11), *the ICT itself* (n=10), and *the learning area* (n=8).	
Student responses – most important part of ICT being used in the lesson	Themes of *learning and teaching* (n=14), *the ICT itself* (n=7), and *the activity* (n=7).	
Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.92	3.47
Average Confidence	4.07	3.47

Research Question 1 – Teacher and Student Observed Behaviours

Both the teacher and students used the electronic whiteboard and document processor but the teacher determined who would use them and when. This process incorporated many instances where the teacher asked students to answer questions by coming up to the electronic whiteboard. As a result, there were many teacher initiated interactions with the students, including the students responding. The occurrences of teacher directions when ICT was used reflected the teacher's response concerning the student concentration – "lose concentration … deal with more behaviour issues" (Teacher E, 01/12/2009). As a result, the teacher organised the lesson to be "quick". When ICT was not used, the most frequently occurring behaviours were students interacting with other students which may have resulted from the more individualistic nature of the activities they completed.

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher focus on teaching skills was reflected in the response that ICT was "a skill that is a must have in 1/4 of classroom lessons" (Teacher E, 01/12/2009). Her focus on the knowledge of ICT and using ICT in her pedagogy was demonstrated with her response, "save documents print work and use the internet to find information for interactive lessons" (Teacher E, 01/12/2009). Her responses were reflected in the student responses for why a teacher should be able to use ICT, with the most prevalent themes were *learning and teaching*, *being beneficial for students*, and *the ICT itself* (see Table 4.6).

The teacher stated in the pre-observation interview that she preferred to have lessons with ICT that were "structured and not open ended" (Teacher E, 01/12/2009), which reflected the use of ICT in the observation. Although the teacher stated ICT was used as part of the learning outcomes, her response focused on the learning opportunities as the ICT would be used to provide "a different aspect of learning for those who learn better from technology" (Teacher E, 01/12/2009). The students' responses regarding ICT use during the observation reflected their responses regarding the most important part of using ICT during the observation, with commonalities in two of the themes – *learning and teaching* and *the ICT itself*. The focus on learning was also evident in the teacher's response regarding the learning enabled by ICT as the teacher positioned ICT as a way to maintain student engagement and to provide different aspects of learning.

Research Question 3 – Teacher self-reported competence and confidence

The teacher's average competence and average confidence were the highest of all of the teachers (see Table 4.6). Apart from three ICT where the teacher did not rate herself (*mobile telephones* and *social networking programs*), her ratings were all competent or higher for all ICT (see Table M5, p. 288). Teacher E rated herself higher in competence than confidence for *photograph and image software* and *movie or DVD editing programs* and higher in confidence than competence for *internet browsers* and *document processors*.

Research Question 4 – Student self-reported competence and confidence

As shown in Table 4.6, the student average competence was the same as the average confidence and the student average competence was lower than the average confidence for seven ICT. The ICT with the highest student average competence was *social networking programs*, which was the only ICT with an average 4.00 or above (see Table M5, p. 288). The ICT with the lowest student average competence was *statistical or database software*, which was one of three below 3.00. The ICT with the highest student average confidence was *internet browsers*, which was the only ICT with an average 4.00 or above. The ICT with the lowest student average confidence was *wikis, blogs or twitter*, one of two below 3.00. Most variance in student competence occurred for *vodcast, podcast, video conferencing, or webinars*, and for *social networking programs* for student confidence.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. Kendall's τ_b indicated that there was no correlation between the ranked teacher's competence and the student average competence, τ_b = .000, p>.05, two-tailed, N = 12. However, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was moderate and positive, τ_b = .46, p<.05, two-tailed, N = 14. The two ICT used during the observation, *electronic whiteboard* and *document processors*, were both ICT where the teacher's competence and confidence were higher than the student average competence and confidence. The effect size for the difference in overall averages for teachers and students for both competence and confidence was medium, d = -.54 and d = -.58, respectively. This was one of two cases where the teacher's overall average for competence and confidence were higher than those of the students, though the only one where the effect size was medium.

Summary of Case E

When ICT was used, the most frequently occurring behaviours were teacher initiated interactions with the students, including the students responding. This reflected the teacher's concern regarding students losing concentration and increasing behaviour issues, which resulted in her wanting the lesson to be quick. These teacher initiated interactions may also have been due to the interchanging control over the ICT, with the teacher determining who would use it during the lesson. The use of ICT to improve learning opportunities during the lesson was indicated by the teacher's responses to whether ICT was a learning outcome from the lesson (to which the teacher stated "yes", but her clarification indicated otherwise), and the response that using ICT would have resulted in the students being more engaged. This was supported by the majority of students' responses to the most important aspect for using ICT during the lesson incorporating the theme *learning and teaching*. This theme was also the most frequently occurring in student responses to *why* teachers should be able to use ICT in the classroom. The teacher's average competence and confidence were higher than the student average competence and confidence for all ICT.

CASE I

Context

The female teacher and her 29 Year 6 students were observed over a 26 minute session. There were 16 males and 13 females observed in the classroom. The students were sitting in split rows when ICT was not used and when it was used (see Figure D6, p. 265). The observation was of a mathematics lesson and involved ICT for part of the observed session. The first 10 minutes involved revision of a mathematics test on operations and did not use ICT. The last 16 minutes involved the use of the electronic whiteboard to work through how to use a calculator to complete calculations. The teacher and students used the electronic whiteboard interchangeably, though the teacher selected who would control the ICT (and when), as well as selecting both the hardware (electronic whiteboard) and software (document processor) that were used.

Table 4.7

Case I results

Behaviours	
ICT used by whom	Electronic whiteboard and document processor used by both the teacher and students interchangeably.
Class organisation when ICT used	In rows.
Most frequently occurring behaviours when ICT not used	• Teacher initiated interactions with the students, including students responding (18 occurrences) • Student initiated interactions with the teacher, including the teacher responding (6 occurrences)
Most frequently occurring behaviours when ICT used by both the teacher and students interchangeably	• Teacher initiated interactions with the students, including students responding (25 occurrences) • Individual student behaviours (9 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *role modelling ICT use* and *specific ICT*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT and skills related to ICT use.
Student responses – should teachers be able to use ICT in their lessons	27 out of 29 responding students affirmed teachers should be able to use ICT in their lessons
Student responses – why should teachers be able to use ICT in their lessons	Theme of *the ICT itself* (n=15) and *being beneficial for students* (n=11).
ICT use in the observed session	
Teacher response –what the students learned by using ICT	Category of *learning from using the ICT*
Student responses – was ICT important in the lesson	13 out of 29 responding students stated ICT was important to the lesson
Student responses –what ICT was used for in the lesson	Most frequent responses referred to *the learning area* (n=26) and *the activity* (n=10).
Student responses – most important part of ICT being used in the lesson	Themes of *the activity* (n=11), *learning and teaching* (n=7), and *the ICT itself* (n=5).

Self-reported Competence and Confidence

	Teacher	Student
Average Competence	3.43	3.65
Average Confidence	3.71	3.74

Research Question 1 – Teacher and Student Observed Behaviours

When ICT was used, it was used by both the teacher and students. However, the teacher determined who would use it and when. This incorporated many instances where the teacher asked students to answer questions by coming up to the electronic whiteboard. As a result, there were many teacher initiated interactions with the students, including the students responding. This pattern of behaviour also occurred when ICT was not used. The similarities in the most frequently occurring behaviours when ICT was used and when it was not used may be due to the teacher's preference to use the electronic whiteboard "for putting up text" (Teacher I, March 19, 2010), much like the whiteboard was used when the ICT was not used.

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The focus on the learning enabled by ICT was evident in both student and teacher responses. Role modelling ICT and specific ICT use was reflected in the teacher's response "it is important that we display to our students the correct way to use the technologies available to us e.g. we need to show them that spell checkers are not always correct" (Teacher I, 19/03/2010). The knowledge of ICT and skills related to ICT use was demonstrated with her focus on "typing … internet searching skills … page design" (Teacher I, 19/03/2010). The focus on specific ICT was also evident in student responses as to why teachers should be able to use ICT in the classroom, with *the ICT itself* being the most frequently occurring response, followed by *being beneficial for students* (see Table 4.7).

The teacher stated in the pre-observation interview that she preferred to have lessons with ICT that involved "a lot of interaction activities" (Teacher I, 19/03/2010). During the post-observation interview, the teacher stated using ICT meant the students were "able to explain to each other the process … helps with confidence as get flustered if rub out text." (Teacher I, 19/03/2010). Under half of the responding students (n=13) wrote using ICT was important in the lesson. As shown in Table 4.7, the *learning area*, *the activity*, and *the ICT itself* were reasons for ICT use in the lesson, and these were similar to the themes reflected in the students' responses to the question regarding the most important part of using ICT during the observation – *the activity*, *learning and teaching*, and *the ICT itself*.

Research Question 3 – Teacher self-reported competence and confidence

As shown in Table 4.7, the average for competence and confidence showed that Teacher I was slightly more than competent and slightly more than confident. Teacher I rated herself as expert for *document processors* and *social networking programs* and competent or higher (but not expert) for eight ICT and rated herself as less than competent for four ICT (see Table M6, p. 289). The teacher rated herself as highly confident in six ICT, two of which were ICT for which the teacher rated herself as expert. The teacher rated herself as more than confident for the *electronic whiteboard* and *presentation software*. For all other ICT, the teacher rated herself as confident or below. The teacher rated herself higher in confidence than in competence for five items – *desktop or laptop computers*, *electronic whiteboard*, *mobile telephones*, *internet browsers*, and *email or messaging programs* – with the teacher rating herself as highly confident for four of these ICT (not including the *electronic whiteboard*).

Research Question 4 – Student self-reported competence and confidence

As shown in Table 4.7, the student average competence was slightly lower than the average confidence with the student average competence lower than the average confidence for eight ICT. The ICT with the highest student average <u>competence</u> was *email or messaging programs*, which was one of three ICT with an average of 4.00 or above (see Table M6, p. 289). The ICT with the highest student average <u>confidence</u> was *mobile telephones*, which was one of five ICT with ratings of 4.00 or above. The ICT with the lowest student average competence and confidence was *wikis, blogs or twitter*, and it was one of two ICT with an average confidence ratings below 3.00. Most variance in student competence occurred for *wikis, blogs or twitter*, and for *statistical or database software* for student confidence.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. The relationship between the teacher's competence and the student average competence were calculated. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was significant, $\tau_b = .53$, $p<.05$, two-tailed, $N = 14$. However, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was not significant, $\tau_b = .41$, $p>.05$, two-tailed, $N = 14$. For the ICT used during the observation, the *electronic whiteboard* and *document processors*, the teacher's competence was higher for *document processors* but not for the *electronic whiteboards*. However, the teacher's confidence was higher than the student average rating for both ICT used during the observation. The effect size for the difference in overall averages for teachers and students for both competence and confidence was small, $d = .19$ and $d = .02$, respectively.

Summary of Case I

The prevalence of behaviours involving teacher initiated interactions with the students including the students responding when ICT was used and when ICT was not used may have been due to the question and answer format used by the teacher. In addition, her use of ICT was as a replacement for the whiteboard, which was used when ICT was not used. The teacher considered her role to incorporate ICT to both show students how to use it appropriately and to enable learning opportunities for students. The students considered ICT a part of the teacher role both due to the ease with which students could use it and the benefits for using it in the lesson. When the ICT use in the lesson was considered, the teacher viewed ICT as providing a way to assess the student understanding and to help them share their understanding, while the students considered ICT was used for the activity itself, the learning area, and the ICT itself. The students' consideration of the activity and the learning area reflected the teacher consideration of ICT use for enabling learning opportunities. The teacher's average competence and confidence for all ICT were lower than the student average competence and confidence for all ICT.

WHEN ICT WAS USED TO SUPPORT LEARNING – SUMMARY OF CASES A, B, D, F, E, AND I

All of the preceding cases used the electronic whiteboard, and when the teacher used it, the most frequently occurring behaviours were teacher initiated interactions with the students. When the internet was also used (Cases A, B, and D), the teacher referred to using ICT beyond focusing on pedagogy as an ICT skill that teachers needed. The students did not use ICT at all during the observation for Case F, and the students did not refer to the benefits to students of the teacher using the ICT in their role. The two cases where the teacher first used the ICT then the students used the ICT, Cases B and D, were the only cases of the six where the students did not refer to the ICT itself as one of the frequently occurring reasons why the teacher should use ICT. These two cases were also the only two where the students did not refer to ICT itself as why using ICT was important in the lesson. In three of the cases (Cases A, B, and D), the students used ICT by themselves. Whereas in Cases B and D, the most frequently observed behaviours when the students used ICT were student initiated, in Case A, the most frequently observed behaviours were teacher initiated and Teacher A had a confidence rating of below confident. All cases apart from Case B referred to knowledge of ICT as an ICT skill that teachers needed.

CASE K

Context

The male teacher and his 25 Year 6 students were observed over a 42 minute session. There were 11 male and 14 female students organised in groups of between four and five students per group (see Figure D7, p. 266) for the ten minutes required for the teacher to outline the next task. During this time, the teacher used the electronic whiteboard and document processor to demonstrate the task requirements. Approximately half of the class, 13 male students and 1 female student, went into the computer laboratory for 32 minutes to work on the desktop computer using document processor or presentation software (see Figure D8, p. 267) and the other students (all females) went in small groups to other classrooms to use their desktop computers whilst the other class was still in the classroom. During the observed session with ICT, the students were required to create a cover page for their portfolio.

Table 4.8

Case K results

Behaviours	
ICT used by whom	Electronic whiteboard and document processor used by the teacher. Desktop computer and document processor or presentation software used by the students.
Class organisation when ICT used	Individually in computer laboratory.
Most frequently occurring behaviours when ICT used by the teacher	• Teacher initiated interactions with the students, including students responding (18 occurrences) • Student initiated interactions with the teacher that involved the teacher responding (14 occurrences)
Most frequently occurring behaviours when ICT used by the students	• Student interacting with other student/s (53 occurrences) • Individual student behaviours (18 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *changing world* and *student learning*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT and using ICT in pedagogy.
Student responses – should teachers be able to use ICT in their lessons	11 out of 12 responding students affirmed teachers should be able to use ICT in their lessons
Student responses – why should teachers be able to use ICT in their lessons	Theme of *useful* (n=8), *being beneficial for students* (n=7), and *for information* (n=6).
ICT use in the observed session	
Teacher response –what the students learned by using ICT	Category of *learning the ICT itself*
Student responses – was ICT important in the lesson	7 out of 12 responding students stated ICT was important to the lesson
Student responses –what ICT was used for in the lesson	Most frequent response referred to *the activity* (n=11).
Student responses – most important part of ICT being used in the lesson	Themes of *the activity* (n=5) and *the ICT itself* (n=4).

Self-reported Competence and Confidence

	Teacher	Student
Average Competence	3.43	4.13
Average Confidence	3.50	4.24

Research Question 1 – Teacher and Student Observed Behaviours

The teacher selected the hardware and software, but offered students the choice of two software programs when the students used the ICT. The most frequently occurring behaviours were initiated by the teacher when the teacher used the ICT and the most frequently occurring behaviours involved student initiated interactions when the students used the ICT. The level of student initiated interactions, particularly with other students, could be explained by the teacher comment – "these students more sociable, less self-disciplined" (Teacher K, 26/03/2010).

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher responses regarding the importance of ICT focused on the changing world, specific ICT use, and student learning as reflected in his response "in this day and age you would be doing your students an injustice if you did not include IT in your daily lessons" (Teacher K, 26/03/2010). The knowledge of ICT and using ICT in his pedagogy were demonstrated with his response "software skills … teaching pedagogy …adequate equipment and resources at hand … hardware knowledge" (Teacher K, 26/03/2010). As shown in Table 4.8, two of the three most frequent themes for the student responses for *why* teachers should be able to use ICT in the classroom – *useful*, for example, "use ICT items in the lessons" (Student K05, 26/03/2010), *being beneficial for students*, for example, "it would help me and because I look forward to going on the computer" (Student K06, 26/03/2010), and *for information*, for example, "if we have a topic and we want to get more info on it and if you are not sure of the answer they can look it up"(Student K07, 26/03/2010) – reflected the teacher response regarding the importance of ICT.

The teacher stated in the pre-observation interview that he preferred to use ICT to "demonstrate as a whole class don't use small group work with ICT. When demonstrate use IWB" (Teacher K, 26/03/2010), which was how the ICT was used when the teacher used the ICT. The teacher stated ICT was not used as part of the learning outcomes, more that it was used for the "cover page for portfolios so not assessing that" (Teacher K, 26/03/2010), indicating he used ICT to for supporting learning. The teacher's preferences and actual use of ICT and his focus on the ICT to support learning were reflected in the most frequent themes occurring in student responses regarding the most important aspect of using ICT during the observation, *the activity* and *the ICT itself* (see Table 4.8). This was related to the teacher's positioning of ICT as being used to create the final object. The student focus on the activity in response to what the ICT was used for and as one of the most important parts of using ICT during the lesson also coincided with the teacher view that the ICT was supporting students in completing their task.

Research Question 3 – Teacher self-reported competence and confidence

As shown in Table 4.8, the teacher's average <u>competence</u> was slightly below his average <u>confidence</u>. Teacher K rated himself as an expert for the *electronic whiteboard*, which was the ICT used when the teacher used the ICT (see Table M7, p. 290). He rated himself as competent or higher for all other items apart from *social networking programs*, *wikis, blogs or twitter*, and *vodcast, podcast, video conferencing, or webinars*. The teacher rated himself as highly confident in three items – the *electronic whiteboard*, *document processors*, and *presentation software*. These three were three of the four ICT used during the observation. Additionally, the last two of these ICT were rated higher in confidence than competence. The teacher rated himself as higher in competence than confidence for *digital cameras or video recorders*.

Research Question 4 – Student self-reported competence and confidence

Overall, as shown in Table 4.8, the student average <u>competence</u> was slightly lower than the average <u>confidence</u>. The ICT with the highest student average competence was *internet browsers*, which was one of eight ICT with an average 4.00 or above (see Table M7, p. 290). The ICT with the lowest student average competence was *statistical or database software* which also had the lowest student average confidence. The ICT with the highest student average confidence was also *internet browsers* along with *desktop or laptop computers*, and these were two of 11 ICT with ratings of 4.00 or above. The ICT used during the observation, *desktop or laptop computers* had one of the highest average ratings. Most variance in student competence occurred for *social networking programs*, and for *statistical or database software* for student confidence (which also had the lowest average confidence).

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was not significant, $\tau_b = .21$, $p > .05$, two-tailed, $N = 14$. Similarly, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was not significant, $\tau_b = .05$, $p > .05$, two-tailed, $N = 14$. The teacher's competence was the same as the student average competence for *desktop or laptop computers*, but was lower for *document processors* and *presentation software*. The teacher's competence was the higher as the student average competence for the *electronic whiteboard*. The teacher's confidence was lower than the student average confidence for *desktop or laptop computers*, but higher for the *electronic whiteboard*, *document processors* and *presentation software*. The effect size for the difference in overall means for teachers and students for competence was medium, $d = .67$ but the effect size for the difference in overall means for teachers and students for competence was large, $d = .70$.

Summary of Case K

The most frequently occurring behaviours when the teacher used the ICT were teacher initiated, whereas when the students used the ICT the most frequently occurring behaviours were student initiated. The level of student initiated behaviours with other students could be attributed to either the ICT use or what the teacher described as the students being more sociable or a combination of the two. When the teacher used the ICT, he used it in his preferred way. The teacher indicated that the ICT was used to in the activity, rather than as the learning outcome, and this was reflected in the student responses regarding what ICT was used for in the lesson and the most important aspects of using ICT in the lesson. The teacher's average competence and confidence for all ICT were lower than the student average competence and confidence for all ICT.

CASE H

Context

The male teacher and his 19 Year 6 students were observed over a 48 minute session. There were 8 male and 10 female students sitting in five self-selected groups in the library when ICT was not used (see Figure D9, p. 268) and 8 male and 11 female students sitting individually or in pairs at desktop computers in the computer laboratory when ICT was used (see Figure D9, p. 268). The observed session involved the Society and Environment learning area and focused on creating a timeline about the Gold Rush. The first part of the session went for 30 minutes and involved students reading provided information and considering how to use the information in a timeline. ICT was not used during this part of the session. The second part of the session went for 18 minutes and involved students creating their timeline using ICT.

Table 4.9

Case H results

Behaviours	
ICT used by whom	Desktop computers with document processor or presentation software used by the students.
Class organisation when ICT used	Mostly individually in computer laboratory
Most frequently occurring behaviours when ICT not used	• Teacher initiated interactions with the students, including students responding (48 occurrences) • Students interacting with other students (10 occurrences)
Most frequently occurring behaviours when ICT used by the students	• Students interacting with other students (25 occurrences) • Teacher initiated interactions with the students, including students responding (14 occurrences)

Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *changing world*, *student learning*, and *teaching skills*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT and skills related to ICT use
Student responses – should teachers be able to use ICT in their lessons	18 out of 19 responding students affirmed teachers should be able to use ICT in their lessons
Student responses – why should teachers be able to use ICT in their lessons	Themes of *being beneficial for students* (n=9), *learning and teaching* (n=8) and *the ICT itself* (n=6).
ICT use in the observed session	
Teacher response –what the students learned by using ICT	Category of *learning the ICT itself*
Student responses – was ICT important in the lesson	12 of the 19 responding students stated ICT was important to the lesson
Student responses –what ICT was used for in the lesson	Themes of *the activity* (n=13) and *the ICT itself* (n=11).
Student responses – most important part of ICT being used in the lesson	Most frequent responses referred to *the ICT itself* (n=11) and *the activity* (n=10).

Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.00	3.59
Average Confidence	2.79	3.82

Research Question 1 – Teacher and Student Observed Behaviours

Although the teacher selected the hardware and software, he gave the students a choice of two software programs to use during the lesson. When ICT was used, the most frequently occurring behaviours involved students interacting with each other. When ICT was not used, the most frequently occurring behaviours involved the teacher initiating interactions with the students and the students responding, which was the second most frequent type of behaviours when students used the ICT. The teacher referred to keeping the students on-task through his preference to “keep it short and sharp ... don’t let them wander” (Teacher H, 18/03/2010).

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher responses to the post-observation questionnaire regarding the importance of ICT focused on the changing world, student learning, and teaching skills, and were reflected in his response "critical for engaging students in learning - Prepares students for the 21st - Assists us in our teaching of content, knowledge (makes life easier)" (Teacher H, 18/03/2010). The knowledge of ICT, personal attributes, and using ICT in his pedagogy were demonstrated with his response "Enthusiasm … knowledge and application of skills… explicitly (*sic*) teaching strategies… willingness to facilitate children to explore and discover" (Teacher H, 18/03/2010). The teacher focus on the development of ICT skills and student engagement with their activities as reasons why teachers should use ICT in their role was reflected in the student responses regarding why teachers should be able to use ICT. Student responses focused on the themes of *being beneficial for students*, *learning and teaching*, and the *ICT itself* (see Table 4.9).

The teacher responses indicated he used ICT for the students to learn the ICT itself. He his preferred way of using ICT would use the electronic whiteboard "as an instructional tool … [encouraging] … engagement" (Teacher H, 18/03/2010), this did not occur during the observed session. During the post-observation interview, the teacher focused on ICT, stating the students "can use word documents, word art, go into Publisher, Powerpoint … Learnt getting up timeline, key wording. Set up of a page" (Teacher H, 18/03/2010). As shown in Table 4.9, the student responses regarding ICT use reflected the teacher's responses, with reference to *the activity* and the *ICT itself*. The students' responses to the question regarding the most important part of using ICT during the observation reflected the same themes – *the ICT itself* and *the activity*.

Research Question 3 – Teacher self-reported competence and confidence

The teacher's average competence was higher than his average confidence, as shown in Table 4.9, with his average confidence below confident and the lowest of all the teachers. The teacher rated himself as expert for *document processors* and highly competent for eight of the specified ICT (see Table M8, p. 291). Teacher H did not rate himself as highly confident in any ICT in the questionnaire. He rated himself confident or higher on eight items and less than confident in six items (see Table M8, p. 291). The teacher rated himself higher in terms of competence than confidence for *document processors* and *statistical or database software*. The teacher rated himself as competent or higher and confident or higher in the three ICT used during the observation – *desktop or laptop computers*, *document processors*, and *presentation software*.

Research Question 4 – Student self-reported competence and confidence

As shown in Table 4.9, the student average competence was slightly lower than the average confidence. The ICT with the highest student average competence was *mobile telephones*, and this was one of three ICT with an average 4.00 or above (see Table M8, p. 291). The ICT with the lowest student average competence was the *electronic whiteboard*, one of two with an average below 3.00. The ICT with the highest student average confidence was *email or messaging programs*, which was one of six ICT with ratings 4.00 or above. The ICT with the lowest student average confidence was the *electronic whiteboard*, the same as for student average competence. This was also the only ICT with an average confidence below 3.00. The ICT with the most variance was the same for both student competence and confidence – *statistical or database software*.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was not significant, $\tau_b = .28$, $p>.05$, two-tailed, $N = 14$. In contrast, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was moderately strong and positive, $\tau_b = .52$, $p<.05$, two-tailed, $N = 14$. This may have been related to the teacher's competence for the three ICT used during the observation being higher than the student average competence, but his confidence was lower than the student average confidence for the ICT. The effect size for the difference in overall means for teachers and students for competence was small, d = .47 but the effect size for the difference in overall means for teachers and students for competence was large, d = .84.

Summary of Case H

The teacher's preference of keeping the lesson short and the students focused may have contributed to teacher initiated interactions with the student being the most frequently observed behaviours when ICT was not used and the second most frequently observed behaviours when ICT was used. The teacher consideration of both specific ICT skills and how to use the ICT for teaching and learning as the ICT skills required by a teacher was reflected in the student responses focusing on ICT being beneficial for students, learning and teaching, and the ICT itself being most frequent. The teacher considered that ICT was used in the lesson to enable the students to learn and develop their ICT skills. This also was evident in the themes present in student responses, with the ICT itself and the activity being most frequent in terms of what students used ICT and the most important part of using ICT in the lesson. The teacher's average competence and confidence for all ICT were lower than the student average competence and confidence for all ICT.

CASE G

Context

The male teacher and his 28 Year 5 students were observed over a 28 minute session. There were 14 male and 14 female students sitting in six self-selected groups in the library when ICT was not used (see Figure D10, p. 269) and 13 male and 15 female students sitting individually or in pairs at desktop computers in the computer laboratory when ICT was used (see Figure D10, p. 269). The first 10 minutes of the session did not use ICT and involved the teacher explaining the activity (a timetable) to be completed in the next session. The second part of the observation was 18 minutes long and involved the students using ICT to create a timetable.

Table 4.10

Case G results

Behaviours	
ICT used by whom	Desktop computers with spreadsheet software used by the students.
Class organisation when ICT used	Mostly individually in computer laboratory
Most frequently occurring behaviours when ICT not used	• Teacher initiated interactions with the students, including students responding (17 occurrences)
Most frequently occurring behaviours when ICT used by the students	• Teacher initiated interactions with the students, including students responding (14 occurrences) • Individual student behaviours (4 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *specific ICT* and *student learning*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT and personal attributes
Student responses – should teachers be able to use ICT in their lessons	24 out of 27 responding students affirmed teachers should be able to use ICT in their lessons
Student responses – why should teachers be able to use ICT in their lessons	Themes of *learning and teaching* (n=18), *being beneficial for students* (n=12), and *the ICT itself* (n=8).
ICT use in the observed session	
Teacher response –what the students learned by using ICT	Category of *learning the ICT itself*
Student responses – was ICT important in the lesson	15 of the 27 responding students stated ICT was important to the lesson
Student responses –what ICT was used for in the lesson	Themes of *the ICT itself* (n=17) and *the activity* (n=15).
Student responses – most important part of ICT being used in the lesson	Most frequent responses referred to *learning and teaching* (n=15), *the activity* (n=12), and *the ICT itself* (n=10).

Self-reported Competence and Confidence

	Teacher	Student
Average Competence	2.71	3.32
Average Confidence	3.00	3.51

Research Question 1 – Teacher and Student Observed Behaviours

When the ICT was used and when it was not used, the most frequently occurring behaviours were teacher initiated interactions with the students including the students responding. The teacher use of a question and answer format reflected the teacher's response describing the lesson with ICT as a "guided lesson" (Teacher G, 18/03/2010).

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher focus regarding specific ICT and student learning were reflected in his response "Most students can use cameras, computers etc. better than many teachers. What they don't know is how to apply their knowledge to their school work, and this is where ICT can drive student's learning." (Teacher G, 18/03/2010). These were connected to the themes of knowledge of ICT and personal attributes as main teacher ICT skills, as demonstrated with his response "Knowing how to use the hardware ie laptop, camera, interactive whiteboard … knowing or have the ability to learn how the software works …have a real interest in ICT otherwise you won't put in much of an effort" (Teacher G, 18/03/2010). As shown in Table 4.10, combinations of these themes were evident in student responses as to why teachers should be able to use ICT in the classroom – *learning and teaching*, *being beneficial for students*, and the *ICT itself*.

The teacher stated in the pre-observation interview that he preferred "letting students experiment … doing is learning so students get in" (Teacher G, 18/03/2010), and although students did not experiment, they did use the ICT to create their timetable during the observation. Although the teacher stated ICT would be part of the learning outcomes for the series of lessons, during the post-observation interview, the teacher stated students "didn't have much time … learnt some basic things about Excel." (Teacher G, 18/03/2010). His responses indicated he used ICT for learning the ICT itself. The student responses regarding why ICT was important in the lesson focused on the ICT itself or the activity for example, "making a timetable in excel" (Student G24, 18/03/2010). These themes were also evident in students' responses to the question regarding the most important part of using ICT, with focus on *learning and teaching*, *the activity*, and *the ICT itself* (see Table 4.10).

Research Question 3 – Teacher self-reported competence and confidence

The teacher's average competence was the lowest of all of the teachers and below competent, as shown in Table 4.10, and his average confidence was at confident. Teacher G did not rate himself as expert or highly confident in any of the ICT (see Table M9, p. 292). He rated himself as competent or higher in all but four ICT. He rated himself as less than confident for the five ICT. The teacher rated himself as higher in confidence than competence for the *electronic whiteboard*, *mobile telephones*, *document processors*, and *presentation software*. The teacher rated himself as competent or higher and confident or higher in the two ICT used during the observation.

Research Question 4 – Student self-reported competence and confidence

As shown in Table 4.10, the student average competence was lower than the average confidence. The ICT with the highest student average competence and confidence was *digital cameras or video recorders*, which was the only ICT with an average competence 4.00 or above but one of two with an average confidence of 4.00 or above (see Table M9, p. 292). The ICT with the lowest student average competence was *presentation software*, which was one of three below 3.00. The ICT with the lowest student average confidence was *wikis, blogs or twitter*, one of two below 3.00. Most variance in student competence and confidence occurred for *social networking programs*.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was not significant, τ_b = .42, p>.05, two-tailed, N = 14. Likewise, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was also not significant, $\tau_b = .06$, $p>.05$, two-tailed, $N = 14$. This would indicate dissimilarities in which ICT the teacher and students rated themselves as competent and confident.

The teacher's competence and confidence was higher than the student average competence for *desktop or laptop computers* and the teacher's competence was higher than the student average competence for *statistical or database software*. However, the student average confidence was higher than the teacher's confidence for *statistical or database software*. The effect size for the difference in overall means for teachers and students for competence was medium, $d = .54$ but the effect size for the difference in overall means for teachers and students for competence was small, $d = .42$.

Summary of Case G

When ICT was used by the students and when ICT was not used, the most frequently occurring behaviours were teacher initiated interactions with the students including the students responding. This may reflect the teacher's reference to the lesson as a guided lesson and his use of a question and answer format. It could also be related to the teacher's average confidence being less than a rating of confident resulting in a need to keep control of the lesson. The teacher referred to ICT skills in his reasons as to why ICT was important in his role as a teacher and this corresponded to the theme of the ICT itself, which was one of the three themes that emerged from the student reasons for why teachers should be able to use ICT. The teacher's responses regarding ICT during the observation indicated it was used for the ICT itself. This focus was also evident in the student responses regarding what ICT was used for in the lesson. The teacher's average competence and confidence for all ICT were lower than the student average competence and confidence for all ICT.

WHEN ICT LEARNING WAS A FOCUS – SUMMARY OF CASES K, H, AND G

All of the three cases used ICT in similar ways – desktop computers used by students in a computer laboratory after the teacher had explained what was to be done. In addition, teacher perceptions shared similarities – the male teacher in each case referred to student learning as a reason for the importance of ICT in the teacher role and knowledge of ICT as one of the main teacher ICT skills. There were also similarities in student perceptions, with one of the most frequently occurring reasons given by students for why the teacher should use ICT in their role was the benefits enabled for students and two of the most frequently occurring reasons students gave for why ICT was important in the lesson referred to the ICT itself and the activity. In two of the three cases, the most frequently observed behaviours when the students used the ICT were student initiated. In the one case where the most frequently occurring behaviours when the students used the ICT were teacher initiated (Case G), the teacher had a competence rating of below competent.

CASE C

Context

The female teacher and her 10 Year 6 and year 7 students were observed over an 82 minute session. There were 7 male and 3 female students. The students were sitting in three groups on the floor in the classroom when ICT was not used (see Figure D11, p. 270) and were seated individually at desktop computers in the computer laboratory when the desktop computers and spreadsheet program were used (see Figure D12, p. 271). The first 45 minutes of the session was a literacy lesson that involved students working on a time line of Albert Einstein's life. The second part of the session was 37 minutes long and the students worked on a mathematics exercise from the previous day and on a timeline on Australian heroes from a previous literacy lesson.

Table 4.11

Case C results

Behaviours	
ICT used by whom	Desktop computers with spreadsheet software used by the students.
Class organisation when ICT used	Individually in computer laboratory
Most frequently occurring behaviours when ICT not used	• Teacher initiated interactions with the students, including students responding (76 occurrences) • Student initiated interactions with the students, including teacher responding (13 occurrences)
Most frequently occurring behaviours when ICT used by the students	• Student interacting with other student/s (36 occurrences) • Student initiated interactions with the students, including teacher responding (32 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *the changing world*, *the curriculum*, and *specific ICT*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT and personal attributes
Student responses – should teachers be able to use ICT in their lessons	8 out of 10 responding students affirmed teachers should be able to use ICT in their lessons
Student responses – why should teachers be able to use ICT in their lessons	Theme of *being beneficial for students* (n=7).
ICT use in the observed session	
Teacher response –what the students learned by using ICT	Categories of *learning from using the ICT* and *learning the ICT itself*
Student responses – was ICT important in the lesson	All 10 responding students stated ICT was important to the lesson
Student responses –what ICT was used for in the lesson	Themes of *the ICT itself* (n=7) and *the activity* (n=5).
Student responses – most important part of ICT being used in the lesson	Most frequent responses referred to *ICT itself* (n=5) and *the activity* (n=4).

Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.79	4.06
Average Confidence	3.79	4.33

Research Question 1 – Teacher and Student Observed Behaviours

Although the teacher selected the hardware and software, when ICT was used, it was used by the students. When the ICT was used, the most frequently occurring behaviours were student initiated, either with other students or with the teacher. The lack of teacher directions when ICT was used reflected the teacher's response concerning the lack of student off-task behaviours – "very rarely have behaviour issues when teaching ICT" (Teacher C, 26/11/2009). When ICT was not used, the most frequently occurring behaviours were teacher initiated interactions with the students, including the students responding.

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher responses to the post-observation questionnaire regarding the importance of ICT focused on the changing world, the curriculum, and specific ICT as reflected in her response that ICT "assists in attaining outcomes in various curriculum areas" and "IWB's (*sic*) also stimulate students lrng (*sic*) and participation" (Teacher C, 26/11/2009). Her focus on knowledge of ICT was evident with her response "Word - emailing - Excel - internet skills/search engines etc. - Powerpoint - Login & passwords" (Teacher C, 26/11/2009). As shown in Table 4.11, the most frequent student responses for *why* teachers should be able to use ICT in the classroom reflected the student learning and participation aspect of the teacher's response, with the most prevalent theme *being beneficial for students*.

The teacher stated in the pre-observation interview that she preferred to "integrate it into curriculum" (Teacher C, 26/11/2009), which reflected the use of ICT in the observation. The teacher stated ICT was used as part of the learning outcomes by "assessing T&E skills to use computer/Excel appropriately" (Teacher C, 26/11/2009), while during the post-observation interview, the teacher stated using ICT meant the students would "be independent … [learn] how to use excel … problem solving and critical thinking" (Teacher C, 26/11/2009). Together these indicated she used ICT to improve learning opportunities and for learning the ICT itself. The teacher's positioning of ICT as part of the learning outcomes and as why the ICT was used was reflected in the student responses as to why ICT was important in the lesson and the most important part of using ICT in the lesson, with the most frequent student response to both questions referring to *the ICT itself* or *the activity* (see Table 4.11).

Research Question 3 – Teacher self-reported competence and confidence

As shown in Table 4.11, the teacher's average competence and confidence were the same. The teacher rated herself as expert for *desktop and laptop computers* and *document processors* (see Table M10, p. 293). The only item where the teacher rated herself as less than competent was *vodcast, podcast, video conferencing or webinars*. She rated herself higher in competence than confidence for *photograph and image software* and higher in confidence than competence for the *electronic whiteboard*. The teacher rated herself competent or higher and confident or higher for the two ICT used during the observation (*desktop or laptop computers* and *statistical or database software*), with her competence matching her confidence for these ICT.

Research Question 4 – Student self-reported competence and confidence

As shown in Table 4.11, the student average competence was lower than the average confidence, with the student average competence was lower than the average confidence for of the 11 ICT. The ICT with the highest student average competence was *presentation software*, which was one of nine ICT with an average 4.00 or above (see Table M10, p. 293). The ICT with the lowest student average competence and confidence was *wikis, blogs or twitter*. There were no ICT with a student average rating of 3.00 or below. The ICT with the highest student average confidence was *email or messaging programs*, which was one of 12 ICT with ratings 4.00 or above. Most variance in student competence occurred for *vodcast, podcast, video conferencing, or webinars*, and for *social networking programs* for student confidence.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was moderately strong and positive, $\tau_b = .45$, $p<.05$, two-tailed, $N = 14$. In contrast, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was not significant, $\tau_b = .20$, $p>.05$, two-tailed, N = 14. This would indicate similarities in which ICT the teacher and students rated themselves as competent and dissimilarities in the ICT the teacher and students rated themselves confident.

Three of the ICT for which the teacher's competence was higher than the student average competence, *desktop or laptop computers*, *document processors*, and *presentation software*, were also the ICT where the teacher's confidence was higher than the student average confidence. Additionally, the first-mentioned ICT was one of the two ICT used during the observation. The student average competence and confidence were higher than the teacher's competence and confidence for the other ICT used during the observation, *statistical or database software*. The effect size for the difference in overall means for teachers and students for competence was small, d = .31 but the effect size for the difference in overall means for teachers and students for competence was medium, d = .58.

Summary of Case C

The teacher's stated preferences for integrating ICT into the curriculum and teaching ICT skills were evident during the observation when ICT was used. The behaviours most frequently observed when ICT was used were student initiated, either with other students or the teacher. When ICT was not used, the most frequently observed behaviours were teacher initiated, resulting in a lesson that was more teacher focused in nature. Student responses regarding the use of ICT during the observed lesson and the most important aspect of using ICT for that lesson focused on the ICT itself. This was connected to the teacher's focus on ICT-specific skills as the skills required as part of the teacher's role. However, the teacher also addressed how the ICT would assist the students' learning in the lesson. The teacher's average competence and confidence for all ICT were lower than the student average competence and confidence for all ICT.

CASE J

Context

The female teacher and her 24 Year 5 students were observed over a 62 minute session. There were 15 male and 9 female students sitting in four rows in the classroom when ICT was not used (see Figure D13, p. 272) and 18 male and 8 female students seated individually at desktop computers in the computer laboratory when ICT was used (see Figure D14, p. 273). The 18 minute lesson without ICT involved the teacher presenting a spelling test to the class. The second part of the session was 44 minutes long and involved students working at tables in the library area and working on desktop computers in the computer area of the library, though only the students in the computer area were observed. Students had to finish outstanding work, including research whilst on the desktop computers and mental mathematics whilst sitting at the tables in the library area.

Table 4.12

Case J results

Behaviours	
ICT used by whom	Desktop computers with document processor used by the students.
Class organisation when ICT used	Individually in computer laboratory
Most frequently occurring behaviours when ICT not used	• Teacher initiated interactions with the students, including students responding (28 occurrences) • Individual student behaviours (21 occurrences)
Most frequently occurring behaviours when ICT used by the students	• Student initiated interactions with the students, including teacher responding (43 occurrences) • Student interacting with other student/s (41 occurrences)
Perceptions of ICT use in the classroom	
Teachers using ICT in the classroom	
Teacher response – importance of teacher using ICT	Themes of *the changing world*, *specific ICT*, and *student learning*.
Teacher response – main ICT skills required in the role of primary school teacher	Knowledge of ICT.
Student responses – should teachers be able to use ICT in their lessons	5 out of 7 responding students affirmed teachers should be able to use ICT in their lessons.
Student responses – why should teachers be able to use ICT in their lessons	Themes of *information* (n=5) and *the ICT itself* (n=3).

ICT use in the observed session		
Teacher response –what the students learned by using ICT	Categories of *learning from using the ICT* and *learning the ICT itself*	
Student responses – was ICT important in the lesson	3 of the 7 responding students stated ICT was important to the lesson	
Student responses –what ICT was used for in the lesson	Theme of *the activity* (n=5).	
Student responses – most important part of ICT being used in the lesson	Most frequent response referred to *the activity* (n=5).	
Self-reported Competence and Confidence		
	Teacher	Student
Average Competence	3.09	2.59
Average Confidence	3.25	2.73

Research Question 1 – Teacher and Student Observed Behaviours

When the students used the ICT, the most frequently occurring behaviours were student initiated interactions, either with other students or with the teacher. When ICT was not used, the most frequently occurring behaviours were teacher initiated interactions with the students, including students responding. Although the teacher selected the hardware, students were given a choice between two software programs when they used the ICT. When the ICT was used, the most frequently occurring behaviours were student initiated, either with other students or with the teacher. The lack of teacher directions when ICT was used reflected the teacher's response regarding the student behaviour when ICT was used, as they will "try to follow instructions" (Teacher J, 26/03/2010).

Research Question 2 – Teacher and student perceptions of ICT use in the classroom

The teacher focus on the changing world, specific ICT, and student learning were reflected in her response that ICT "can provide the teacher with a wealth of knowledge, which then enables the teacher to create and provide educational opportunities to further enhance students' depth and range of learning" (Teacher J, 26/03/2010). Her consideration of knowledge of ICT was evident with her response "document processing … able to correct and understand technical problems or issues … internet usage and browsing … electronic whiteboard … digital camera usage … photograph and image software … presentation software" (Teacher J, 26/03/2010).

The student responses regarding why teachers should be able to use ICT in the classroom focused on the themes *information* and *the ICT itself*. These two themes were closely related to the teacher's responses concerning access to knowledge and specific ICT (see Table 4.12).

The teacher stated in the pre-observation interview that she preferred to rotate students through using ICT, specifically for "'proper' work (projects), maths, interactive games, early finishes" (Teacher J, 26/03/2010), which reflected the use of ICT in the observation. Although the teacher stated ICT was not used as part of the learning outcomes for this session, the teacher stated using ICT enabled the students to access "new research page with sheet directly related to site" (Teacher J, 26/03/2010). Her responses indicated she used ICT to improve learning opportunities and for learning the ICT itself. Less than half of the students considered ICT as important in the lesson. As shown in Table 4.12, *the activity* was given as the most frequent response regarding what ICT was use for during the observation and the most important part of using ICT during the observation.

Research Question 3 – Teacher self-reported competence and confidence

Table 4.12 shows the teacher's average <u>competence</u> was slightly lower than her average <u>confidence</u>. The teacher did not rate herself as an expert in any of the ICT. She did rate herself as competent or higher for ten of the ICT and did not rate herself for three (see Table M11, p. 294). Teacher J rated herself the lowest rating for *movie or DVD editing programs*. Teacher J rated herself as highly confident for *desktop or laptop computers* and confident or higher for eight other items. She did not rate herself for *mobile telephones* and *vodcast, podcast, video conferencing, or webinars*. The teacher rated herself higher in competence than confidence for *photograph and image software* and higher in confidence for *desktop or laptop computers*, *electronic whiteboard*, and *statistical or database software* (see Table M11, p. 294). She rated herself higher than competent and higher than confident in the ICT used during the observation.

Research Question 4 – Student self-reported competence and confidence

The students had the lowest average competence and average confidence of all the cases, with both below competent and confident. The average competence was below the average confidence. There were no ICT with an average of 4.00 or above for either student competence or confidence. The ICT with the highest student average competence was *email or messaging programs* and the three ICT with the lowest student average competence were the *electronic whiteboard*, *movie or DVD editing programs*, and *vodcast, podcast, video conferencing, or webinars*, which each had an average of 2.00 (see Table M11, p. 294). There were a total of eight ICT with a student average competence of below 3.00. The ICT with the highest student average confidence was *internet browsers*, and the ICT with the lowest student average confidence was *photograph and image software*, one of nine below 3.00. Most variance in student competence and confidence occurred for *digital cameras or video recorders*, though *mobile telephones* had equal highest variance for student confidence. When comparing student average competence and confidence, the student average competence was lower than the average confidence for nine ICT.

Comparison of teacher and student average competence and confidence

The size and relationship between the teacher competence and confidence and the student average competence and confidence were calculated. Kendall's τ_b indicated that the correlation between the ranked teacher's competence and the student average competence was not significant, $\tau_b = .46$, $p>.05$, two-tailed, $N = 11$. Likewise, Kendall's τ_b indicated that the correlation between the ranked teacher's confidence and the student average confidence was again not significant, $\tau_b = .45$, $p>.05$, two-tailed, $N = 12$. The teacher's average competence and confidence were higher than the student average competence and confidence for all ICT used during the observation (*desktop or laptop computers*, *document processors*, and *presentation software*). This was one of two cases where the teacher's overall average for competence and confidence was higher than those of the students. However, the effect size for the difference in overall averages for teachers and students for both competence and confidence was small, $d = -.40$ and $d = -.41$, respectively.

Summary of Case J

When the students used the ICT, the most frequently occurring behaviours were student initiated interactions, either with the teacher or other students. When ICT was not used, the most frequently occurring behaviours were teacher initiated interactions with the students. One reason for the different behaviours would be the activities conducted when ICT was used (a range of activities that the student selected from) and when ICT was not used (a spelling test). The teacher viewed ICT as important in her role as it could provide information and knowledge needed for teaching and to improve the learning of her students. She focused on specific ICT when listing the main ICT skills needed by a teacher. The reasons given by students as to why ICT was important to the teacher role also focused on information as well as the ICT itself, which linked their responses to those of the teacher. The teacher described her use of ICT as providing learning opportunities for her students and for the students to learn the ICT, mimicking her reasons why a teacher should be able to use ICT. Although less than half of the students considered ICT important in the observed lesson, the majority referred to the activities as how ICT was used as well as the most important reason for using ICT. The teacher's average competence and confidence for all ICT were higher than the student average competence and confidence for all ICT. This may have been related to the low student average competence and confidence.

WHEN ICT WAS USED TO SUPPORT LEARNING AND A FOCUS OF LEARNING – SUMMARY OF CASES C AND J

Cases C and J both involved students using desktop computers after an initial session where no ICT was used. Student initiated behaviours were the most frequently observed when students used the ICT. These cases were the only cases where the teacher referred to ICT knowledge as a main ICT skill required of teachers. Both teachers were female and both referred to the changing world and specific ICT as reasons for the importance of ICT in their role. One of the most frequently occurring reasons given by students for why ICT was important during the lesson was for the activity. One of the most significant differences was that the student average competence and confidence for Case C were among the highest of all cases whereas the student average competence and confidence for Case J were the lowest of all cases.

CONCLUSION

The presentation of the cases was organised by what the teacher considered the ICT was used for during the observation – either to support student learning or as a focus of learning. When presented this way, several patterns become apparent in which ICT was used and who used the ICT. Other patterns that emerged included the most frequently occurring behaviours when ICT was used, the teacher and student perception of ICT use in the classroom, student perceptions of the importance of the teacher using ICT, and teacher and student average self-reported competence and confidence. These relationships will be explored further in Chapter 5.

CHAPTER 5

CROSS CASE AND QUANTITATIVE ANALYSES

INTRODUCTION

This chapter presents both the qualitative and quantitative analysis of the data to investigate factors that are related to the use of ICT in upper primary classrooms. As shown in Figure 3.2 in Chapter 3 (p. 91), data were collected through Likert-style questionnaires, open ended questionnaires, interviews, and observations. The research questions – the behaviours observed when ICT is used and when it is not used, the teacher and students' perceptions of ICT use, and teachers' and students' competence and confidence in using ICT – will be answered through comparisons of the cases outlined in Chapter 4 and through quantitative analysis of the data (see Figure 5.1). Quantitative analysis of the data was conducted for the respondent role (that is, teacher and student), the year of education (Year 5 or Year 6), gender, and class.

Teacher and student observed behaviours
Teacher and student perception of ICT use in the classroom
Teacher self-reported competence and confidence
Student self-reported competence and confidence
Main Findings

Figure 5.1. The framework for investigating the factors related to ICT use.

RESEARCH QUESTION 1 - TEACHER AND STUDENT OBSERVED BEHAVIOURS

Observed behaviours when ICT was used

There were three most frequently occurring behaviours when ICT was used, teacher initiated interactions with students including students responding, students interacting with student/s, and student initiated interactions with teacher including teacher responding (see Figure 5.2).

		Most frequently occurring behaviours		
		Teacher initiated interactions with students including student responding.	Student interacting with student/s.	Student initiated interactions with teacher including teacher responding
Second most frequently occurring behaviours	Student interacting with student/s.	**Case D** (teacher using EWB; LA)		**Case J** (students using desktops; LA & ICT) **Case C** (students using desktops; LA & ICT)
	Student initiated interactions with teacher including teacher responding.	**Case B** (teacher using EWB; LA) **Case F** (teacher using EWB; LA) **Case K** (teacher using EWB; ICT)		
	Individual student behaviours.	**Case E** (both using EWB; LA) **Case I** (both using EWB; LA) ***Case G*** (students using desktops; ICT)	**Case D** (students using EWB; LA) **Case B** (students using laptops; LA) **Case K** (students using desktops; ICT)	
	Teacher giving directions.	***Case A*** (students using EWB & laptops; LA)		
	Teacher initiated interactions with students including student responding.		***Case H*** (students using desktops; ICT)	

Note: Italicised case – low teacher average competence of confidence; Underlined case letter – students sitting in groups; EWB – electronic whiteboard; LA – teacher stated students learned from using the ICT; ICT – teacher stated students learned the ICT itself.

Figure 5.2. The cases by the most frequently and second most frequently occurring behaviours when ICT was used.

Cases D, B, F, and K all had teacher initiated interactions with students including students responding as the most frequently occurring behaviours followed by student interacting with student/s (Case D) and student initiated interactions with teacher including teacher responding (Cases B, F, and K). These four cases also involved the teacher using the electronic whiteboard. Three of the cases shared two more commonalities – Cases D, B, and F also had students sitting in groups in the classroom whilst using ICT and the teacher had responded that students were learning from using the ICT. With Case K, the students were sitting (mostly) individually in the computer laboratory and the teacher responded that the students were learning the ICT itself.

There were commonalities for two of the three cases where the most frequently occurring behaviours were teacher initiated interactions with students including students responding and individual student behaviours. Cases E and I involved both the teacher and students using the electronic whiteboard and the teacher had responded that students were learning from using the ICT. Both observations took place in the classroom with students in Case E sitting in groups and the students in Case I sitting in rows. The students in Case G were using desktop computers (mostly) individually in the computer laboratory. The teacher in Case G had responded that the students were learning the ICT itself. Teacher G also had an average self-reported competence of below competent (this was the lowest average self-reported competence of the teachers).

There were commonalities with the three cases where the most frequently occurring behaviours were students interacting with student/s and individual student behaviours. The students in Cases D, B, and K all used the ICT. In Case D the students used the electronic whiteboard and in Cases B and K the students used laptop or desktop computers. The students were sitting in groups in the classroom in Cases D and B and the teacher responded that students were learning from using the ICT. In Case K the students were sitting individually at desktop computers in the computer laboratory and the teacher responded that the students were learning the ICT itself.

Case A was the only case where the two most frequently occurring behaviours were teacher initiated interactions with students including students responding and student initiated interactions with teacher including teacher responding. Case A was the only case where both the electronic whiteboard and laptops were used. The students used the ICT sitting in groups in the classroom and the teacher responded that the students were learning the ICT itself. Case H was the only case where the most frequently occurring behaviours were students interacting with student/s and teacher initiated interactions with students including students responding. The students used desktops, sitting mostly individually in the computer laboratory. The teacher in Case H had responded that the students were learning the ICT itself. For both Case A and Case H, the teacher had an average self-reported confidence of below confident.

Cases C and J were the only observed sessions with ICT that had student initiated interactions with teacher including teacher responding as the most frequently occurring behaviours and student interacting with student/s as the next most frequently occurring behaviours. In both of these cases, the students were sitting individually at desktop computers in the computer laboratory. These two teachers were the only two who responded that ICT was used both for the ICT itself and for the learning made possible by using the ICT.

Observed behaviours when ICT was not used

For all but one observed session, the most frequently observed behaviours when ICT was not used were teacher initiated interactions with the students including students responding (see Figure 5.3). The underlined cases involved the students sitting in groups and the cases that were not underlined involved the students sitting in rows or individually. The session without ICT in Cases B and F (the last session) involved the students presenting work to the class at the end of the observation. The sessions without ICT in Cases C, E, and F (the first part of the observation) involved the students sitting in groups, but only Case C involved students working together as the students worked individually in the specified sessions in Cases E and F. Case G and Case H involved the teacher introducing and outlining the task students would complete when they worked on the desktop computers. Cases I and J involved the students sitting in rows, with the teacher explaining how to complete multiplication equations in Case I and the students completing a spelling test in Case J.

		Most frequently occurring behaviour	
		Teacher initiated interactions with students including student responding.	Student interacting with student/s.
Second most frequently occurring behaviour	Student interacting with student/s.	Case C Case H	
	Student initiated interactions with teacher including teacher responding.	Case B Case I	
	Individual student behaviours.	Case F Case J	Case E
	Teacher giving directions.		
	Teacher initiated interactions with students including student responding.		
	(no other behaviours frequently occurring)	Case F Case G	

Figure 5.3. The cases by the most frequently and second most frequently occurring behaviours when ICT was not used.

RESEARCH QUESTION 2 - TEACHER AND STUDENT PERCEPTIONS OF ICT USE IN THE CLASSROOM

The importance of the teacher using ICT

In all cases except for Case J, the majority of students responded affirmatively to the question regarding whether teachers should be able to use IC in the classroom. The students in Case J were a smaller group (n=7) and this was the only case where the average student self-reported competence and confidence were below competent and below confident.

Table 5.1

Reasons Given by Students for Why Teacher Should Use ICT by Teacher Perceptions of Student Learning from ICT use

Case	Most frequently occurring reasons
	ICT used to support learning
A	learning and teaching (n=12), being beneficial for students (n=12), and the ICT itself (n=11)
B	being beneficial for students (n=6)
D	being beneficial for students (n=5) and learning and teaching (n=5)
F	learning and teaching (n=7) and the ICT itself (n=6)
E	learning and teaching (n=12), being beneficial for students (n=9), and the ICT itself (n=6)
I	the ICT itself (n=15) and being beneficial for students (n=11)
	ICT itself was learned
K	useful (n=8), being beneficial for students (n=7), and for information (n=6)
H	being beneficial for students (n=9), learning and teaching (n=8), and the ICT itself (n=6)
G	learning and teaching, (n=18), being beneficial for students (n=12), and the ICT itself, (n=8)
	ICT itself was both learned and used to support learning
C	being beneficial for students (n=7)
J	information (n=5) and the ICT itself (n=3)

When reasons why teachers should be able to use ICT in the classroom were examined within the cases grouped by teacher perceptions of student learning (see Table 5.1), where teachers believed students learned from the ICT being used to support learning, *being beneficial for students*, *learning and teaching*, and *the ICT itself* were the most frequently occurring reasons given. These three reasons were also evident when the teachers believed the students learned the ICT itself. There were no patterns in the two cases where the teachers believed students learned both the ICT itself and from the ICT being used to support learning.

When reasons why teachers should be able to use ICT in the classroom were examined for all of the cases together, the reason that occurred most frequently in the 11 cases concerned ICT being beneficial for students (9 cases). Two of the cases, Case B and Case C, this was the only frequently occurring reason. Case B was the only case where students had choice in whether to use ICT during the observation. The students in Case C had the second highest average self-reported competence and the highest average self-reported confidence (4.06 and 4.33 respectively).

The two cases where benefits for students was not a frequent reason provided by students were Case F and Case J. Case F was the only case observed where students did not use ICT in the lesson (the teacher used the ICT). The students in Case J had the lowest average self-reported competence and lowest average self-reported competence of all cases, with the average ratings being below competent and below confident. When these four cases are considered together, the message given by students having the choice to use ICT may act as an empowering agent as to why students saw the benefits for themselves in the teacher using ICT. Likewise, if the students were more than competent and more than confident in using ICT, then their perceptions of ICT use may be beneficial. The opposite was true when students did not get to use ICT or when they were not competent or confident in its use. The students who did not use ICT during the lesson did not suggest that teachers using ICT would be beneficial for students and the students whose average self-reported competence and average self-reported competence were low did not see benefits in the teacher being able to use ICT.

When teacher responses regarding the importance of ICT in their role as a teacher were examined, the most frequently occurring response involved specific ICT (n=7), followed by the changing world (n=5) and student learning (n=5). All three male teachers' responses involved specific ICT and student learning, which was the only pattern that emerged. When teacher responses regarding the main ICT skills required in the role of the teacher were examined, all teachers referred to knowledge of ICT (n=11). Using ICT in their pedagogy was the next most frequent response (n=5). Teachers C and J focused on knowledge of ICT as the main ICT skill.

Perceptions of ICT use

Teacher perceptions of what students learned from ICT in the observed sessions had two foci – learning the ICT itself or for the benefits to learning that using ICT generated. Cases where the teachers focused on using ICT to support learning all used electronic whiteboards (Cases A, B, D, F, E, and I). Cases where the teacher focused on students learning the ICT itself all involved students using desktop computers in the computer laboratory (Cases K, H, and G). In cases where the teacher referred to both learning the ICT itself and the benefits to learning that using

ICT generated (Cases C and J), the students used desktop computers in the computer laboratory.

Table 5.2

Responses Given by Students for the Most Important Reason for Using ICT in the Lesson by Teacher Perceptions of Student Learning from ICT use

Case	Most frequently occurring reasons from students
	ICT used to support learning
A	learning and teaching (n=5) and the activity (n=3)
B	obtaining information and facts (n=8)
D	the activity (n=5) and learning and teaching (n=4)
F	the activity (n=9) and the ICT itself (n=7)
E	learning and teaching (n=14), the ICT itself (n=7), and the activity (n=7)
I	the activity (n=11), learning and teaching, (n=7), and the ICT itself (n=5)
	ICT itself was learned
K	the activity (n=5) and the ICT itself (n=4)
H	the ICT itself (n=11) and the activity (n=10)
G	learning and teaching (n=15), the activity (n=12), and the ICT itself (n=10)
	ICT itself was both learned and used to support learning
C	the ICT itself (n=5) and the activity (n=4)
J	the activity (n=5)

When the most important reasons for using ICT in the observed lesson were examined within the cases grouped by teacher perceptions of student learning (see Table 5.1), where teachers believed students learned from the ICT being used to support learning, *the activity*, *learning and teaching*, and *the ICT itself* were the most frequently occurring reasons given. Two of these three reasons, *the activity* and *the ICT itself*, occurred for all cases when the teachers believed the students learned the ICT itself. In the two cases where the teachers believed students learned both the ICT itself and from the ICT being used to support learning, only the theme *the activity* occurred for both cases.

As shown in Table 5.2, the most frequently occurring reason why ICT was important in the lesson related to *the activity* for all but one case, Case B. As mentioned previously, Case B was the only case where students had choice on whether to use ICT or not and not all students chose to use ICT during the lesson. The next most frequently occurring reason was *the ICT itself*, which occurred for 7 cases. Cases A, B, D, and J were the four cases that did not refer to *the ICT itself*, and these were four of the five cases where students used ICT (rather than the teacher) but not all students had access to the ICT (Case K was the fifth).

RESEARCH QUESTION 3 - TEACHER SELF-REPORTED COMPETENCE AND CONFIDENCE

Likert-style questionnaires were used to collect data on competence and confidence for 14 ICT for both teachers and students. As shown in Table 5.3 and discussed in the Methodology Chapter (p. 112), generic terms were used under which commercial ICT were grouped. Cronbach's alpha for the Competence questionnaire for teachers was .61 and for the Confidence questionnaire for teachers was .79. These lower figures, particularly for the Competency questionnaire, may be due to the homogeneity of the smaller sample, as "the more homogeneous the group is with respect to the trait being measured, the lower will be the reliability coefficient" (Ary et al., 2010, p. 247).

Table 5.3

The 14 ICT from the Likert-style questionnaire.

Position on Questionnaire	ICT	Position on Questionnaire	ICT
1	Desktop or Laptop	8	Email or messaging programs (such as Microsoft Outlook, iChat, or MSN)
2	Electronic Whiteboard	9	Photograph and image software (such as importing software or Photoshop)
3	Mobile telephones	10	Movie or DVD editing programs
4	Internet browsers (such as Explorer or Safari)	11	Social Networking programs (such as Facebook or MySpace)
5	Document Processors (such as Word, AppleWorks or Text Edit) programs	12	Digital cameras or video recorders
6	Presentation software (such as PowerPoint or KeyNote)	13	Wikis, Blogs or Twitter
7	Statistical Software or Database Software (such as Excel)	14	Vodcast, Podcast, video conferencing, or webinars

All ratings for teachers were combined for competence and for confidence to provide average ratings of 3.29 and 3.35 respectively. Prior to further statistical analyses, the assumptions of normality were assessed to determine whether the data were approximately normally distributed. In all analyses, skewness and kurtosis indicated the assumption of normality was supported for both groups of respondents. A visual inspection of the normal Q-Q and detrended Q-Q plots for each of the variables confirmed both were normally distributed. As a result, the *t* test, one-way between groups analysis of variance (ANOVA), and bivariate Pearson's product-movement correlational coefficient (*r*) were conducted to analyse the data.

To assess the size and direction of the linear relationship between the teachers' competence and confidence ratings, a bivariate Pearson's product-movement correlation coefficient (*r*) was calculated. The bivariate correlation between these variables was positive and very strong, $r(9) = .885$, $p<.001$. The coefficient of determination was calculated and, as a result, 78.3% of the variability in teachers' competence ratings could be predicted by the teachers' confidence ratings.

One teacher had an average self-reported competence of below competent (see Table 5.4). Teacher G had an average competence of 2.71 and his average confidence was 3.00. Two teachers had an average self-reported confidence of below confident. Teacher H had an average confidence of 2.79 and an average competence of 3.00. Teacher A was the only other teacher with an average self-reported confidence of below confident. Her average confidence was 2.93 and her average competence was 3.21. As shown in Table 5.4, the only similarity between all three cases was that the students used the ICT. There were some similarities between pairs of these three cases. For example, in Cases A and G, the students used the ICT but the teacher initiated the most frequently occurring behaviours. Students in Cases G and H used desktop computers and in Case A the students used the electronic whiteboard and laptops. Teachers G and H referred to the students learning ICT whereas Teacher A referred to the students learning from using the ICT.

Table 5.4

Teacher average competence and confidence, ordered by teacher average competence.

Case	Average competence	Average confidence	Teacher stated learning for students	What ICT was used	Who used ICT	Who initiated most behaviours
G	2.71	3.00	ICT	Desktop	Student	Teacher
H	3.00	2.79	ICT	Desktop	Student	Student
J	3.09	3.25	LA & ICT	Desktop	Student	Student
F	3.14	3.14	LA	EWB	Teacher	Teacher
D	3.18	3.33	LA	EWB	Teacher then Student	Teacher then Student
A	3.21	2.93	LA	EWB & Laptop	Student	Teacher
B	3.27	3.27	LA	EWB then Laptop	Teacher then Student	Teacher then Student
K	3.43	3.50	ICT	EWB then Desktop	T then Student	Teacher then Student
I	3.43	3.71	LA	EWB	Both Teacher & Student	Teacher
C	3.79	3.79	LA & ICT	Desktop	Student	Student
E	3.92	4.07	LA	EWB	Both Teacher & Student	Teacher

RESEARCH QUESTION 4 - STUDENT SELF-REPORTED COMPETENCE AND CONFIDENCE

Overview

Prior to further statistical analyses, the assumptions of normality were assessed to determine whether the data were approximately normally distributed. In all analyses, skewness and kurtosis indicated the assumption of normality was supported for both groups of respondents. However, in one analyses (student competence and competence by class, as discussed below), the Sharpiro-Wilk statistic was significant for students. The Kolmogorov-Smirnov was significant for student respondents for both competence and confidence. However, a visual inspection of the normal Q-Q and detrended Q-Q plots for each of the variables confirmed both were normally distributed. As a result, a bivariate Pearson's product-movement correlational coefficient (r) were conducted to analyse the data. Cronbach's alpha for the Competence questionnaire for students was .91 and for the Confidence questionnaire for students was .92.

To assess the size and direction of the linear relationship between the students' competence and confidence, a bivariate Pearson's product-movement correlation coefficient (r) was calculated. The bivariate correlation between these variables was positive and strong, $r(162) = .793$, $p<.001$. The coefficient of determination was calculated and, as a result, 62.9% of the variability in students' competence ratings could be predicted by the students' confidence ratings.

Class comparison

Comparisons of student competence and competence by class were conducted. Inspection of the skewness and kurtosis indicated the assumption of normality was supported for each of the 11 classes for both student competence and confidence. However, Sharpiro-Wilk statistics were significant for both student competence and confidence. Levene's statistic was significant for both student competence and confidence, indicating the assumption of homogeneity of variance was violated. A Kruskal-Wallis ANOVA indicated there were statistically significant differences between the classes for both student competence and student confidence (see Table 5.5), with H = 23.613, df = 10, N = 170, p =.009, Cohen's f = .403 for student competence and H = 24.663, df = 10, N = 164, p =.006, Cohen's f = .422 for student confidence.

Table 5.5

Mean Ranks for Each Case for Student Self-reported Competence and Confidence

Case	Competence		Confidence	
	N	Mean Rank	N	Mean Rank
K	12	119.00 *	11	111.36 *
C	10	117.75	10	116.15 *
D	8	116.69 *	8	106.94 *
B	8	97.00	7	84.36 *
I	29	84.38	28	78.66
A	16	84.19	16	101.88 *
H	19	83.50	18	82.36 *
E	24	81.27 *	23	68.67 *
F	11	71.18	10	65.85
G	27	70.24 *	27	71.65
J	6	34.92	6	35.00
Total	170		164	

The effect size (Cohen's d) was medium when the averages for competence were compared between teachers and students for Cases D, E, G, and K (those with an * in Table 5.5), with student averages being higher for Cases D, G, and K, and the teacher average higher for Case E. Seven of the cases with higher mean confidence (those with an * in Table 5.5) had an effect size (Cohen's d). The effect size was large when the averages for confidence were compared between teachers and students for Cases A, H, and K, with student averages being higher. The effect size was medium when the averages for confidence were compared between teachers and students for Cases B, C, D, and E, with student averages being higher for Cases B, C, and D and the teacher average higher for Case E.

MAIN FINDINGS

There were eight main findings from the research that can be grouped under the research questions.

RQ 1 What behaviours are observed when ICT is used and when it is not used?

1. There were differences in most frequently occurring behaviours when ICT was used and when ICT was not used. When ICT was used in the cases, it was more likely for the most frequently occurring behaviours to be student initiated. When ICT was not used, all but one of the cases had teacher initiated behaviours occurring most frequently.

2. Who used the ICT and the ICT used was related to who initiated the most frequently occurring behaviours.
   When ICT was used, if the teacher used the ICT, it was likely to be the electronic whiteboard. In all of these cases, the most frequently occurring behaviours were teacher initiated. When ICT was used by the students, they mostly used desktop or laptop computers and the most frequently occurring behaviours were student initiated.

RQ 2 What were the teacher and student perceptions of ICT use in the classroom?

3. Teacher perceptions of student learning related to the ICT that was used, who used the ICT, and the most important reason given by students for using for ICT in the lesson
   In the majority of cases where the teacher used the electronic whiteboard, the teacher believed that the students learned from using the ICT and one of the most frequently occurring reasons why ICT was important in the lesson was for learning and teaching. In the *majority* of cases where students used laptop computers and sat in groups, the teacher stated that the students learned from using the ICT. If the students used desktop computers in a computer laboratory, in the teacher believed the students learned the ICT itself and the most frequently occurring reasons why ICT was important in the lesson were the activity and the ICT itself. There were two cases where the students used

desktop computers and the teachers believed the students learned the ICT and learned from using the ICT. These two cases were the only cases where the top two most frequently occurring behaviours were student initiated – either with the teacher or with other students.

4. There was a relationship between the reasons student provided to explain why teachers should be able to use ICT in the classrooms and student perceptions of their ICT use.

   There were only two cases out of the 11 where being beneficial for students was not a frequently occurring reason why students stated teachers should use ICT in the classroom. In these two cases, the students' lack of competence and confidence or lack of use may reduce their perceptions of benefits. In two cases where this was the only reason frequently given by students, the teacher giving students the choice of whether they used ICT in one case and the high average self-reported competence and confidence may indicate the students believe they are capable with ICT and can therefore see the benefits in its use.

RQ 3 What are the teachers' self-reported competence and self-reported confidence in ICT?

5. There was a strong correlation between the teachers' self-reported competence and self-reported confidence and the teachers mostly reported that they were competent and confident with the specified ICT.

   In the majority of cases, the teachers' average self-reported competence was competent or higher and the teachers' average self-reported confidence was confident or higher. One teacher's average competence was lower than competent and two teachers' average confidence was lower than confident.

6. When the teachers' average self-reported competence or average confidence were less than competent or less than confident, there were relationships with the most frequently occurring behaviours.

   The only three cases where the students used desktop or laptop computers and one of the two most frequently occurring behaviours were teacher initiated interactions with the students including students responding and these cases had the three teachers who had an average self-reported competence or average confidence at less than competent or less than confident.

RQ 4 What are the students' self-reported competence and self-reported confidence in ICT?

7. There was a strong correlation between the students' self-reported competence and self-reported confidence and most cases had a student average self-reported competence and average self-reported confidence of more than competent and more than confident.
   The correlation between student self-reported competence and student self-reported confidence was strong and positive for all cases. Only one of the 11 cases had an average self-reported competence of less than competent and an average self-reported confidence less than confident, although the small number of student respondents (n=7) may have been a factor.

8. There was a relationship between the student perceptions of the importance of the teacher using ICT and the student average self-reported competence and average self-reported confidence.
   The only case where less than a majority of students responded affirmatively that teachers should be able to use ICT in the classroom was the case where the average self-reported competence and average self-reported confidence of less than competent and less than confident.

CONCLUSION

This chapter presented a comparison of the results of the case studies to identify commonalities and discords. Relationships between the factors investigated in the research were identified, specifically, relationships were found between the most frequently observed behaviours, the ICT was used, who used the ICT, teacher perceptions of student learning, student perceptions of the role of ICT in the teacher role, and the effects of a lack of competence or confidence for either the teacher or the students. Chapter 6 will situate these relationships within existing research and literature.

CHAPTER 6

DISCUSSION

INTRODUCTION

This chapter situates the findings presented in Chapter 4: Case studies and Chapter 5: Cross case and quantitative analysis within existing literature. As shown in Figure 6.1, the teacher and student perceptions of ICT that may be related to the use of ICT in Catholic upper primary classrooms are addressed in terms of the research questions, with both main and addition findings connected to the literature.

Teacher and student observed behaviours
Teacher and student perceptions of ICT use in the classroom
Teacher self-reported competence and confidence
Student self-reported competence and confidence
Implications for teachers and students in upper primary classrooms
Limitations

Figure 6.1. The organisation of the discussion.

TEACHER AND STUDENT OBSERVED BEHAVIOURS

Main findings

Behaviours when ICT was used and when it was not used

Differences were noted in the most frequently occurring behaviours when ICT was used by the students, when ICT was used by the teachers, and when ICT was not used. When ICT was used by the students, in all but two sessions, the most frequently occurring behaviours were student initiated. In the classes where the most frequently occurring behaviours were student initiated, they were behaviours initiated with other students, which resulted in talk within the classroom. Literature provides several potential reasons for these changes. This may in part reflect what Somekh et al. (2007) referred to as ICT changing the teachers' practice "to a more interactional one" (p. 13). Beauchamp and Kennewell (2010) proposed that this would be reflected in changes to teacher questioning, but that when the student had greater control over the ICT, the interactions would be more interactive between the teacher and the students.

Who used the ICT, the ICT used, and the initiator of the most frequently occurring behaviours

In two sessions where ICT was used by the students, the most frequently occurring behaviours were teacher initiated. In one of these cases, the teacher had an average self-reported competence of below competent and in the other case, the teacher had an average self-reported confidence of below confident. The most frequently occurring behaviours when students used ICT and the teacher had an average rating of below competent or below confident, were the same as when the teacher used the ICT or when ICT was not used. In all of these observed sessions, the most frequently occurring behaviours were teacher initiated interactions with students, with student response required. This connects to Sutherland's (2004) finding concerning the discourse utilised by the teachers, where teachers could become more authoritative when ICT was used, particularly when there was a lack of teacher competence involving how to integrate learning area content with ICT knowledge.

Teacher initiated interactions with students involved a dialogue where the teacher initiated interactions with students and the students responded. When the electronic whiteboard was used the teacher was often positioned separately from the class and had control of the electronic whiteboard. These results – teacher positioning and teacher initiated questioning – reflected what Maher (2012) referred to as a less engaged dialogue involving the process of teacher question, student response, teacher feedback. He found this form of dialogue was evident when the teacher stood in front of the class and used the electronic whiteboard.

When the teacher used the ICT, they used the electronic whiteboard, either with document processors (two observed sessions), with the internet and a program (one observed session), or with the internet only (one observed session). In all of these sessions, the teacher used the electronic whiteboard to show information to the class – either what they would have to do next or information as part of the activity – to expedite directions to the students. This coincides with Martinovic and Zhang's (2012) finding that pre-service teachers were most likely to use ICT in class to present information in a more teacher-centric way, both in terms of how it was used and why it was used.

When students used the ICT, the most frequently occurring interactions were student initiated. As stated above, these cases usually involved the students using desktop or laptop computers. The only cases where these ICT were used and there were more teacher initiated interactions, the teacher had an average self-reported competence below competent or an average self-reported confidence below confident. The only other teacher who had an average self-reported confidence below confident gave students a choice in the ICT used (the software used). In terms of Rasmussen et al. (2003), this could indicate the teacher moving towards a less structured environment, which may related to the most frequently occurring behaviours being student initiated.

Beauchamp and Kennewell (2010) noted that student ICT skills and students having more influence over the use of ICT were required for lessons to be more student driven. This element was evident when students used the ICT, as in all but one of these situations, the most frequently occurring behaviours were student driven. The situation where this did not occur were where the teacher average self-reported competence was below competence. This relates to Smeets' (2005) findings, that the teachers needed to be confident with ICT before they would encourage student independent learning, but that the confidence had to be even higher before students were allowed to be autonomous. In this research, the students having a choice over which ICT to use seemed to negate the impact of another teacher's average self-reported confidence being lower than confident, with the most frequently occurring behaviours during that session being student initiated.

When the electronic whiteboard was used by the teacher or by both the teacher and students interchangeably, the most frequently occurring behaviours were teacher initiated. Stevenson (2008) described the pedagogical action of presenting information as involving teachers using ICT to provide students with information. In these instances, teachers would work with the entire class and would be the one who used the ICT. Maher (2012) found that the teacher asked mostly clarifying questions that required, and generated, limited responses from the students in one of the observed session in his research on the impact of the interactive whiteboard in two primary school classrooms.

Additional Findings

The use of the internet and observed behaviours

In the 11 case studies from this research, the internet was used with the electronic whiteboard and laptop computers during four observed sessions. However, the most frequently occurring behaviours when the internet was used were not the same for all of the sessions. For one of the observed sessions, laptop computers and a program were available with the internet, and in this session the students used the ICT and the most frequently occurring behaviours were student initiated. For the other observed sessions, electronic whiteboards were used with the internet. One of these observed sessions also used laptop computers and programs, and the most frequently occurring behaviours were teacher initiated. The teacher in this case had an average self-reported confidence of below confident. In two of the observed sessions, the teacher used the ICT, one with a program as well, and the most frequently occurring behaviours were teacher initiated. In the final observed session, the students used the ICT with a program as well, and the most frequently occurring behaviours were student initiated.

The literature provides several explanations for the connections between behaviours and the use of the internet. Inan et al. (2010) noted that student-centred strategies were observed more than teacher-centred strategies, with the use of internet browsers, word processing and presentation software associated with more student-centred activities. Leander et al. (2010) proposed that if the teacher saw the internet as enabling students to work beyond the physical bounds of the classroom (and the teacher desired to maintain control of the expansion beyond the classroom), the teacher may purposefully use the ICT when the internet was one of the ICT with the incorporation of the electronic whiteboard to ensure this was usable with the class. Used this way, the teacher could control the interactions with the internet.

TEACHER AND STUDENT PERCEPTIONS OF ICT USE IN THE CLASSROOM

Main Findings

Teacher perceptions of student learning

Teachers provided two responses regarding what students learned from using ICT during the observed sessions – learning the ICT itself or learning from using the ICT. Six teachers referred to learning from using the ICT, three teachers referred to learning the ICT itself, and two teachers referred to both. These two reasons can be connected to those suggested by Pelgrum and Schipper (1993) 20 years ago and Ananiadou and Claro (2009) more recently, as well as to two of the three types of educational use outlined by Tondeur et al. (2005). Pelgrum and Schipper referred to students learning about computers (that is, focusing on how to use computers) and learning with computers (that is, using computers when learning about another subject, whilst Ananiadou and Claro referred to ICT skill (in and of itself) and competence (when used for other learning). Tondeur et al. referred to the descriptions "'basic computer skills', 'computers as an information tool', and 'computers as a learning tool'" (p. 204). In some aspects, the second two descriptions regarding the of educational use could be considered as using the ICT to benefit learning as the ICT use would enable information to be accessed or learning to occur that would otherwise not be possible.

The focus of the teachers on using the ICT and learning the ICT, when viewed in terms of Ananiadou and Claro's (2009) ICT skill and ICT competence, reflect the aims of the OECD's New Millennium Learners (NML) project (OECD, 2010). The

NML states the impact of students not having the required skills and competencies is the second digital divide, as they will gain less in educational terms when ICT is used. From the perspective of how teachers use ICT, these reasons correspond with two of the uses identified by Ertmer et al. (2012) – helping students develop appropriate ICT skills and access content and using ICT to help students to learn and to demonstrate their learning.

Ertmer's et al. (2012) connection of students demonstrating their learning can be connected to other research. Hennessy et al. (2005) examined teacher responses to questions regarding the use of ICT in the classroom and they found teachers referred to the need for a fit between the learning objectives of the lesson and the ICT. This is related to Underwood's (2009) proposal that every ICT affects learning affordances, and it is these affordances that should determine whether an ICT is utilised. These affordances affected how students could engage in the learning process. However, teachers needed to move beyond only using ICT that suited their pedagogy and to accept there were instances where they had to change their pedagogy to use ICT. The inclusion of this aspect by Ertmer et al. (2012) reflects the transformation of the teachers' teaching and learning and adopts aspects of Mishra and Koehler's (2006) TPACK.

There were three more teachers whose responses referred to learning from ICT use rather than to learning the ICT itself. Reasons for this slight difference may be related to the smaller number of teachers in this research or through the use of interviews to obtain clarity from the teachers' questions. This might be particularly relevant as almost all teachers initially responded that ICT was a learning outcome of the observed session, but when questioned more thoroughly after the observation, their answers focused more on the students learning from using the ICT. These perceptions of student learning were the opposite of the large-scale research into the three ICT competencies outlined by the Flemish government (Tondeur et al., 2007). They found that teachers focused on students being able to operate the ICT most, followed by using ICT in the learning process, and ethical use.

Student perceptions of ICT in the teacher role and the importance of ICT during the observed session

When the reasons given by students as to why teachers should be able to use ICT in the classroom were examined, the most frequently occurring reason focused on ICT being beneficial for students. This was one of the most frequent responses in nine of the cases. In two cases, it was the only reason and in two cases it was not referred to at all. When these four cases are considered together, the effect of students having the choice to use ICT or of the students being more than competent and more than confident in using ICT may have increased the students' perceptions of the benefits of ICT use to the point that no other reasons were proposed in the two cases. The opposite was true when students did not get to use ICT or when they were not competent or confident in its use, as in both of these cases students did not refer to ICT use as being beneficial. A potential explanation is the level of expertise of the students – reflected in the teacher giving students choice in whether to use ICT. Ilomaki and Rantanen (2007) found that the level of expertise students affected how they viewed and used ICT and their intentions for using ICT in the future. Ilomaki and Rantanen's (2007) findings could also explain why the students in the classroom with average self-reported ratings of below competent and below confident did not view teachers using ICT as being beneficial to students.

The most frequently occurring reason why ICT was important in the lesson related to the activity itself. Reference to the activity itself was one of the most frequent reason in all but one case – the only case where students had choice on whether to use ICT or not and not all students chose to use ICT during the lesson. This in itself may be the indication that ICT was not essential for the lesson. The reason may be related to students being engaged and motivated in their tasks, which was reflective of how Balanskat et al. (2006) found ICT benefited students in schools in Europe. Goodison (2002) also found that Year 2 and Year 6 students considered that ICT could make lessons enjoyable and that they could benefit from using ICT.

When the cases were considered in terms of the teacher perceptions of student learning, when the teacher stated ICT was used to support learning, learning and teaching was a frequent student response; when the teacher stated ICT itself was learned, the most frequent student responses concerned the activity and the ICT itself; and, when the teacher referred to both learning the ICT and using ICT to support learning the only common frequently occurring response from students for the two cases was the activity.

Additional Findings

Teacher perceptions of the main ICT skills required of teachers

All but one teacher referred to ICT knowledge as one of the main teacher ICT skills. This was evidenced by the response "able to use Microsoft programs, save documents, print work, and use the internet" (Teacher E interview, 01/12/2009). The next most frequent main reason involved using ICT for teaching (5 teachers). An example of this type of reason was "ICT teaching pedagogy" (Teacher K interview, 26/03/2010). The skill of being able to use ICT reflects the findings of Zhao et al. (2002), specifically that the teachers considered themselves proficient in ICT and their proficiency impacted on their decision to successfully use ICT.

All three teachers who used the electronic whiteboard, internet, and a program during one of the observed sessions referred to using ICT beyond their teaching as a main ICT skill required of teachers. Literature provides two explanations for these findings, one that focuses within the classroom and the other that looks at the potential to move beyond the classroom. Crook et al. (2010) proposed that ICT had the potential to modify practices in the classroom by changing the classroom space and enabling activities that would involve new learning practices. Valentine and Holloway's (2001) suggested that the use of the online environment enabled via the internet could enable connections beyond the physical world, which would require the teacher to develop skills beyond those of the classroom and for more than teaching.

Teacher perceptions of the importance of ICT in the teacher role

Teacher responses regarding ICT knowledge as one of the main teacher ICT skills and their responses regarding the importance of ICT in their role as a teacher were related. The most frequently occurring response regarding the importance of ICT in their role involved specific ICT, followed by the changing world, and student learning. The teacher focus on the specific ICT reflected what Jimoyiannis and Komis (2007) described as a focus on the technological aspect. The teachers' incorporation of the changing world and student learning reflects more of what Trinidad (2002) described going beyond the focus on provision of ICT to view ICT as benefitting teaching and learning. Likewise, it reflected Hermans et al. (2008) view of the move from just learning ICT skills to using ICT to support the teaching and learning within the classroom.

All three male teachers involved referred to specific ICT in their response to the question regarding the main teacher ICT skills and to student learning as a reason for ICT in the teaching role, which was the only pattern that emerged. Smeets (2005) found that male teachers were more likely to use open-ended applications that could create active and autonomous learning. The focus on student learning may indicate this aspect, but given the small number of teachers involved in the research, this pattern may be related to other unidentified factors than gender. There was a lack of statistical differences between the self-reported competence and self-reported confidence of the three male and eight female teachers, though this was likely due to the small number of teacher. However, it was supported by the lack of gender difference in the teacher competence and confidence for secondary teachers in Malaysia (Hong & Koh, 2002) and Chinese pre-service teachers (Sang et al., 2010).

TEACHER SELF-REPORTED COMPETENCE AND CONFIDENCE

Main Findings

Correlations between teacher self-reported competence and self-reported confidence

There was a strong and positive relationship between the teachers' average self-reported competence and the teachers' average self-reported confidence for the specified ICT. The overall average competence was slightly less than the overall average confidence and both were above competent and above confident (3.29 and 3.35, respectively). This corresponds with Smarkola's (2008) findings of the level of confidence of the experienced and pre-service teachers she investigated. In addition, Hsu (2010) found that the self-reported competency in ICT teachers at Taiwanese schools was related to their reported use of ICT, which Hsu interpreted as teachers with higher ICT abilities using ICT more in their classrooms. Although Jamieson-Proctor and Finger (2008) found gender difference in confidence to teach with ICT in their research with 1723 pre-primary through to secondary teachers in Queensland, a gender difference was not found in this research. However, the low numbers of teachers (3 male and 8 female) may have affected this. Smeets (2005) found skills-based application use was related to teachers who rated themselves confident with ICT, but that teachers who used open-ended applications had rated themselves more confident with ICT and encouraged students to engage in more cooperative learning.

Lower teacher average self-reported competence or average self-reported confidence and most frequently occurring behaviours

Relationships were found between the teacher's self-reported competence and confidence and the most frequently occurring behaviours. When the ICT was used by the students, if the teacher's competence or confidence was below competent or confident, the observed behaviours were likely to be teacher initiated. Two of the three teachers who focused solely on learning the ICT itself had an average self-reported competence of below competent or an average self-reported confidence of below confident. However, another teacher had average self-reported confidence of below confident and she stated that the students learned from using the ICT. In addition, two teachers stated that students both learned the ICT itself and learned from using the ICT. Although these two teachers did not have lower average self-reported competence or confidence, one teacher's students had the second highest average self-reported competence and the highest average self-reported confidence of all of the classes and another teacher's students had the lowest average self-reported competence and the average self-reported confidence of all the classes (with averages being below competent and below confident).

Relationships found between the teachers' self-reported competence and confidence and behaviours were identified in the literature. Petko (2012) found a positive relationship between the teacher's self-reported competence for teaching with ICT and the teacher's use of ICT in the classroom. This relationship was further elaborated by Prestridge (2012), who found that the teachers at the lower level of competence and confidence were less likely to use ICT in their classroom, and when they did, they were more likely to focus on learning the ICT itself rather than learning with the ICT. Papanastasiou and Angeli (2008) also found relationships between teacher reported knowledge and use of ICT, their attitude towards and confidence with ICT and to how successfully they integrated ICT into their teaching. Likewise, Menese et al. (2012) found teachers' ICT skills and attitudes were related to the teacher using ICT with students in a supportive way and in their management. Tondeur et al. (2008) suggested there may be a relationship between teachers having a broad belief base and teaching constructivistly and willingness to use ICT in innovative or different ways.

Although the relationship between students using the ICT and the most frequent interactions being initiated by students was also evident during a session where students used the electronic whiteboard, in the session where students used the electronic whiteboard and laptop computers, the most frequently observed behaviours were teacher initiated. This may indicate a stronger relationship with the teacher's self-reported competence or self-reported confidence, as the teacher in this class had an average self-reported confidence of below confident. The relationship between teacher competence and confidence and who used ICT was found by Stevenson (2008) to be related to teacher concerns regarding a loss of control, with teachers who had lower skills more likely to be worried about losing control. Leander et al. (2010) also connected teachers enforcing control to situations where they were concerned that they would not have control or could lose control particularly if the use of ICT changing the learning space. The change in learning space from the physical bounds to the almost unlimited access possible via ICT may require teachers to embrace a pedagogy more commensurate with that of the online teacher, who Pegrum (2007, p. 25) described as balancing several roles that require the relinquishing of control whilst promoting and maintaining "educational dialog". Perhaps this is what happened when the most frequently occurring behaviours were student initiated.

Additional findings

Teacher self-reported competence and self-reported confidence and ICT use

There may be a symbiotic relationship between teacher self-reported competence and confidence and ICT use, with several studies supporting this relationship. Mueller et al. (2008) proposed that positive experiences using ICT in their classroom would contribute to how confident the teacher would feel with using ICT in their teaching. Tezci's (2009) findings from his survey of primary school teachers in Turkey, indicated that experience with ICT, attitudes towards ICT, self-reported knowledge of ICT, and self-reported usage of ICT were interrelated. In addition, he found that an important starting point for teachers was to ensure they had adequate and appropriate experiences with ICT.

STUDENT SELF-REPORTED COMPETENCE AND CONFIDENCE

Main Findings

Correlations between student self-reported competence and self-reported confidence

There was a strong and positive relationship between the students' average self-reported competence and the students' average self-reported confidence for the specified ICT. The overall average competence was slightly less than the overall average confidence, but both were above competent and confident (3.58 and 3.75 respectively). The lack of gender difference reflects Bain and Rice's (2006/2007) findings of no significant gender differences in student attitudes and perceptions towards ICT nor for how ICT was used, with students' attitudes towards ICT found to be positive and reflecting enjoyment in using and learning how to use ICT at school and home. However, although, Volman's et al. (2005) research with students at primary and secondary Dutch schools found students had positive views regardless of gender, boys were found to have higher interest, to be more knowledgeable, and to state they knew more than the teacher regarding ICT.

The connections between confidence and use were also found by Tomte and Hatlevik

(2011). In their analysis of Finnish and Norweigan data from PISA 2006 and the ICT survey incorporated into PISA 2006, Tomte and Hatlevik (2011) found self-efficacy (considered similarly to confidence) in tasks involving the internet increased with reported use of ICT for leisure and self-efficacy in tasks involving software increased with reported use of ICT for either leisure or education.

Relationship between the student perceptions of the importance f the teacher using ICT and the student average self-reported competence and self-reported confidence

Relationships were found between the students' average self-reported competence and confidence or whether students used ICT and their perceptions of ICT in the teacher's role. When the ICT was used by the students and the students' average self-reported competence and confidence were below competent and confident, they did not offer reasons referring to student benefits when asked why teachers should be able to use ICT in their role. Likewise, when students did not use ICT during the observation, they did not offer reasons referring to student benefits when asked for why teachers should be able to use ICT in their role. In his study with first year university students, van Braak (2004) found that computer confidence had an impact on the self-reported ICT competence. In addition, Gerjets and Hess (2004) saw student perceptions of the usefulness of ICT in education as having the potential to impact on their perceptions of and interactions with the learning environment, specifically that lower perceptions increased the likelihood of a less powerful learning environment.

Additional Findings

Teacher and student self-reported competence and confidence

There were strong and positive correlations between the teacher average competence, the teacher average confidence, the student average competence, and the student average confidence. In addition, there was a significant difference between Year 5 and Year 6 teachers in competence, with the averages for the Year 6 teachers higher than the averages for the Year 5 teachers (though the number of participants was small) and there was a significant difference with Year 5 students less competent than Year 6 students (though the difference in means was only slight). The difference for Year 5 and Year 6 students reflects Stevenson's (2008) finding of a strong and positive correlation between students' experiences with ICT and their age, with experience increasing as age increased.

The strong and positive relationships that were found can be considered through the research discussed regarding teacher findings and student findings. That is, teachers who are more competent and confident use ICT more (Hargittai 2010; Mueller et al., 2008). If they use ICT more, then their students are likely to also use ICT more (Ananiadou & Claro 2009; Levin & Wadmany, 2008). This use would be related to students perceiving themselves competent and confident (Tomte & Hatlevik 2011).

Teacher and student self-reported competence and confidence for specific ICT

When average teacher ratings of competence and confidence for each of the specified ICT were considered, the five ICT with the highest teacher average competence were also were the five ICT with the highest teacher average confidence. Likewise, the four ICT with the lowest teacher average competence also had the lowest teacher average confidence. This also occurred for the student average competence and student average confidence, with the five ICT with the highest average competence also having the highest average confidence and the four ICT with the lowest average competence also having the lowest average confidence. When the results for teachers and students were compared, two ICT that were used during the observations were in the top five for the average competence and average confidence for both – *desktop or laptop computers* and the *internet*. A third ICT, *mobile telephones*, was also in common.

The results are in contrast to Prensky's (2001) anticipated mismatch between the teacher and students' self-reported competence and confidence. Likewise, Beardon and Way's (2003) expectation that students may bring a higher level of ICT skills and knowledge to the classroom than the teacher does was not supported. The results did reflect Kolikant's (2010) results with Year 8, 10, and 11 students, who considered themselves less competent than previous generations, indicating a lack of a gap. The lack of difference could not be attributable to the teachers also belonging to the ICT generation, as although two teachers did not report how long they had taught for, if a four year degree was added to the minimum age for entering university, the youngest teachers would still be in their twenties and of a different generation to the students.

The teachers' and students' average competence and confidence for the ICT used during the observations were competent and higher and confident and higher for all but one ICT – *statistical or database software*. The ICT that teachers and students had lower average competence and confidence also shared similarities, being – *statistical or database software*, *wikis, blogs or twitter*, and *vodcast, podcast, video conferencing, or webinars*. At the time of the research, wikis, blogs, and twitter were newer technologies and could be seen as higher level ICT due to the recency of their introduction. As a result, these ICT could be viewed as higher level as they required more effort on the part of the user, either due to being more involved or newer technologies. This lack of using higher level ICT may be related to the lack of confidence in those ICT, reflecting Hargittai's (2010) finding linking teacher confidence in the internet and internet use and Hsu's (2010) finding that the teachers' self-reported competency in ICT was related to the teacher's reported use of ICT. Overall, the teacher use of ICT reflected what Martinovic and Zhang (2012) described as for the preparation and presentation aspects of teaching that used a small portion of the wide range of available ICT. In addition, this may reflect Martinovic and Zhang's conclusion that these uses result in teacher-centric approaches – in this research, this was evident with the use of electronic whiteboards.

IMPLICATIONS FOR TEACHERS AND STUDENTS IN UPPER PRIMARY CLASSROOMS

As this research was conducted within schools that fit specific criteria, the implications for ICT use can only be considered in terms of upper primary classrooms in schools with access to either computer laboratories or class sets of laptops. Aspects of the relationships found between who used the ICT, how it was used, and the behaviours in the classroom have been found in other research (for example, Maher, 2012; Stevenson, 2008), but these relationships need to be brought into the open to ensure that teachers are aware that their choices in ICT use (both which ICT and who uses it) will impact on other aspects of their learning environment.

The relationship between teacher self-reported competence and confidence with ICT and whether the behaviours result in a teacher-directed or student-centred lesson also need to be acknowledged. This is important for two wider reasons – the impact on the likelihood of teacher-directed classrooms not realising the opportunities ICT present in terms of classroom interaction and a variety of learning (Spring, 2004) and through the potential for teacher perceptions of their competence and confidence in other subject areas impacting on their classroom environments (for example, Graven 2004).

Student perceptions of the value of ICT in their learning were found to be affected by whether they had the opportunity to use ICT in their lesson. The focus on the ICT skills required by children (MCEETYA, 2008; OECD, 2010) predicates the children having access to the ICT in a learning environment. In addition, teachers need to ensure students have the opportunity to develop ICT skills and the competence to use ICT in their learning (Ananiadou & Claro, 2009). However, this focuses on the point that how ICT is used in the classroom is not an isolated issue related to provision of the ICT (Trinidad, 2002), but one also related to teacher and student perceptions of ICT.

LIMITATIONS

The main limitations of this research were related to data collection and quantitative analysis. With only one observer making observations, there would have been behaviours that were missed. Limitations evident in the data collection relate to the observations and Likert-style questionnaire collecting the data for self-reported competence. The decision to not use video cameras was based on the potential of the video camera to be disruptive (Merriam, 2009), the level of ethics that would have been required, and the potential impact on the willingness of teachers and students to participate. In addition, the researcher conducting observations would have benefitted from more experience conducting observations in classrooms.

The use of "Satisfactory" rather than "Beginner" (as with the teacher's questionnaire) as the lowest item in the range for students to indicate their competence in the Likert-style questionnaire was also a limitation, though the potential impact of this cannot be ascertained. The use of self-reported data for competence and competence can be seen as a limitation, although other research has used this method and have justified its use (e.g., see Bunz, Curry, & Voon, 2007; Hsu, 2010). Hartner (1982), specifically, investigated the self-reported competence of students in grades 3 to 9. The self-reported competence was compared to teacher perceptions and the findings indicated that students' self-reported competence judgments were increasingly realistic up to the final year (Grade 7) of elementary school. However, when comparisons with additional sources are not available, the use of data collected from respondents in any form that cannot be verified can be problematical (Papanastasiou & Angeli, 2008).

Teachers were not asked if the observed sessions were indicative of their usual lessons. Although teachers were asked how they preferred to used ICT (and this was compared with the observation), a measure of the representativeness of the observed session was not conducted. The teacher's preferences for how they used ICT was asked in the pre-observation interview but other substantiating data was not collected.

The small number of teachers and the small number of students in some of the cases were a limitation for the quantitative analysis. The first factor was determined by the number of cases in the research overall. Yin (2009, p. 55) stated "9 to 12 cases, in the aggregate, would provide substantial support" for qualitative analysis. However, 11 teachers was a very small number for quantitative analysis, with, for example, Creswell (2008, p. 156) recommending "approximately 30 participants for a correlational study". This did not prohibit the use of quantitative analysis but it does need to be taken into account when interpreting the results of the analysis of the teacher data. Likewise, the small number of students in the case studies would need to be taken into account. However, due to the cases being bound by the classroom and its participants (Merriam, 2009) and the determination to observe what occurred in the natural setting (Cohen et al., 2002) without observer manipulation, the researcher did not influence any aspect of the observation apart from requesting that ICT be used at some stage whilst the researcher was observing. This was a delicate balancing act between the naturalistic setting, as much as realistically possible, and researcher manipulation (Johnson & Turner, 2003; Merriam, 2009).

The decision to collect data for 11 case studies was based on the need for sufficient teacher and student numbers for the quantitative analysis (Yin, 2009). There was a conscious decision made by the researcher to include a larger number of cases as this enabled themes to be generated based on the large number of responses. A smaller number of cases may have allowed for more in-depth analysis but could have prevented the emergence of themes in the data (Stake, 2006).

CONCLUSION

This chapter discussed the findings regarding teacher and student factors related to the use of ICT in upper primary classrooms and situated the findings within existing research. These findings were considered in terms of the research questions, teacher and student observed behaviours, teacher and student perceptions of ICT use in the classroom, teacher and student self-reported competence and confidence. The next chapter, Chapter 7: Conclusion, will consider the wider implications of this research and suggest areas for future research.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

Relationships were found between teacher and student perceptions of ICT use, the ICT used, the most frequently occurring behaviours in the classroom, teacher beliefs regarding student learning, and teacher and student average self-reported competence and self-reported confidence. These findings are outlined below and implications are considered in terms of both practice in upper primary classrooms and future research (see Figure 7.1).

Teacher and student perceptions of ICT related to ICT use
Implications for practice in upper primary classrooms
Implications for research
Significance

Figure 7.1. The organisation of the conclusion and recommendations.

TEACHER AND STUDENT PERCEPTIONS OF ICT RELATED TO ICT USE

The ICT used was strongly linked to who initiated the interactions. Behaviour differences were noted when ICT was used by students, by teachers, or not at all. In almost all sessions where the most frequently occurring behaviours were student initiated, students used the ICT, desktop computers were used, and students mostly sat individually at computers. In all sessions where the most frequently occurring behaviours were teacher initiated, the teacher used the ICT, electronic whiteboards were used, and students sat in groups. In almost all sessions where ICT was not used, the most frequently occurring behaviours were teacher initiated. Salimi and Ghonoodi (2011) found that using ICT created student-centred environments, however, this research found that the relationship may be more nuanced, reflecting components of Stevenson's (2008) belief that the dialogue teachers and students engage would determine whether the classroom was teacher-centred or student, and Bidarian et al. (2011) and Peeraer and Van Petegem (2012), who proposed that teachers had to use ICT in ways that changed student learning before a student-centred environment was created.

The interaction of the lower self-reported competence or confidence of the teacher and the frequency of teacher initiated behaviours reflects the findings of Prestridge (2012), specifically that there were connections between the teachers' self-reported competence and confidence with ICT and how they used ICT in their classrooms. In addition, Jarvela (2010) proposed that the teacher determined whether the environment would be strict and confined when ICT was used. The results of this research may indicate that the teacher will direct the interactions when they wish to have more constrained ICT use and that constrained ICT use was more likely if the teacher had lower self-reported competence or confidence.

Conversely, one teacher with a competence of below competent gave the students some choice in the ICT used (the software, which also occurred in two other cases where desktop computers were used by the students and the same software options of document processors or presentation software were given). The observed behaviours in this session were mostly student-initiated. Jarvela (2010) stated that when the teacher used ICT to change learning and teaching opportunities, the results could be an environment where students had choice in what they did and how they did it. This, she suggested, would result in the teacher both requiring and enabling students to control the tasks and their learning. The implications may be that the teachers' decisions to create this environment would require them to willingly give the students greater choice in ICT use and in initiating interactions. However, this could not be determined from this research.

Teacher beliefs regarding student learning during the observed sessions focused on using ICT to support learning, learning the ICT itself, or both learning the ICT itself and using ICT to support learning. These foci were evident in research from almost 30 years ago (Pelgrum & Schipper, 1993), when the focus was on computers rather than ICT. The direction of relationships between the ICT used (electronic whiteboard and desktop computers) and the learning teachers considered occurred (learning from the ICT and learning the ICT itself, respectively) cannot be determined – whether the teacher chose the ICT that resulted in the perceived learning, or the teacher focused on the perceived or desired learning and that determined which ICT would be used, or the teacher preference determined both the learning and the ICT.

Relationships between the teacher giving choice to students and student perceptions of the importance of ICT were evident. When students were given choice on whether to use ICT at all during the session, not all students chose to use ICT. This case was one of two where the most frequently occurring reasons given by students for why ICT was important for the lesson did not include for learning and teaching. The other case was the only one where students did not use ICT at all during the observed session (the teacher used the ICT in that case). If students were given the choice whether to use ICT or do not use ICT, they did not consider the teacher use of ICT as for learning and teaching. This reflects Deaney's et al. (2003) conclusion that the students' perception of the importance of ICT was affected by the action of the teacher selecting the ICT that would be used in the lesson.

The teacher who gave students the choice on whether or not to use ICT was the only teacher who did not refer to ICT knowledge (that is, specific ICT) as one of the main ICT skills teachers required. The most frequently occurring reason given by the students for why a teacher should be able to use ICT referred to the use being beneficial for students. In two cases, this was the only reason. These two cases involved either the teacher giving students choice on whether or not to use ICT (the aforementioned case) or the students having the second highest average self-reported competence and the highest average self-reported confidence of all 11 cases. This coincides with Ilomaki and Randanen's (2007) finding that students with higher ICT skills were more interested in using ICT.

Where students did not perceive ICT use by teachers as beneficial for students, either the students did not use ICT in the lesson or the students had the lowest average self-reported competence and lowest average self-reported competence of all cases, with the average ratings being below competent and below confident. This reinforces the implications that teacher and student perceptions and self-reported competence and confidence interrelate with perceptions of ICT use. Ma et al. (2005) found that the students' perceptions of how easy the ICT was to use influenced the perceived usefulness of the ICT, which then influenced the intent to use ICT.

Students who focused on ICT being beneficial for the students as reason for teachers using ICT had choice in whether to use ICT or considered themselves more than competent and more than confident to such an extent that they had the second highest competence and highest confidence of all cases. The implication may be that students' perceptions of the importance of teacher ICT use focused on the benefits for their learning due to their own use of ICT, either through having choice in whether to use it or through higher competence and confidence. This could be due to the impact of student perceptions on their learning environments, in a similar way to Gerhets and Hesse's (2004) findings that student perceptions of the usefulness of ICT in education impacted on the effectiveness of the learning environment.

Teacher self-reported competence and self-reported confidence were strongly correlated and student self-reported competence and self-reported confidence were strongly correlated. For the majority of cases, the difference between the teacher and student averages self-reported competence produced a small effect size. Where there was a medium effect size, in two cases, the student average self-reported competence was well-above a rating of competence and moving towards expert; in once case, the teacher's average self-reported competence was below competent; in the final case, the teacher's average self-reported competence was higher than the students and highest of all the teachers. With average self-reported confidence, the effect sizes were evenly spread over the cases with three having small effects, three medium, and three large, with one having a medium effect in favour of the teacher (the case discussed above regarding average self-reported competence, where the teacher also had the highest average self-reported confidence with a rating moving towards highly confident). The students in the three cases with medium differences had average self-reported confidence moving highly confident and for the three with large differences, the students also had student average self-reported confidence moving highly confident for two and the teacher's average self-reported confidence was below confident for the last. These findings, particularly in terms of self-reported competence, reflect Waycott et al. (2010), who did not find substantial gaps overall.

IMPLICATIONS FOR PRACTICE IN UPPER PRIMARY CLASSROOMS

The implications for practice in upper primary classrooms occurs in five ways – the anticipated skills required of current students for their future, the use of policy in bridging the leap from current ICT skills to future ICT skills, the embodiment of the "school", teacher skills, and recognising the impact of future but as yet undeveloped ICT. MCEETYA (1999) recognised the importance of ICT as skills for children. This focus extends beyond childhood and into adulthood, with the Programme for International Assessment of Adult Competencies (PIAAC) discussed by Levy (2010).

Teacher perceptions of ICT can affect how ICT is used in the classroom and this has implications for the incorporation of ICT into education. The teachers used ICT that they reported competence and confidence with. Government policy recognised the importance of ICT in education (MEECTYA, 2002; Martinovic & Zhang, 2012; Wiseman & Anderson, 2012) but there is also an impact of school policy (Trinidad et al., 2005). These findings regarding teacher perceptions of ICT have implications in terms of the incorporation of ICT into the classroom through their pedagogy (Zhao et al., 2002) and how the curriculum is enacted (Ertmer et al., 2012). Increasing teacher willingness to use ICT can be addressed via professional development focusing on ICT skills (Ainley, 2001), teacher perceptions of their competence and confidence (Prestridge, 2012), pedagogy (Way et al., 2009), and teacher delivery of curriculum content (Ghonoodi & Salimi, 2011), as well as the interaction of these (Chai & Lim, 2011; Loveless et al., 2006; Mischra & Koehler, 2006).

Overall, student perceptions of the importance of teachers being able to use ICT reflect the expectations of policymakers (Underwood, 2009). Likewise, student perceptions of the importance of ICT to their lessons reiterated the increased motivation and engagement found in other studies (Balanskat et al., 2006). Students' perceptions of ICT were found to be related to their opportunities to use ICT in the classroom, which indicates the importance of students having access to ICT in their classroom and, potentially, outside of the classroom (Tomte & Hatlevik, 2012). However, there were not consistent differences between the average student self-reported competence and confidence and the average teacher self-reported competence and confidence, indicating that the anticipated digital divide between students and teachers (Prensky, 2001; Beardon & Way, 2003) did not eventuate.

RECOMMENDATIONS FOR FURTHER RESEARCH

Definitions of ICT change as new ICT become available and updated research as new ICT become available could compare how the features of the new ICT impact on teacher and student perceptions of ICT use in upper primary classrooms. For example, handheld devices such as iPads will have an impact on the use of ICT in classrooms. Proctor and Marks (2013) indicate that both usefulness and ease of use are important aspects of teacher perceptions when considering ICT use in the classroom. However, the use of newer handheld devices may also impact on how ICT is used in the classroom as there are differences in the functionality between these and existing ICT such as laptops (Kreijns, Van Acker, Vermeulen, & van Buuren, 2013).

This research has identified further questions related to teacher and student perceptions of ICT use that need to be answered:

- ICT used, who uses ICT, most frequently occurring behaviours
    - How is the link between the ICT used and who initiates the interactions forged - is it due to who is using the ICT, how the ICT use is organised, or the ICT itself?
    - Do teachers select the ICT used in terms of the dialogue they wished to conduct in the lesson and this resulted in the behaviours or is the ICT used selected without consideration of potential dialogue and behaviour effects?
- Student perceptions and ICT use
    - Whether it is students not using ICT that results in their perception of the lack of importance for learning and teaching or the ICT not being used reflecting the lack of perceived importance of ICT for learning and teaching?
    - Was it the student perceptions of higher competence and confidence or the teacher empowering the students by giving them choice in

whether or not to use ICT that led to the students' perceptions of the value of using ICT or if it was the students' perception of the value of ICT that was created their the higher belief in their competence and confidence and encouraged the teacher to provide them with choices?

  - Whether the student perceptions of the benefits of teacher ICT use are indications of how ICT is used, which results in choice and competence and confidence, or whether student choice and competence and confidence result in students' perceptions of the importance of ICT in the teacher role as focusing on the benefits to their learning?

- Relationship between ICT use and competence and confidence
  - Is there is a start point in ICT that is used – is it that using the ICT leads to competence and confidence or that confidence and competence lead to ICT use?
  - Does the teacher select ICT they consider themselves competent in and are confident of using, or does using the ICT develop the teacher competence and confidence to use it?
- Changes in ICT availability
  - With more ICT becoming available, has the range of ICT used in the classroom changed and, if so, how does the ICT used relate to the competence and confidence of the teacher and students in those ICT?

ICT also has the capacity to change classroom practices on a larger scale, both in terms of student achievement (Ainley et al. 2012; Levy, 2010) and learning opportunities such provided by flipped classrooms (Fulton, 2012). In their consideration of the flipped classroom, Herreid and Schiller (2013) recognised that ICT has made flipping more possible. However, flipping classrooms impacts on teacher and student practices and use of ICT (Fulton, 2012) and, as the perceptions of ICT of teachers and students interacts with their use of ICT, further studies in teacher and student perceptions of ICT need to be conducted to consider implications for and from flipped classrooms.

SIGNIFICANCE

Although the use of case studies limits the generalisability of this research, the findings of this research are significant as they identify several factors related to ICT use in the upper primary classroom and the relationships between these factors and ICT use. The opportunities for ICT to positively impact on both teaching and learning in the classroom (Ananiadou & Claro, 2009; Levin & Wadmany, 2008; Wiseman & Anderson, 2012), and the necessity for students to become digitally literate (Pegrum, 2010) and develop what are termed 21st century skills (OECD, 2010), needs to recognise that ICT can and probably will change what happens in the classroom (Crook et al., 2010). The identification of these relationships and the recognition that these factors interrelate is important. These new understandings need to be incorporated by participants within education as they have the potential to impact on planning. Confluence is needed between the ICT used, who uses the ICT, the learning involving the ICT (that is, learning the ICT itself or using ICT to support learning), and the teaching approach (teacher centred, student centred).

CONCLUSION

Relationships were found between the ICT used, the classroom behaviours, teacher and student perceptions of ICT in the teacher’s role and during the observed session, teacher perceptions of student learning, and teacher and student self-reported competence and self-reported confidence in ICT. The focus on ICT literacy necessitates that ICT is used, but this research highlights the importance of teachers knowing why they are using ICT and the how the use of ICT could affect behaviours, competence, and confidence within the classroom.

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Every reasonable effort has been made to acknowledge the owners of copyright material. I would be pleased to hear from any copyright owner who has been omitted or incorrectly acknowledged.

Appendix A

Questionnaire 1 for Students

Please circle: Male Female   What grade are you in: ________

For this questionnaire, please use the following definition for information and communication technology (ICT): Desktop, laptop, and handheld computers that run software and can enable access to the Internet, along with software and using the Internet itself (Hew & Brush, 2007).

What did you use the ICT for in this lesson?
What would you change about how ICT was used in the lesson?

How important was the ICT for the lesson?
What was the most important part of using ICT in the lesson?

Do you think primary school teacher should able to use information and communication technology (ICT) in your lessons? Please explain your answer.

Questionnaire 2 for Students

Please circle: Male Female What grade are you in: ________

For this questionnaire, please use the following definition for information and communication technology (ICT): Desktop, laptop, and handheld computers that run software and can enable access to the Internet, along with software and using the Internet itself (Hew & Brush, 2007).

1. Please show **how well** you use the items listed at home or at school by placing a circle around the number to show how well you think you use that item. **Leave the line blank if you don't use that item.** Add in any other information and communication technology (ICT) you use at home or at school that are not on the list.

ICT Item	Satisfactory		Competent		Expert
Desktop or Laptop	1	2	3	4	5
Electronic Whiteboard	1	2	3	4	5
Mobile telephones	1	2	3	4	5
Internet browsers (such as Explorer or Safari)	1	2	3	4	5
Document Processors (such as Word, AppleWorks or Text Edit) programs	1	2	3	4	5
Presentation software (such as PowerPoint or KeyNote)	1	2	3	4	5
Statistical Software or Database Software (such as Excel)	1	2	3	4	5
Email or messaging programs (such as Microsoft Outlook, iChat, or MSN)	1	2	3	4	5
Photograph and image software (such as importing software or Photoshop)	1	2	3	4	5
Movie or DVD editing programs	1	2	3	4	5
Social Networking programs (such as Facebook or MySpace)	1	2	3	4	5
Digital cameras or video recorders	1	2	3	4	5
Wikis, Blogs or Twitter	1	2	3	4	5
Vodcast, Podcast, video conferencing, or webinars	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

2. Please show how **confident** you feel using the items listed by placing a circle around the number to show how confident you are using that item. **Leave the line blank if you don't use an item.** Add in any other information and communication technology (ICT) you use in the classroom that are not on the list.

ICT Item	Highly Anxious		Confident		Highly Confident
Desktop or Laptop	1	2	3	4	5
Electronic Whiteboard	1	2	3	4	5
Mobile telephones	1	2	3	4	5
Internet browsers (such as Explorer or Safari)	1	2	3	4	5
Document Processors (such as Word, AppleWorks or Text Edit) programs	1	2	3	4	5
Presentation software (such as PowerPoint or KeyNote)	1	2	3	4	5
Statistical Software or Database Software (such as Excel)	1	2	3	4	5
Email or messaging programs (such as Microsoft Outlook, iChat, or MSN)	1	2	3	4	5
Photograph and image software (such as importing software or Photoshop)	1	2	3	4	5
Movie or DVD editing programs	1	2	3	4	5
Social Networking programs (such as Facebook or MySpace)	1	2	3	4	5
Digital cameras or video recorders	1	2	3	4	5
Wikis, Blogs or Twitter	1	2	3	4	5
Vodcast, Podcast, video conferencing, or webinars	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

Questionnaire 1 for Teachers

For this questionnaire, please use the following definition for ICT: Desktop, laptop, and handheld computers that run software and can enable access to the Internet, along with software and using the Internet itself (Hew & Brush, 2007).

What do you see as the main ICT skills required for a primary school teacher? Please place a number above the skills in order of importance. If two items are equally important, place the same number above them.

How would you describe the importance of ICT in your role as a primary school teacher?

What other factors should be considered along with ICT skills when a teacher's use of ICT is being assessed?

Questionnaire 2 for Teachers

For this questionnaire, please use the following definition for ICT: Desktop, laptop, and handheld computers that run software and can enable access to the Internet, along with software and using the Internet itself (Hew & Brush, 2007).

1. Please rate how **competent** you are with the listed ICT in the classroom by drawing a circle around the number for that item. **Leave the line blank if you do not use an item.** Add in any other ICT you use in the classroom that are not on the list.

ICT Item	Beginner		Competent		Expert
Desktop or Laptop	1	2	3	4	5
Electronic Whiteboard	1	2	3	4	5
Mobile telephones	1	2	3	4	5
Internet browsers (such as Explorer or Safari)	1	2	3	4	5
Document Processors (such as Word, AppleWorks or Text Edit) programs	1	2	3	4	5
Presentation software (such as PowerPoint or KeyNote)	1	2	3	4	5
Statistical Software or Database Software (such as Excel)	1	2	3	4	5
Email or messaging programs (such as Microsoft Outlook, iChat, or MSN)	1	2	3	4	5
Photograph and image software (such as importing software or Photoshop)	1	2	3	4	5
Movie or DVD editing programs	1	2	3	4	5
Social Networking programs (such as Facebook or MySpace)	1	2	3	4	5
Digital cameras or video recorders	1	2	3	4	5
Wikis, Blogs or Twitter	1	2	3	4	5
Vodcast, Podcast, video conferencing, or webinars	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

2. Please rate how **confident** you feel using the listed ICT in the classroom by drawing a circle around the number to show what you think your level of confidence is for that item. **Leave the line blank if you do not use an item.** Add in any other ICT you use in the classroom that are not on the list.					
ICT Item	Highly Anxious		Confident		Highly Confident
Desktop or Laptop	1	2	3	4	5
Electronic Whiteboard	1	2	3	4	5
Mobile telephones	1	2	3	4	5
Internet browsers (such as Explorer or Safari)	1	2	3	4	5
Document Processors (such as Word, AppleWorks or Text Edit) programs	1	2	3	4	5
Presentation software (such as PowerPoint or KeyNote)	1	2	3	4	5
Statistical Software or Database Software (such as Excel)	1	2	3	4	5
Email or messaging programs (such as Microsoft Outlook, iChat, or MSN)	1	2	3	4	5
Photograph and image software (such as importing software or Photoshop)	1	2	3	4	5
Movie or DVD editing programs	1	2	3	4	5
Social Networking programs (such as Facebook or MySpace)	1	2	3	4	5
Digital cameras or video recorders	1	2	3	4	5
Wikis, Blogs or Twitter	1	2	3	4	5
Vodcast, Podcast, video conferencing, or webinars	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

3. What factors affect how confident you feel when using ICT in the classroom

Appendix B

Pre-Observation Interview Questions for Teachers

In this interview, please use the following definition for ICT: Desktop, laptop, and handheld computers that run software and can enable access to the Internet, along with software and using the Internet itself (Hew & Brush, 2007).

1. What factors did you consider when planning to use ICT in the lesson?

2. Do you have a preferred way of using ICT in the classroom? (Prompt: What is it?)

3. Was ICT used in the lesson as part of the learning outcome/s? (Prompt: Why?)

4. What ICT is available for use in the school?

Thank the teacher for answering the questions. Refer them to the contact details on the consent form if they have any questions.

Post-Observation Interview Questions for Teachers

In this interview, please use the following definition for ICT: Desktop, laptop, and handheld computers that run software and can enable access to the Internet, along with software and using the Internet itself (Hew & Brush, 2007).

1. Do you think the students stayed on task during the lesson? (Prompt: Why do you think so?)

2. Were there other factors that affected the lesson? (Prompt: What are they?)

3. Did the students behave as they usually do in a lesson with ICT? (Prompt: What were the common or different behaviours?)

4. Did the students behave in the same way as other students during a lesson with ICT? (Prompt: What were the common or different behaviours?)

5. What do you think the students learnt by using ICT in this lesson? (Prompt: Would it have been different if ICT wasn't used?)

Thank the teacher for answering the questions. Refer them to the contact details on the consent form if they have any questions.

Appendix C

Information Sheet and Consent Forms

Information Sheet and Consent Form for School Principal

Information Sheet and Consent Form for Teacher Interview, Survey, and Observation

Information Sheet and Consent Form for Student Survey and Observation

Curtin University of Technology
Science and Mathematics Education Centre
Information Sheet and Consent Form for Research for School Principals

<<School>>
<<Principal>>5
<<Address Line 1>>
<<Address Line 2>>   <<Post Code>>

Dear <<Name>>

My name is Audrey Cooke and I am currently completing a research thesis for my Doctor of Mathematics Education at Curtin University of Technology.

Purpose of Research
I am investigating the research topic: "The impact of student and teacher ICT skill on student engagement and learning".

Your Role
I will conduct research by interviewing teachers and requesting teachers and students to complete questionnaires concerning ICT use in the classroom. Students involved will complete two questionnaires. Teachers will have two short interviews and two questionnaires to complete about ICT and their use of ICT. Two lessons will be observed – one lesson where the teacher is not using ICT and one lesson where the teacher is using ICT. Participation is voluntary and will be of a short duration (10 – 15 minutes for students and 15 – 20 minutes for teachers, not including the observation).

Consent to Participate
The teachers, students, and your school's involvement in the research is entirely voluntary. You have the right to withdraw at any stage without it affecting your rights or my responsibilities. When you have signed the consent form I will assume that you have agreed to your school's participation and allow me to use data collected in your school in this research.

Confidentiality
The information you provide will be kept separate from teacher and student personal details, and only myself and my supervisor will have access to this. Neither the questionnaires nor observation notes will have names or any other identifying information on it and in adherence to university and CEOWA policy, the interview notes, observation notes, and questionnaires will be kept securely by the CEOWA for a minimum of five years before a decision is made as to whether they should be destroyed.

Further Information
This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number SMEC-09-09). If you would like further information about the study, please feel free to contact me by email audrey.cooke@postgrad.curtin.edu.au. Alternatively, you can contact my supervisor, Associate Professor Vaille Dawson on 9266 7484 or email v.dawson@curtin.edu.au. . *If participants have any complaint regarding the manner in which a research project is conducted, it may be given to Research and Innovation, Catholic Education Office of Western Australia, PO Box 198 Leederville WA 6930, phone (08) 6380 5362.*

Thank you very much for your involvement in this research.
Your participation is greatly appreciated.

Curtin
University of Technology

Principal's Consent Form

- I have read and understood the purpose and procedures of the study as outlined in the provided information sheet for the research topic "The impact of the divergence between student and teacher ICT skill on student engagement and learning".
- I understand that the procedure itself may not benefit me.
- I understand that my school's involvement is voluntary and I can withdraw at any time without problem.
- I understand that no personal identifying information like my name and address will be used in any published materials.
- I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.
- I have been given the opportunity to ask questions about this research.
- I agree to allow teachers and students from my school to participate in the study outlined to me.

If participants have any complaint regarding the manner in which a research project is conducted, it may be given to Research and Innovation, Catholic Education Office of Western Australia, PO Box 198 Leederville WA 6930, phone (08) 6380 5362.

Name: ______________________________

Signature: ______________________________

Date: ______________________________

Researcher: ______________________________

Audrey Cooke Date

Curtin University of Technology
Science and Mathematics Education Centre

Information Sheet and Consent Form for Teacher Interview, Survey and Classroom Observation

My name is Audrey Cooke and I am currently completing a research thesis for my Doctor of Mathematics Education at Curtin University of Technology.

Purpose of Research
I am investigating the research topic: "The impact of student and teacher ICT skill on student engagement and learning".

Your Role
I will conduct research by interviewing you about and requesting you to complete questionnaires concerning ICT use in your classroom. Your Principal has already been contacted and has agreed in principle to the project. You will be asked to participate in two short interviews and two questionnaires about ICT and your use of ICT. I would also like to observe your class for two lessons – one lesson where the you do not use ICT and one lesson where the you do use ICT. If you agree to the class observation, interviews, and questionnaires, one interview will be conducted before the observation and one interview will be conducted after the observation. Both questionnaires will be completed after the last interview. Participation is voluntary and will be of a short duration (15 – 20 minutes, not including the observation).

Consent to Participate
Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without it affecting your rights or my responsibilities. When you have signed the consent form I will assume that you have agreed to participate and allow me to use your data in this research.

Confidentiality
The information you provide will be kept separate from your personal details, and only myself and my supervisor will have access to this. Neither the interview nor questionnaires will have your name or any other identifying information on it and in adherence to university and CEOWA policy, the interview notes and questionnaires will be kept securely by the CEOWA for a minimum of five years before a decision is made as to whether they should be destroyed.

Further Information
This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number SMEC-09-09).

If you would like further information about the study, please feel free to contact me by email audrey.cooke@postgrad.curtin.edu.au. Alternatively, you can contact my supervisor, Associate Professor Vaille Dawson on 9266 7484 or email v.dawson@curtin.edu.au. . *If participants have any complaint regarding the manner in which a research project is conducted, it may be given to Research and Innovation, Catholic Education Office of Western Australia, PO Box 198 Leederville WA 6930, phone (08) 6380 5362.*

Thank you very much for your involvement in this research.
Your participation is greatly appreciated.

Curtin
University of Technology

Teacher's Consent Form

- I have read and understood the purpose and procedures of the study as outlined in the provided information sheet for the research topic "The impact of the divergence between student and teacher ICT skill on student engagement and learning".
- I understand that the procedure itself may not benefit me.
- I understand that my involvement is voluntary and I can withdraw at any time without problem.
- I understand that no personal identifying information like my name and address will be used in any published materials.
- I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.
- I have been given the opportunity to ask questions about this research.
- I agree to participate in the study outlined to me.

If participants have any complaint regarding the manner in which a research project is conducted, it may be given to Research and Innovation, Catholic Education Office of Western Australia, PO Box 198 Leederville WA 6930, phone (08) 6380 5362.

Name: ______________________________

Signature: ______________________________

Date: ______________________________

Researcher: ______________________________

Audrey Cooke Date

Curtin University of Technology
Science and Mathematics Education Centre

Information Sheet and Consent Form for Student Survey and Classroom Observation

My name is Audrey Cooke and I am currently completing a research thesis for my Doctor of Mathematics Education at Curtin University of Technology.

Purpose of Research
I am investigating the research topic: "The impact of the divergence between student and teacher ICT skill on student engagement and learning".

Student Role
I will be asking students to complete two short questionnaires about the use of information and communication technology (which we call ICT) in their classroom. The teacher and the Principal have already been contacted and have agreed in principle to the project. Students will be asked to complete two questionnaires which should take 10 – 15 minutes. One lesson will also be observed where the teacher is using ICT.

Consent to Participate
Student involvement in the research is entirely voluntary. Students have the right to withdraw at any stage without it affecting your rights or my responsibilities. When parents and students have signed the consent form I will assume that you have agreed to participate and allow me to use the student's data in this research.

Confidentiality
The information you provide will be kept separate from personal details, and only myself and my supervisor will have access to this. The questionnaires will not have names or any other identifying information on it and in adherence to university and CEOWA policy, the questionnaires will be kept securely by the CEOWA for a minimum of five years before a decision is made as to whether they should be destroyed.

Further Information
This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval Number SMEC-09-09) and will be conducted under the auspices of the CEOWA. If you would like further information about the study, please feel free to contact me by email audrey.cooke@postgrad.curtin.edu.au. Alternatively, you can contact my supervisor, Associate Professor Vaille Dawson on 9266 7484 or email v.dawson@curtin.edu.au.

If participants have any complaint regarding the manner in which a research project is conducted, it may be given to Research and Innovation, Catholic Education Office of Western Australia, PO Box 198 Leederville WA 6930, phone (08) 6380 5362.

Thank you very much for your involvement in this research.
Your participation is greatly appreciated.

Curtin
University of Technology

Parent Consent Form

- I have read and understood the purpose and procedures of the study as outlined in the provided information sheet for the research topic "The impact of the divergence between student and teacher ICT skill on student engagement and learning".
- I understand that the procedure itself may not benefit my child.
- I understand that my and my child's involvement is voluntary and I can withdraw my child's involvement at any time without problem.
- I understand that no personal identifying information like my name, my child's name, nor our address will be used in any published materials.
- I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.
- I have been given the opportunity to ask questions about this research.
- I agree to allow my child to participate in the study outlined to me.

If participants have any complaint regarding the manner in which a research project is conducted, it may be given to Research and Innovation, Catholic Education Office of Western Australia, PO Box 198 Leederville WA 6930, phone (08) 6380 5362.

Name: ____________________

Student Name: ____________________

Signature: ____________________

Date: ____________________

Researcher: ____________________

Audrey Cooke
Date

Curtin University of Technology

Student Consent Form

- I have read and understood the purpose and procedures of the study as outlined in the provided information sheet for the research topic "The impact of the divergence between student and teacher ICT skill on student engagement and learning".
- I understand that the procedure itself may not benefit me.
- I understand that my involvement is voluntary and I can withdraw at any time without problem.
- I understand that no personal identifying information like my name and address will be used in any published materials.
- I understand that all information will be securely stored for at least 5 years before a decision is made as to whether it should be destroyed.
- I have been given the opportunity to ask questions about this research.
- I agree to participate in the study outlined to me.

Name: ______________________________

Signature: ______________________________

Date: ______________________________

Researcher: ______________________________

Audrey Cooke
Date

Appendix D

Diagrams

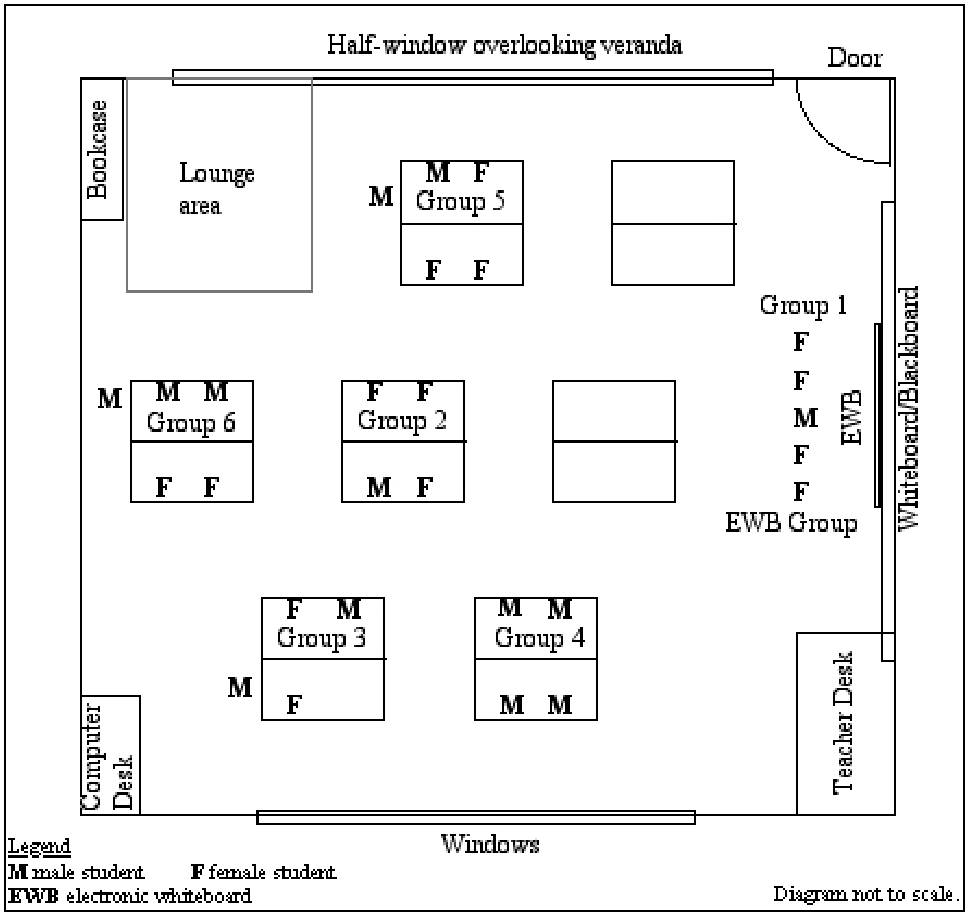

Figure D1. The environment in which the observation for Case A occurred.

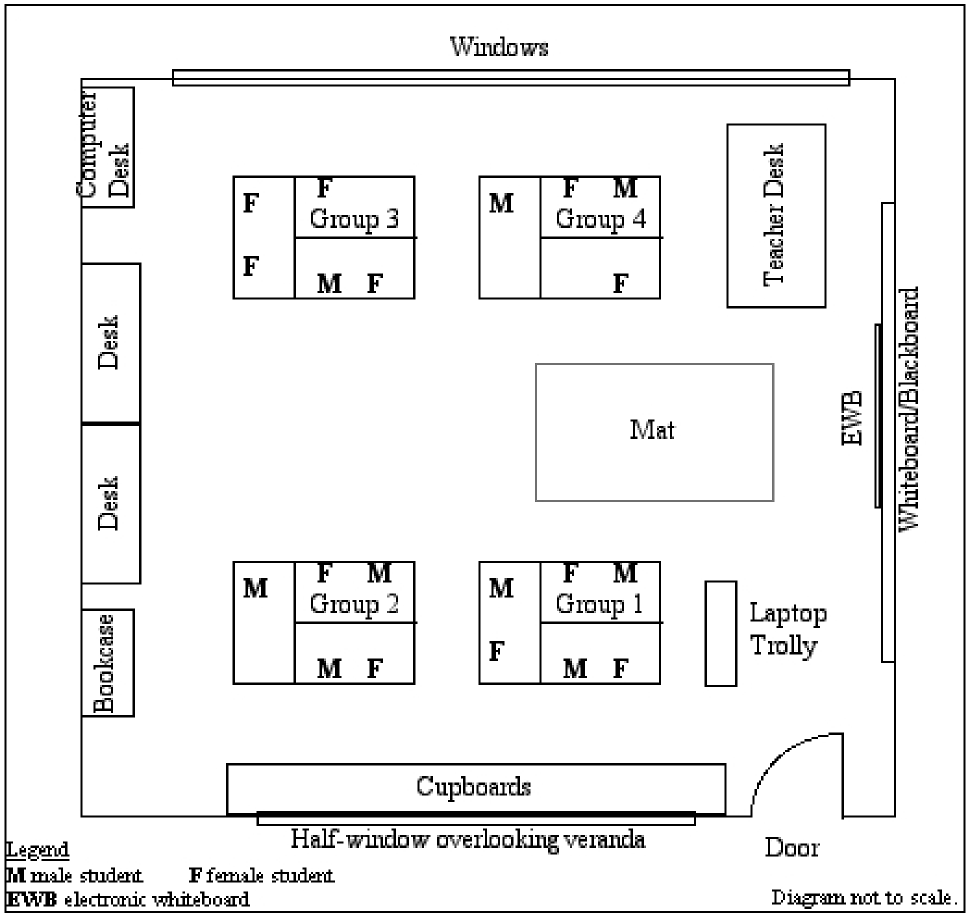

Figure D2. The environment in which the observation for Case B occurred.

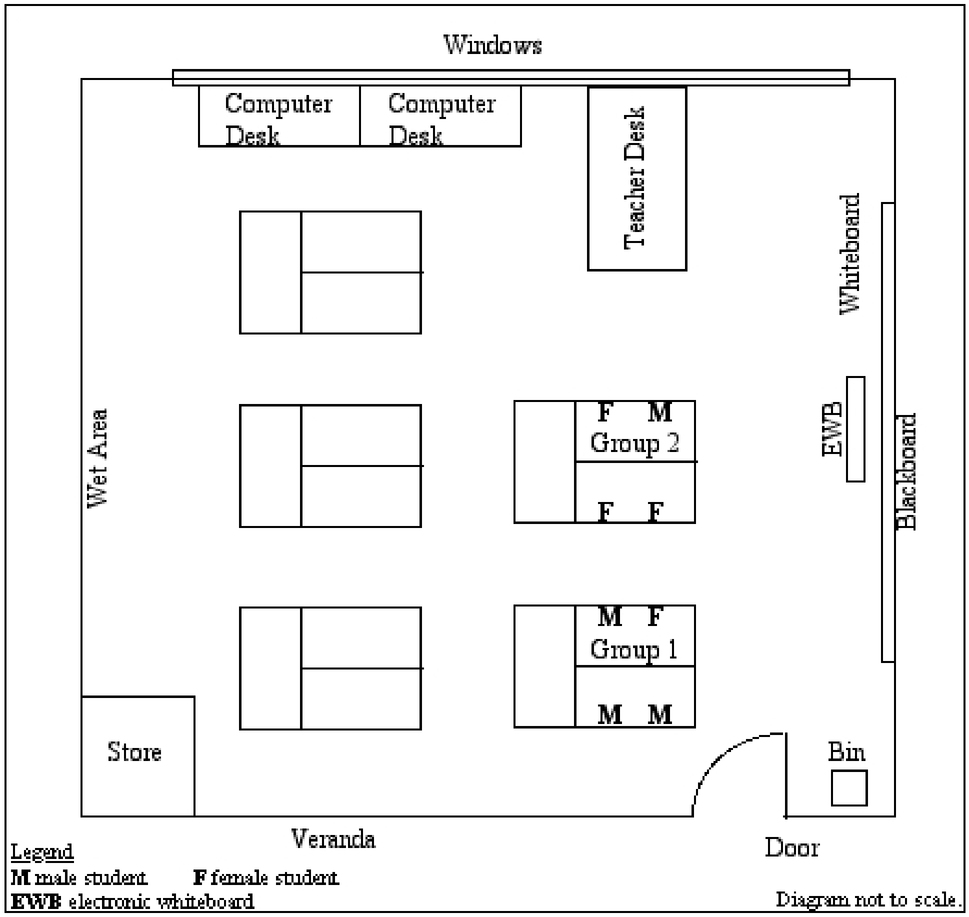

Figure D3. The environment in which the observation for Case D occurred.

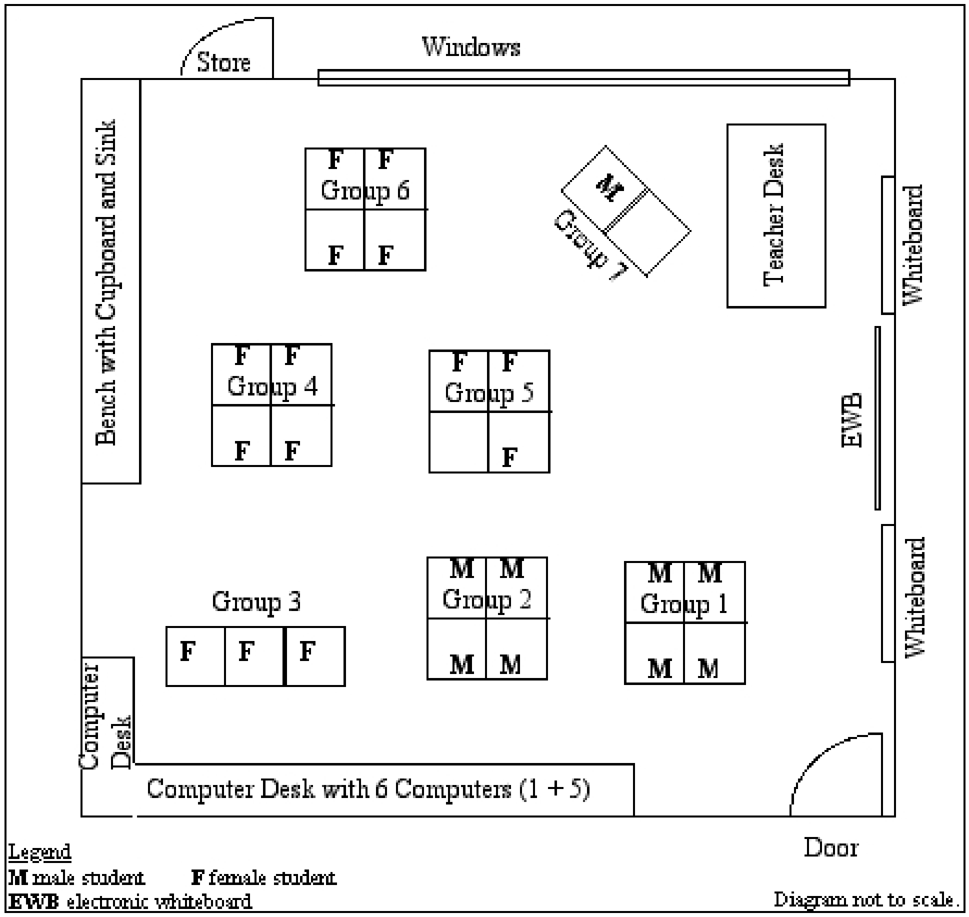

Figure D4. The environment in which the observation for Case F occurred.

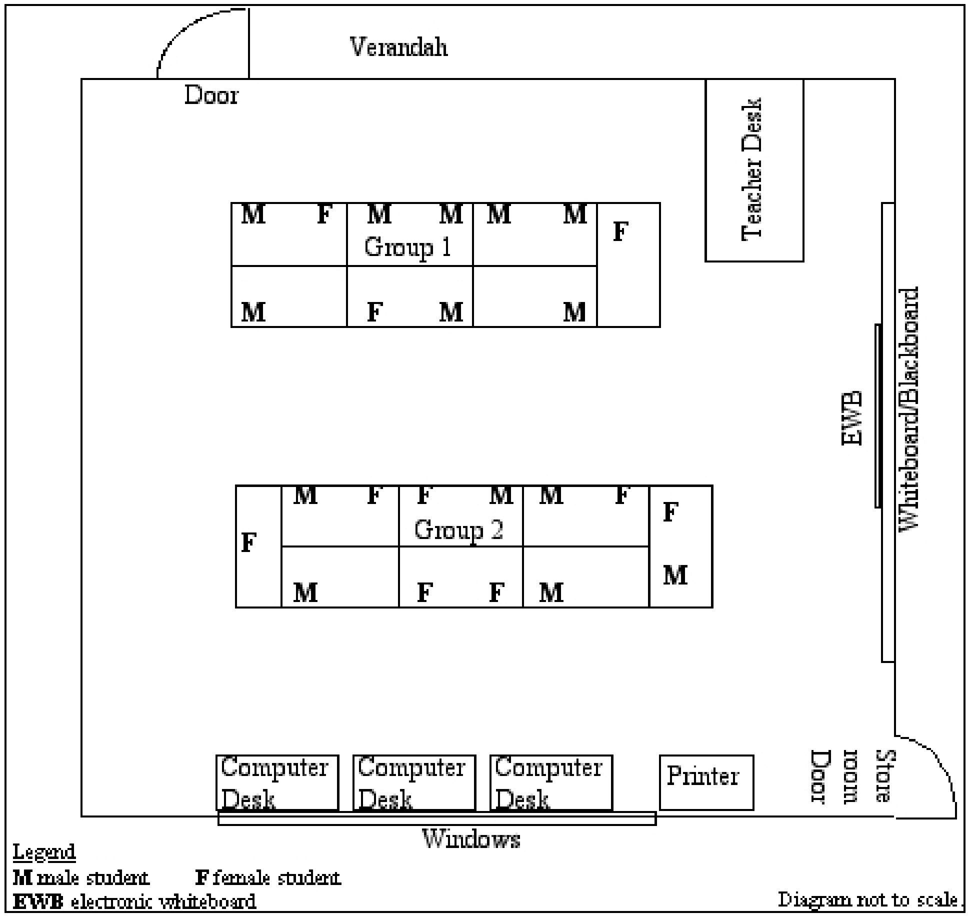

Figure D5. The environment in which the observation for Case E occurred.

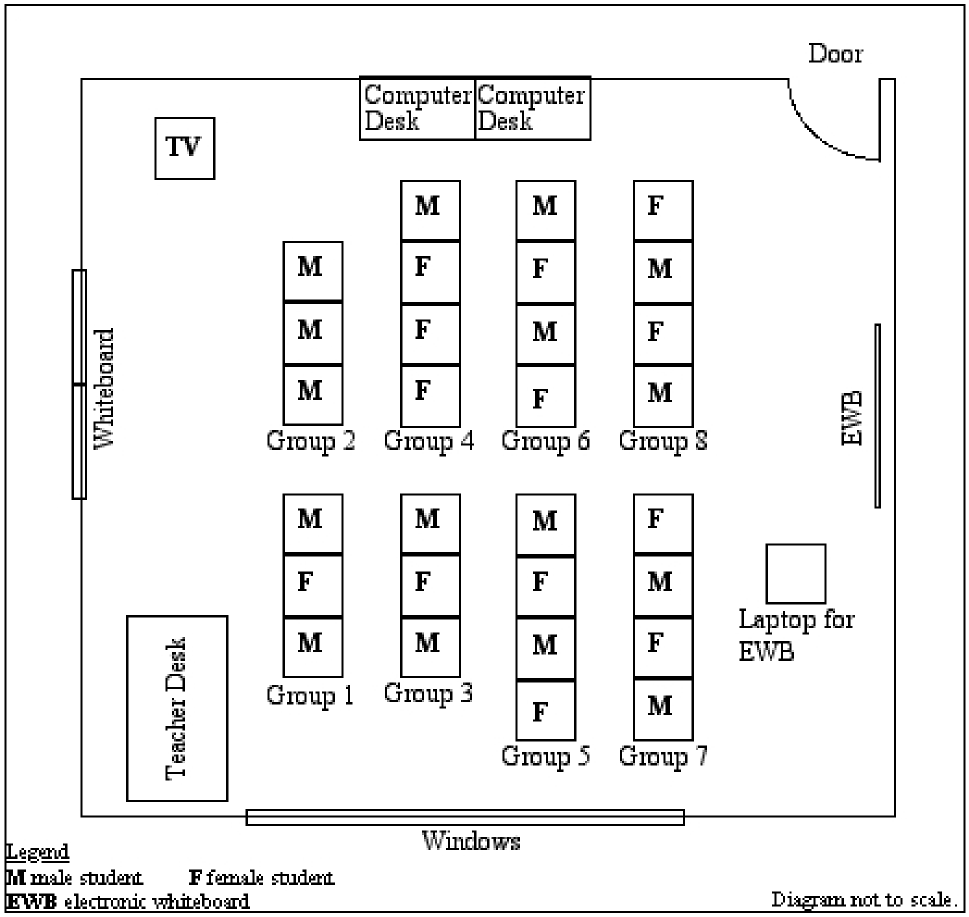

Figure D6. The environment in which the observation for Case I occurred.

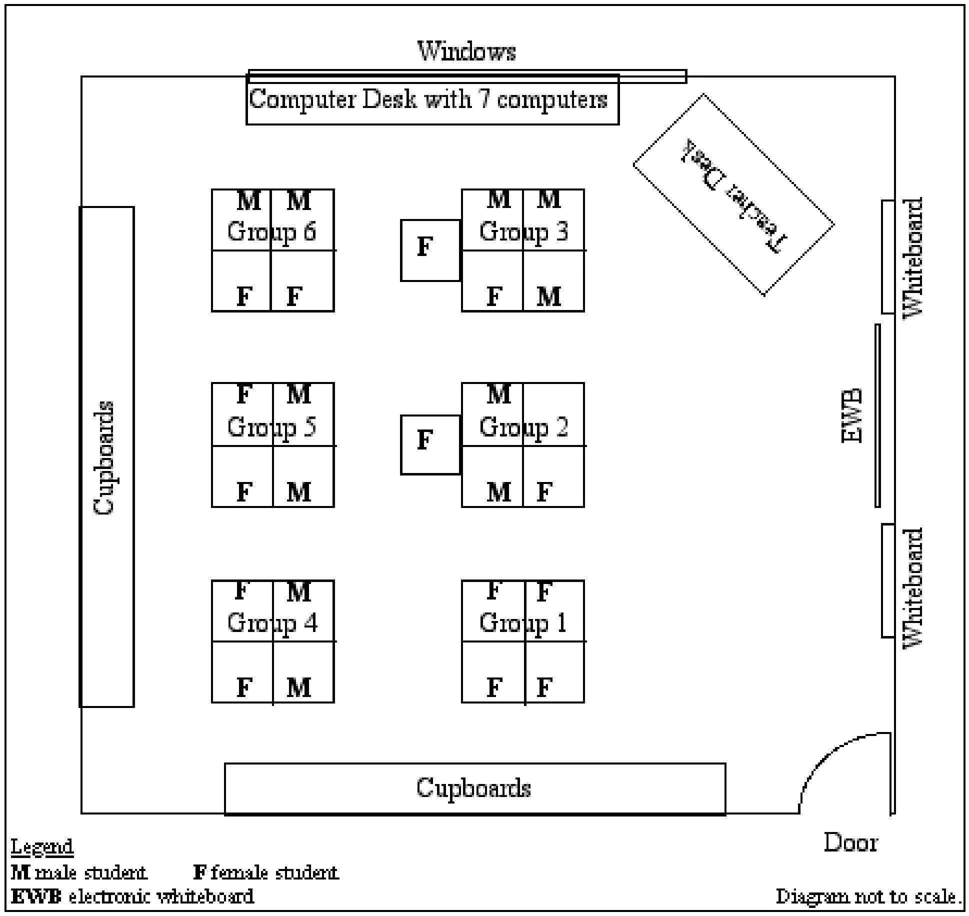

Figure D7. The environment in which the teacher controlled the ICT for Case K

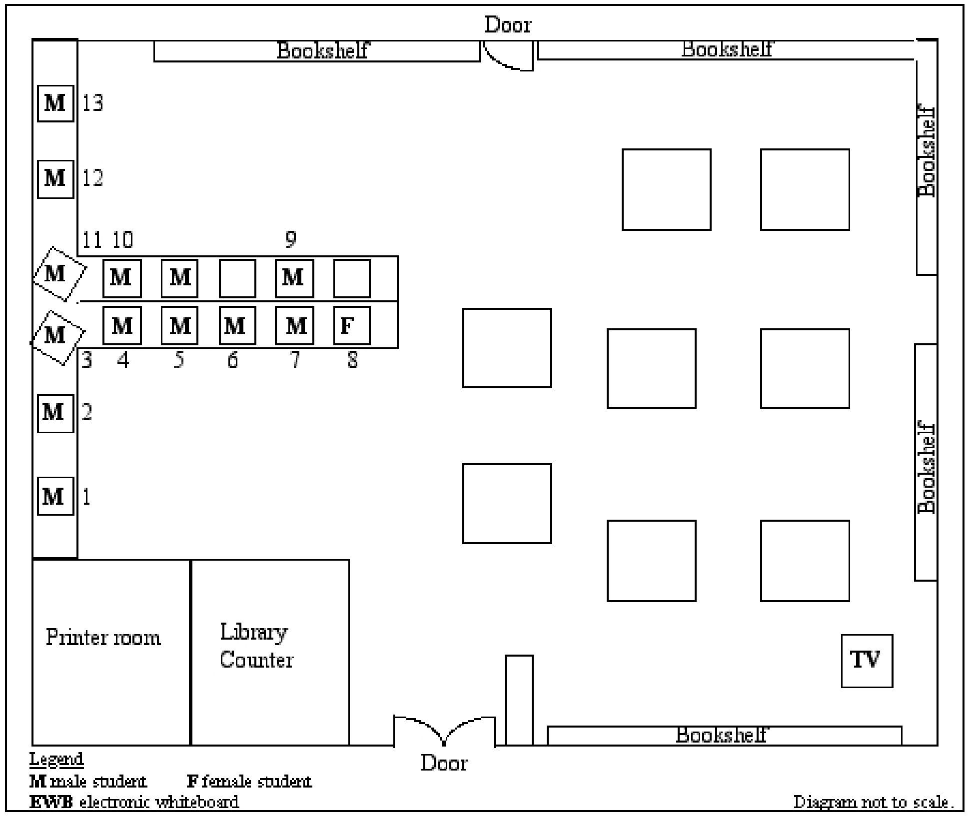

Figure D8. The environment in which the student controlled the ICT for Case K

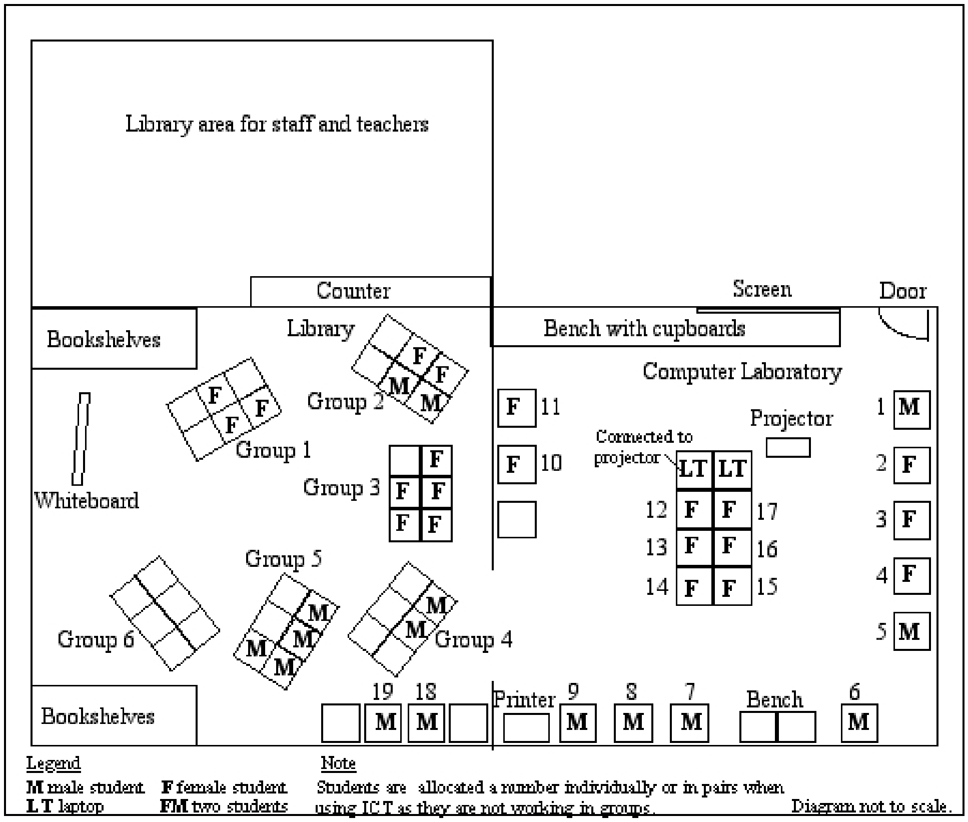

Figure D9. The environments in which the observation for Case H occurred.

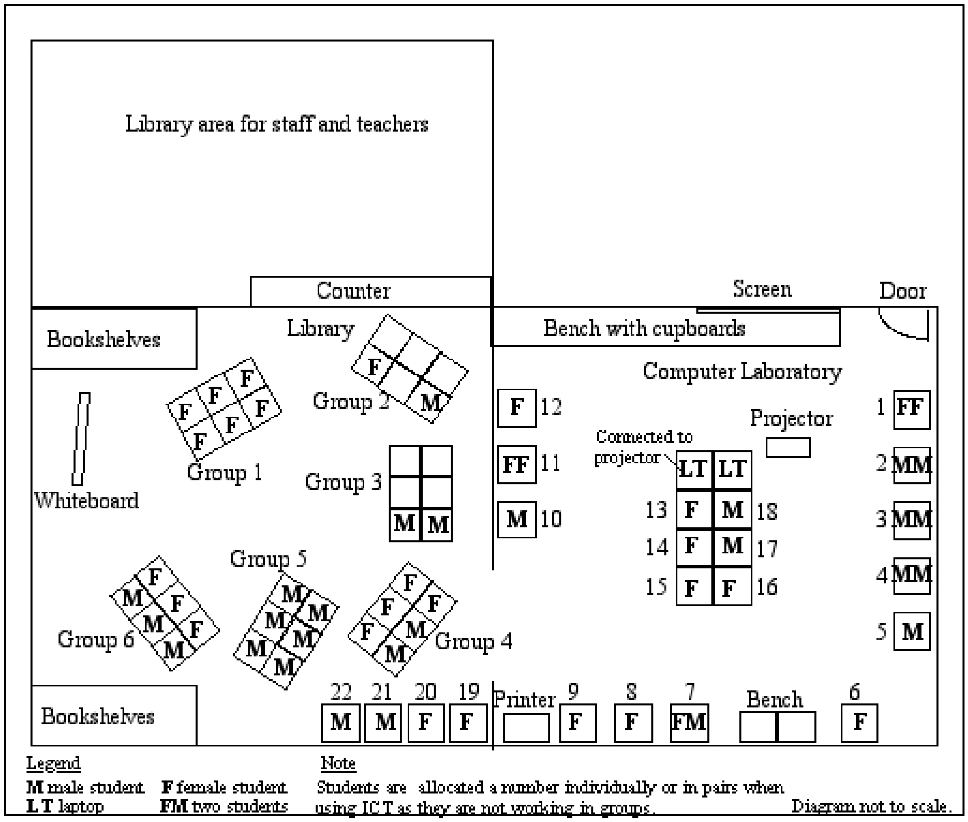

Figure D10. The environments in which the observation for Case G occurred.

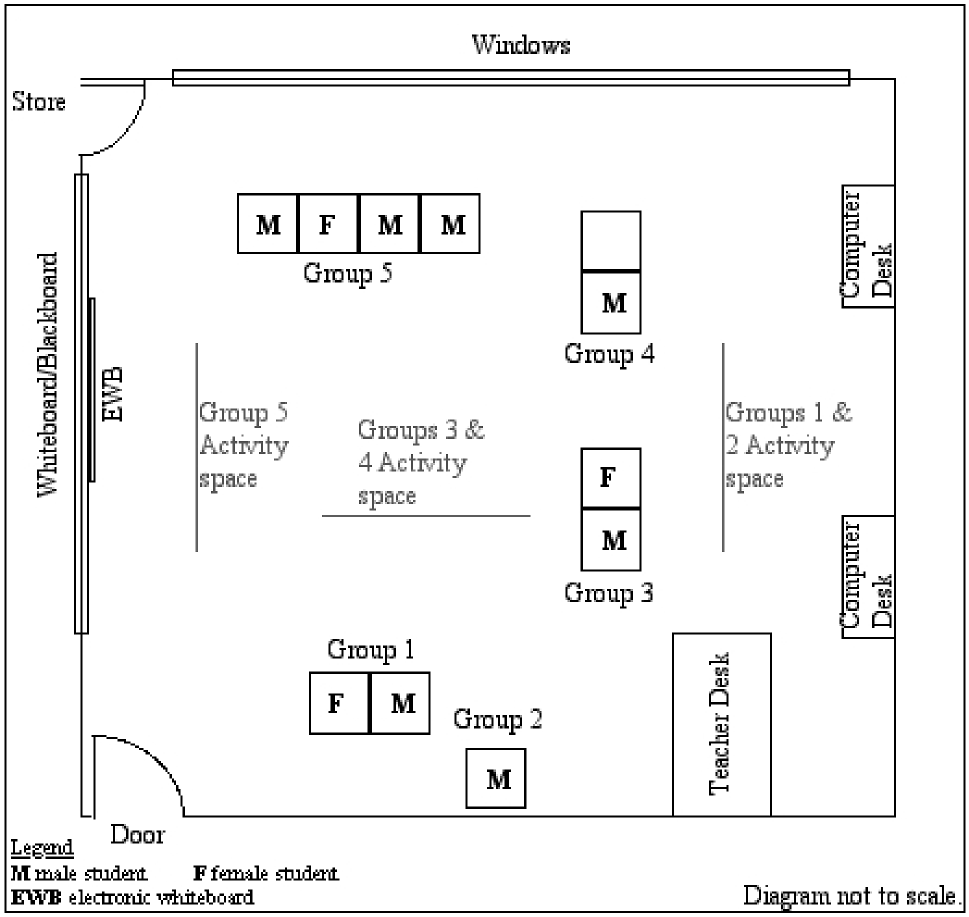

Figure D11. The environment in which the observation without ICT for Case C occurred.

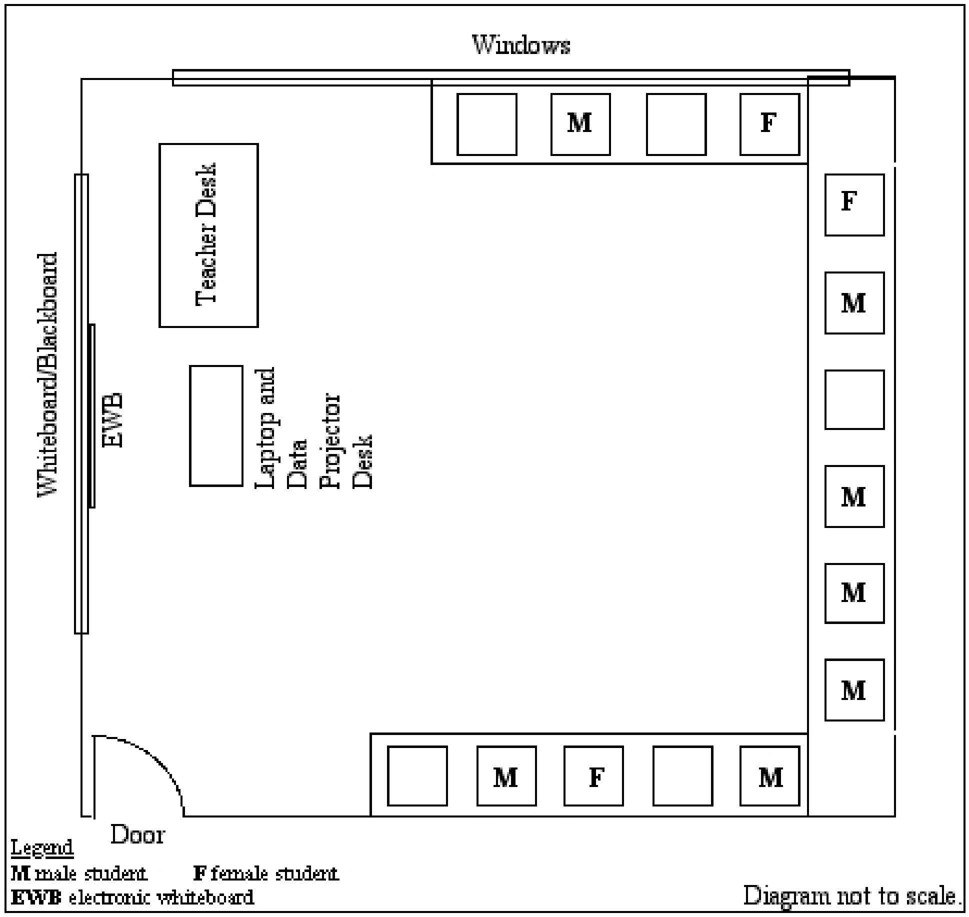

Figure D12. The environment in which the observation with ICT for Case C occurred.

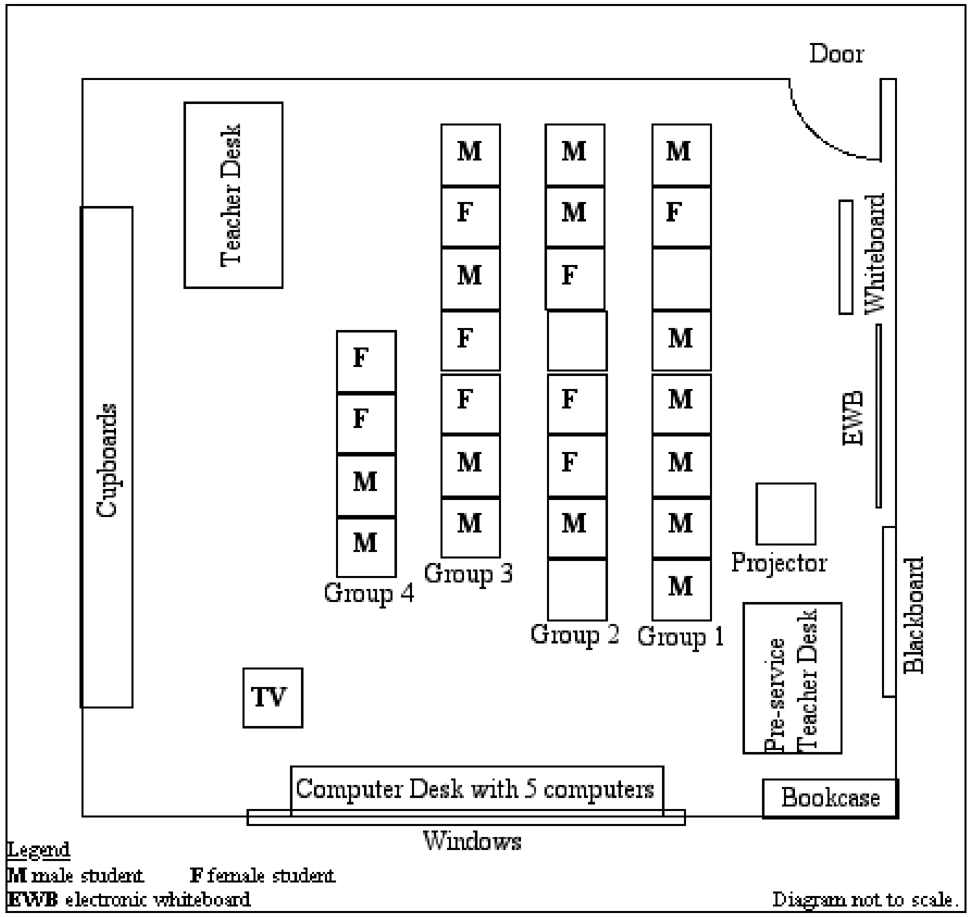

Figure D13. The environment in which the observation without ICT for Case J occurred.

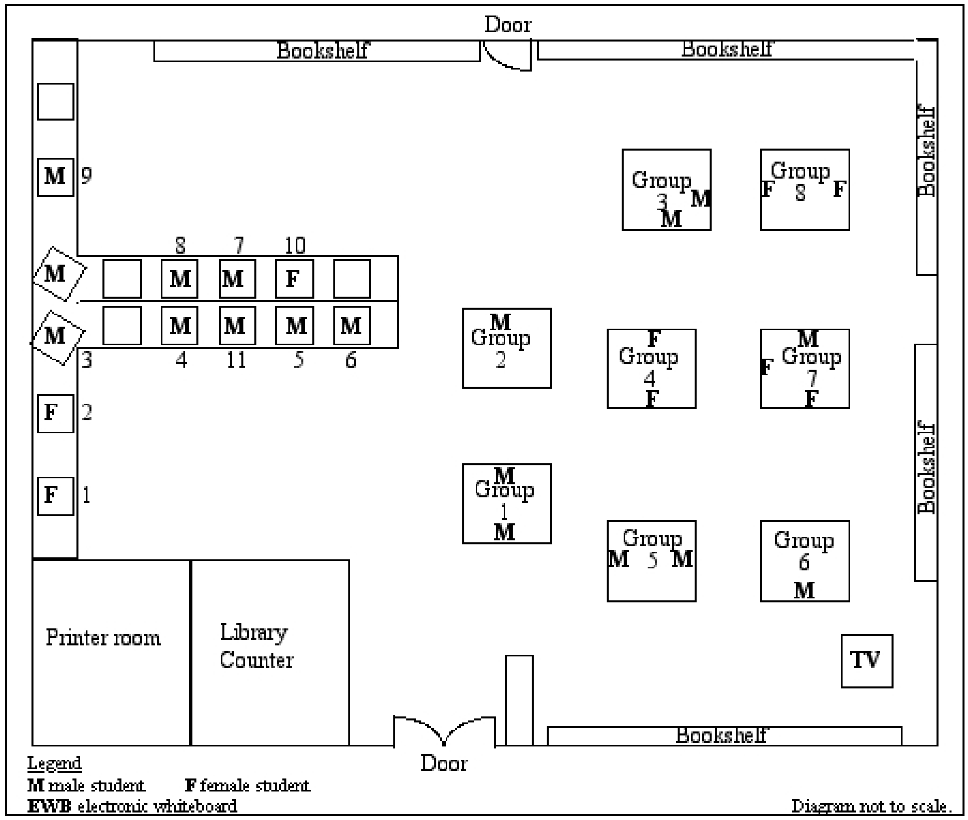

Figure D14. The environment in which the observation with ICT for Case J occurred.

Appendix E

Potential Behaviours and Categories

Potential Behaviours (with original coding numbers)	**Category**
1. Student looking at another student's work. 2. Student looking at another student's resources. 3. Student looking at another student's ICT. 4. Student touching/using another student's stationery. 5. Student touching/using another student's resources. 6. Student touching/using another student's ICT. 8. Student talking to other students. 44. Student answers another student's question.	Student-student interaction
11. Student putting their hand up to ask question of teacher. 12. Student talking to teacher. 13. Students taking work up to the teacher for marking. 14. Student walking up to talk to teacher. 15. Student walking up to teacher to ask question. 23. Teacher responds to student questions. 37. Student asks teacher a question. 43. Student calls out to teacher. 55. Student waiting to talk to teacher.	Student initiated interaction with teacher, including teacher answering
25. The teacher giving directions for task. 26. The teacher giving directions for student behaviour. 27. The teacher asking questions or making points to assist students in their learning. 30. Teacher asking student for a reason for behaviour. 39. Student answers teacher question. 40. Student puts hand up to answer teacher question. 42. Teacher asking question.	Teacher initiated interaction with student, including student answering

Potential Behaviours (with original coding numbers)	**Category**
16. The teacher checking progress. 17. Teacher marking work. 18. Teacher says student name to get attention. 19. Teacher uses non-verbal action to get student attention. 20. The teacher commenting on student following directions. 21. The teacher commenting on student not following directions. 22. The teacher telling students to return to work. 38. Teacher commenting on or checking student work. 41. Teacher commenting on resources.	Teacher talking to student, giving directions, response not required or given
7. Student verbal utterances/singing/cheering. 9. Student moving body/standing/fidgeting without walking away from desk. 10. Students moving around the environment. 28. Student looking away from work. 29. Student looking out window. 48. Student comment, not answering question. 49. Teacher near group. 47. Student question, not directed.	Individual student behaviours
50. Teacher talking to group or student, no further information on what said. 53. Teacher talking to another adult/teacher. 54. Teacher walking around groups/students.	Individual teacher behaviours
31. Student using stationery contrary to purpose. 32. Student using ICT contrary to purpose. 33. Student using resources contrary to purpose. 34. Student gets/returns stationary. 35. Student gets/ returns resources. 36. Student gets/ returns ICT. 51. Setting up ICT. 52. Setting up non-ICT work. 56. Organise ICT resource. 57. Organise non-ICT resource. 58. Problem with ICT. 59. Problem with ICT resource. 60. Problem with non-ICT resource.	Resource access or organising
24. The teacher working with student/s. 45. Student discusses point with teacher.	Teacher and students together
46. Class discussion. 61. Student/s presenting work to class.	Whole class

Appendix F

Sample Behaviour Coding

Male_Student21 explaining what to do to Male_Student11. 8

Male_Student3 "Yeh, got it". 8

Male_Student10 "There's not student photos" 8

Male_Student6 exclaims; 7

Male_Student7 exclaims; 7

Male_Student6 looked at Male_Student7's screen. 3

Male_Student7 "No student photos". 7

Male_Student9 says "No student photos just blank". 47

Teacher looks at it. 24

9 Male_Student9 and Male_Student10 standing. 9

Male_Student7 "oh my god my sister's on here 8

Female_Student8 "Shh" 8

Male_Student5 "<Male_Student's> brother's on here" 8

Male_Student7 "So's my sister" 8

Male_Student5 saying "world's most ugliest person" 8

Male_Student7 singing 9

Male_Student12 comment to Male_Student11 (about monsters) 8

Male_Student7 (comment about monsters) 8

Male_Student5 (comment about monsters) 8

Male_Student3 put up hand, 11 stood. 9

Teacher said "<Male_Student3> you not on there" 41

Teacher "<Male_Student3> do the rest of it" 25

Male_Student3 "What rest?" 37

Teacher "the rest of it" 23

Male_Student5 standing 9 looking at Male_Student7's screen 3

Male_Student12 quiet comment to Male_Student11 8

30 Teacher calls out to Male_Student3 and asks "what did I say to do?" 42

Appendix G

Themes and Examples of Coding for Teacher Response for Open-Ended Question Regarding Main ICT Skills for Teachers

Teacher response to open-ended questionnaire question regarding their beliefs about what the main teacher ICT skills are

Themes

1. Knowledge of or skills with ICT (1)
2. Experience and/or exposure (2)
3. Personal attributes (3)
4. Use for pedagogy (4)
5. Use outside of pedagogy (5)
6. Related skills (6)

Coding examples:

1. Knowledge of hardware. 2. Knowledge of software. (1) 3. Exposure to different websites. (2) 4. Flexibility. 5. Confidence. (3)

1. Enthusiasm (3) 2. Knowledge of and application of skills (1) 2. Explicitly teaching strategies 3. Willingness to facilitate children to explore and discover. (4)

1. Typing (6) 2. Internet searching skills 3. Page design (1)

Appendix H

Themes and Examples of Coding for Teacher Response for Open-Ended Question Regarding Importance of ICT Skills in their Role as a Teacher

Teacher response to open-ended questionnaire question regarding their beliefs about what the importance of ICT in their role as a teacher

Themes

1. Changing world or 21st Century skills (1)
2. Curriculum (2)
3. Role model or expose students to use (3)
4. ICT specific (4)
5. Learning (5)
6. Teacher skills (6)

Coding examples

Critical for engaging students in learning. (5) Prepares students for the 21st (1) – Assists us in our teaching of content knowledge. (2)

It is important that we display to our students the correct way to use the technologies (3) available to us eg we need to show them that spell checkers (4) are not always correct.

A skill that is a must have (6) in ¼ of classroom lessons

Appendix I

Examples of Classification of Teacher Response for Post-Observation Interview Question Regarding What They Believed the Children Learned from ICT Being Used During the Observation

Teacher response to post-observation interview question regarding their beliefs about what the students learned regarding ICT use in the observation

More focused. Respond better than chalk and talk. (Learning from using ICT)

Learnt some basic things about Excel. (The ICT itself)

Appendix J

Themes and Examples of Coding for Student Response for Open-Ended Question Regarding Why Teachers Should Use ICT

Most frequent student response to open-ended questionnaire question regarding reasons why teachers should use ICT

Themes

1. Learning, teaching, and education (1)
2. Enjoyment (2)
3. Useful or helpful (3)
4. The ICT itself (4)
5. Being beneficial for the teacher (5)
6. Being beneficial for the students (6)
7. The future and work (7)
8. Obtaining information (8)

Coding examples

Yes because it helps us (6) to learn (1) and give us information of things. (8)

It would affect our lives (6) because most jobs use computers (7)

I think we should use ICT technology (4) in schools because it makes (3) things easier for kids (6) to understand school work and other work (1)

Yes, to give the kids a fun and enjoyable (2) lesson (1)

Yes, because it will help (3) the teacher (5) explain (1)

Appendix K

Themes and Examples of Coding For Student Response for Open-Ended Question Regarding Most Important Reason for Using ICT During the Observation

Most frequent student response to open-ended questionnaire question regarding reasons why ICT was important in the observed lesson

Themes

1. Activity specific (1)
2. ICT itself (2)
3. Learning and teaching (3)
4. Information or facts (4)

Coding examples

Learning (3) about the time. (1)

Learning (3) how to use Publisher (2)

Looking up information (4)

Appendix L

Themes and Examples of Coding for Student Response for Open-Ended Question Regarding What ICT Was Used for During the Observation

Most frequent student response to open-ended questionnaire question regarding reasons why ICT was important in the observed lesson

Themes

1. Activity specific (1)
2. Learning area (2)
3. ICT itself (3)
4. Did not use ICT during observation (4)
5. Information or facts (5)

Coding examples

Researching (1) information (5) about unicorns.

Excel (3) to create maths (2) worksheets (1).

I did not use ICT in my lesson. (4)

Appendix M

Self-Reported Competence and Confidence Tables

Table M1

Case A teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				Self-reported Confidence			
	Student Ratings			Teacher	Student Ratings			Teacher
ICT	Mean	SD	*n*	Rating	Mean	SD	*n*	Rating
Desktop or laptop computers	3.88	.719	16	3.00	4.60	.507	15	3.00
Electronic whiteboard	3.63	1.088	16	3.00	4.13	1.025	16	3.00
Mobile telephones	3.93	1.280	15	5.00	4.07	1.141	14	5.00
Internet browsers	4.19	.834	16	5.00	4.75	.447	16	5.00
Document processors	3.88	.885	16	3.00	4.19	.911	16	3.00
Presentation software	3.69	.873	16	3.00	3.88	1.025	16	2.00
Statistical or database software	2.88	.991	8	2.00	3.10	1.663	10	2.00
Email or messaging programs	3.94	1.289	16	5.00	4.13	1.147	16	3.00
Photograph and image software	2.93	1.100	15	4.00	3.60	1.352	15	3.00
Movie or DVD editing programs	3.27	1.223	15	2.00	4.29	.825	14	2.00
Social networking programs	3.42	1.379	12	5.00	4.09	1.300	11	5.00
Digital cameras or video recorders	3.87	1.302	15	2.00	4.29	1.204	14	2.00
Wikis, blogs or twitter	2.86	1.610	14	2.00	3.45	1.368	11	2.00
Vodcast, podcast, video conferencing, or webinars	3.27	1.163	15	1.00	4.29	1.139	14	1.00

Table M2

Case B teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				Self-reported Confidence			
	Student Ratings			Teacher	Student Ratings			Teacher
ICT	Mean	SD	*n*	Rating	Mean	SD	*n*	Rating
Desktop or laptop computers	4.13	.354	8	4.00	4.57	.535	7	4.00
Electronic whiteboard	3.29	.756	7	2.00	3.29	.756	7	2.00
Mobile telephones	4.38	.518	8	4.00	4.71	.488	7	4.00
Internet browsers	4.38	.744	8	4.00	4.29	.756	7	4.00
Document processors	4.13	.835	8	4.00	4.29	.951	7	4.00
Presentation software	4.13	1.126	8	3.00	4.14	1.215	7	3.00
Statistical or database software	3.17	1.329	6	2.00	3.00	.816	4	2.00
Email or messaging programs	4.43	.787	7	4.00	4.67	.516	6	4.00
Photograph and image software	3.00	1.633	7	4.00	3.00	1.265	6	3.00
Movie or DVD editing programs	3.29	1.254	7	N.R.	2.86	.690	7	N.R.
Social networking programs	3.40	1.517	5	1.00	2.00	1.414	2	2.00
Digital cameras or video recorders	4.17	.408	6	4.00	4.29	.488	7	4.00
Wikis, blogs or twitter	3.60	1.140	5	N.R.	3.00	-	2	N.R.
Vodcast, podcast, video conferencing, or webinars	3.00	1.225	5	N.R.	4.00	.632	6	N.R.

Table M3
Case D teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				**Self-reported Confidence**			
	Student Ratings			**Teacher**	**Student Ratings**			**Teacher**
ICT	**Mean**	**SD**	***n***	**Rating**	**Mean**	**SD**	***n***	**Rating**
Desktop or laptop computers	4.38	.518	8	4.00	4.25	1.165	8	4.00
Electronic whiteboard	4.00	1.000	7	3.00	4.25	1.165	8	3.00
Mobile telephones	4.43	.787	7	N.R.	4.43	.787	7	N.R.
Internet browsers	4.50	.535	8	5.00	4.88	.354	8	5.00
Document processors	4.25	.886	8	5.00	4.38	.744	8	5.00
Presentation software	4.50	.535	8	4.00	4.13	.835	8	4.00
Statistical or database software	3.71	.756	7	2.00	3.50	.548	6	2.00
Email or messaging programs	5.00		7	4.00	5.00		7	4.00
Photograph and image software	3.38	1.302	8	3.00	3.63	1.061	8	2.00
Movie or DVD editing programs	3.00	1.528	7	1.00	2.60	1.673	5	1.00
Social networking programs	3.75	1.893	4	N.R.	4.67	.577	2	N.R.
Digital cameras or video recorders	4.14	.900	7	3.00	4.14	1.215	7	N.R.
Wikis, blogs or twitter	2.80	1.304	5	N.R.	3.20	1.095	5	N.R.
Vodcast, podcast, video conferencing, or webinars	3.33	1.366	6	1.00	4.00	.816	4	N.R.

Table M4
Case F teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				Self-reported Confidence			
	Student Ratings			Teacher	Student Ratings			Teacher
ICT	**Mean**	**SD**	***n***	**Rating**	**Mean**	**SD**	***n***	**Rating**
Desktop or laptop computers	4.10	.568	10	4.00	4.20	.789	10	4.00
Electronic whiteboard	3.18	.751	11	4.00	3.60	.843	10	4.00
Mobile telephones	3.60	1.075	10	3.00	3.70	1.337	10	3.00
Internet browsers	4.09	.831	11	3.00	4.10	1.101	10	3.00
Document processors	3.80	.632	10	4.00	4.20	.789	10	4.00
Presentation software	4.10	.738	10	4.00	3.80	.789	10	4.00
Statistical or database software	2.78	.972	9	2.00	2.89	.782	9	2.00
Email or messaging programs	3.89	1.269	9	2.00	3.60	.843	10	2.00
Photograph and image software	3.18	1.328	11	4.00	3.20	1.033	10	4.00
Movie or DVD editing programs	2.90	1.370	10	2.00	3.00	1.155	10	2.00
Social networking programs	2.67	1.323	9	2.00	2.90	1.287	10	2.00
Digital cameras or video recorders	3.40	1.265	10	4.00	3.90	1.370	10	4.00
Wikis, blogs or twitter	3.20	1.135	10	3.00	3.44	1.130	9	3.00
Vodcast, podcast, video conferencing, or webinars	3.00	1.000	11	3.00	2.90	1.197	10	3.00

Table M5

Case E teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				**Self-reported Confidence**			
	Student Ratings			**Teacher**	**Student Ratings**			**Teacher**
ICT	**Mean**	**SD**	***n***	**Rating**	**Mean**	**SD**	***n***	**Rating**
Desktop or laptop computers	3.88	1.035	24	4.00	3.96	.976	23	4.00
Electronic whiteboard	3.50	.780	24	3.00	3.48	1.310	23	3.00
Mobile telephones	3.82	1.259	22	N.R.	3.86	1.283	22	5.00
Internet browsers	3.88	1.116	24	4.00	4.13	1.140	23	5.00
Document processors	3.50	1.022	24	4.00	3.39	1.118	23	5.00
Presentation software	3.75	.897	24	4.00	3.52	.947	23	4.00
Statistical or database software	2.68	.946	19	4.00	2.56	.984	18	4.00
Email or messaging programs	3.96	1.296	23	4.00	3.82	1.402	22	4.00
Photograph and image software	3.09	.971	22	5.00	3.16	1.385	19	4.00
Movie or DVD editing programs	2.83	1.249	18	5.00	3.06	1.259	18	4.00
Social networking programs	4.00	1.155	19	N.R.	3.94	1.474	18	4.00
Digital cameras or video recorders	3.48	.994	23	5.00	3.55	1.050	20	5.00
Wikis, blogs or twitter	2.74	1.447	19	3.00	2.47	1.328	17	3.00
Vodcast, podcast, video conferencing, or webinars	3.00	1.455	18	3.00	3.06	1.391	17	3.00

Table M6
Case I teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				Self-reported Confidence			
	Student Ratings			Teacher	Student Ratings			Teacher
ICT	**Mean**	**SD**	***n***	**Rating**	**Mean**	**SD**	***n***	**Rating**
Desktop or laptop computers	3.90	.976	29	4.00	4.18	1.124	28	5.00
Electronic whiteboard	3.39	1.197	28	3.00	3.96	.999	28	4.00
Mobile telephones	3.86	1.268	28	4.00	4.26	1.095	27	5.00
Internet browsers	3.96	1.183	26	4.00	3.88	1.366	26	5.00
Document processors	4.00	1.095	26	5.00	4.07	1.107	27	5.00
Presentation software	3.71	1.243	28	4.00	3.61	1.197	28	4.00
Statistical or database software	3.27	1.430	26	2.00	2.96	1.483	26	2.00
Email or messaging programs	4.12	1.033	26	4.00	3.69	1.379	26	5.00
Photograph and image software	3.29	1.301	28	3.00	3.62	1.329	26	3.00
Movie or DVD editing programs	3.88	1.366	26	2.00	4.13	1.100	23	2.00
Social networking programs	3.46	1.560	24	5.00	3.80	1.414	25	5.00
Digital cameras or video recorders	4.04	1.285	27	4.00	4.23	1.032	26	3.00
Wikis, blogs or twitter	2.88	1.597	24	2.00	2.74	1.453	23	2.00
Vodcast, podcast, video conferencing, or webinars	3.26	1.573	23	2.00	3.00	1.512	22	2.00

Table M7
Case K teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				Self-reported Confidence			
	Student Ratings			Teacher	Student Ratings			Teacher
ICT	Mean	SD	*n*	Rating	Mean	SD	*n*	Rating
Desktop or laptop computers	4.00	1.128	12	4.00	4.82	.405	11	4.00
Electronic whiteboard	3.67	1.073	12	5.00	3.73	1.009	11	5.00
Mobile telephones	4.36	1.206	11	4.00	4.09	1.578	11	4.00
Internet browsers	4.92	.289	12	4.00	4.82	.405	11	4.00
Document processors	4.55	.522	11	4.00	4.80	.422	10	5.00
Presentation software	4.55	.688	11	4.00	4.00	1.155	10	5.00
Statistical or database software	2.86	1.069	7	3.00	3.67	1.658	9	3.00
Email or messaging programs	4.60	.699	10	3.00	4.40	.843	10	3.00
Photograph and image software	4.22	1.302	9	3.00	4.56	.527	9	4.00
Movie or DVD editing programs	3.91	.831	11	4.00	4.00	.816	10	4.00
Social networking programs	3.88	1.808	8	2.00	4.25	1.165	8	2.00
Digital cameras or video recorders	4.00	1.095	11	4.00	4.50	.707	10	2.00
Wikis, blogs or twitter	3.75	1.581	8	2.00	3.88	1.458	8	2.00
Vodcast, podcast, video conferencing, or webinars	3.86	1.574	7	2.00	4.13	.641	8	2.00

Table M8

Case H teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				**Self-reported Confidence**			
	Student Ratings			**Teacher**	**Student Ratings**			**Teacher**
ICT	**Mean**	**SD**	***n***	**Rating**	**Mean**	**SD**	***n***	**Rating**
Desktop or laptop computers	3.89	.809	19	4.00	4.22	.808	18	4.00
Electronic whiteboard	2.84	.898	19	3.00	2.88	1.054	17	3.00
Mobile telephones	4.53	.514	17	4.00	4.44	.892	16	4.00
Internet browsers	3.94	1.056	18	4.00	4.50	.707	18	4.00
Document processors	3.37	1.012	19	5.00	3.72	.826	18	4.00
Presentation software	3.68	.820	19	4.00	4.33	.767	18	4.00
Statistical or database software	3.00	1.369	17	3.00	3.06	1.181	16	2.00
Email or messaging programs	4.19	1.047	16	4.00	4.69	.602	16	4.00
Photograph and image software	3.53	1.246	15	2.00	3.29	.994	14	2.00
Movie or DVD editing programs	3.00	1.069	15	1.00	3.54	1.050	13	1.00
Social networking programs	3.79	1.188	14	1.00	3.64	1.120	11	1.00
Digital cameras or video recorders	4.27	.704	15	4.00	4.00	1.069	15	4.00
Wikis, blogs or twitter	3.17	1.267	12	2.00	3.27	1.104	11	1.00
Vodcast, podcast, video conferencing, or webinars	2.85	.899	13	1.00	3.27	1.009	11	1.00

Table M9

Case G teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				Self-reported Confidence			
	Student Ratings			Teacher	Student Ratings			Teacher
ICT	Mean	SD	*n*	Rating	Mean	SD	*n*	Rating
Desktop or laptop computers	3.67	.832	27	4.00	3.85	1.064	27	4.00
Electronic whiteboard	3.15	1.199	27	3.00	3.46	1.104	26	4.00
Mobile telephones	3.81	1.201	26	3.00	4.00	1.291	25	4.00
Internet browsers	3.70	1.203	27	4.00	3.58	1.270	26	4.00
Document processors	3.35	1.129	26	3.00	3.52	1.159	25	4.00
Presentation software	2.71	.999	24	3.00	2.92	1.152	25	4.00
Statistical or database software	2.85	.967	26	3.00	3.21	1.062	24	3.00
Email or messaging programs	3.40	1.414	25	3.00	3.67	1.341	24	3.00
Photograph and image software	3.27	1.282	26	2.00	3.68	1.215	25	2.00
Movie or DVD editing programs	3.60	1.291	25	2.00	3.80	1.384	25	2.00
Social networking programs	3.00	1.600	26	3.00	3.04	1.781	24	3.00
Digital cameras or video recorders	4.08	1.055	26	3.00	4.40	.764	25	3.00
Wikis, blogs or twitter	2.76	1.508	25	1.00	2.63	1.583	24	1.00
Vodcast, podcast, video conferencing, or webinars	3.04	1.428	25	1.00	3.26	1.421	23	1.00

Table M10
Case C teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				Self-reported Confidence			
	Student Ratings			Teacher	Student Ratings			Teacher
ICT	Mean	SD	*n*	Rating	Mean	SD	*n*	Rating
Desktop or laptop computers	4.00	.667	10	5.00	4.50	.527	10	5.00
Electronic whiteboard	4.10	.738	10	4.00	4.40	.669	10	5.00
Mobile telephones	3.90	.994	10	4.00	4.60	.843	10	4.00
Internet browsers	4.40	.516	10	4.00	4.60	.516	10	4.00
Document processors	4.30	.823	10	5.00	4.50	.850	10	5.00
Presentation software	4.50	.707	10	5.00	4.40	.843	10	5.00
Statistical or database software	3.80	.632	10	3.00	3.89	.601	9	3.00
Email or messaging programs	4.00	1.069	8	4.00	4.78	.667	9	4.00
Photograph and image software	3.88	1.126	8	4.00	4.00	1.000	7	3.00
Movie or DVD editing programs	3.80	.789	10	3.00	4.40	.843	10	3.00
Social networking programs	4.25	1.165	8	3.00	4.14	1.574	7	3.00
Digital cameras or video recorders	4.10	.876	10	4.00	4.00	1.155	10	4.00
Wikis, blogs or twitter	3.60	1.140	5	3.00	3.75	.957	4	3.00
Vodcast, podcast, video conferencing, or webinars	4.00	1.309	8	2.00	4.13	1.246	8	2.00

Table M11

Case J teacher and student self-reported competence and confidence for each of the specified ICT

	Self-reported Competence				**Self-reported Confidence**			
	Student Ratings			**Teacher**	**Student Ratings**			**Teacher**
ICT	**Mean**	**SD**	***n***	**Rating**	**Mean**	**SD**	***n***	**Rating**
Desktop or laptop computers	3.00	1.673	6	4.00	3.33	1.366	6	5.00
Electronic whiteboard	2.00	.894	6	3.00	2.17	.983	6	4.00
Mobile telephones	2.33	1.751	6	N.R.	3.00	1.871	5	N.R.
Internet browsers	3.00	.894	6	4.00	3.50	1.378	6	4.00
Document processors	3.00	1.673	6	4.00	3.17	1.602	6	4.00
Presentation software	2.20	1.304	5	4.00	2.60	1.140	5	4.00
Statistical or database software	3.00	1.581	5	1.00	2.40	1.140	5	2.00
Email or messaging programs	3.80	1.304	5	4.00	2.80	1.789	5	4.00
Photograph and image software	2.20	1.304	5	3.00	1.60	.894	5	2.00
Movie or DVD editing programs	2.00	.707	5	1.00	2.40	1.140	5	1.00
Social networking programs	2.60	1.517	5	N.R.	2.60	1.342	5	3.00
Digital cameras or video recorders	3.00	1.826	4	3.00	3.40	1.871	5	3.00
Wikis, blogs or twitter	2.20	1.304	5	3.00	2.00	1.414	4	3.00
Vodcast, podcast, video conferencing, or webinars	2.00	1.414	5	N.R.	2.80	1.304	5	N.R.