Teaching and learning with digital technologies in the intermediate school classroom: An Activity Theory analysis of classroom interactions

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Abstract

In the three decades since digital technologies were introduced into classrooms with the potential of changing educational practices, an ongoing dialogue continues regarding the impact of these technologies on teaching and learning, for both teachers and their students. While current research has identified a number of elements that influence teachers' integration of digital technologies, there is a need for a careful examination of the relationships between these factors and how they come together to underpin teachers' decisions to use digital devices with their students.

The purpose of the present study was to understand teachers' motivations for integrating digital technologies into their teaching practice, how they accomplished this, and what environmental and personal factors underpinned these decisions. This research also investigated students' experiences of working with digital technologies as they participated in teacher-planned lessons. Both contextual and personal factors contribute to teachers' use of digital technologies; therefore, these aspects were considered through the Cultural-Historical Activity Theory (CHAT) theoretical framework to make sense of the sociocultural environment that influenced these intermediate school teachers as they made decisions to include digital technologies in their classroom practices.

An interpretive multiple case study methodology was used, incorporating data collection methods of interviews, observations, document analysis, 'think alouds', and student focus groups, to explore the practices of teachers and their students in four classroom cases within two intermediate schools in New Zealand over the course of a year.

The results showed that teachers included digital tools in their classroom practices to support their existing pedagogical practices, comply with school policies, communicate with parents and students, motivate and engage students, and prepare students for a digital world. As teachers' knowledge of the affordances of digital technologies increased, they were able to integrate these tools in ways that aligned with their classroom objectives. School leadership and professional development played a key role in the methods through which teachers incorporated digital technologies. In addition, the perception of community members that these teachers

were skilled technology users led to new roles and responsibilities within their school environments. This study showed that while some learners were experienced technology users, teachers' assumptions of student abilities and/or engagement with these tools were sometimes inaccurate. Appropriate teacher scaffolding of student learning as well as teachers' explicit expectations for the use of digital technologies combined to increase the success of learning activities within each classroom.

The findings from this study illustrate the reality experienced by teacher participants when attempting to integrate digital tools into their teaching practices. The teachers were motivated to use digital technologies in their classrooms to support their students' learning, and did so by gaining knowledge of the different tools available in their environments and reconfiguring the most effective ways to incorporate those within their classroom practices.

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Chapter 1. Introduction

> *Integrating technology is not about technology—it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used.* (Earle, 2002, p. 8)

Digital technologies have had an impact on communication, business practices, and many aspects of individuals' everyday lives. Examples include smart phones which connect colleagues and friends in addition to providing access to information at any time and from any location. Businesses provide websites and apps that enable allow consumers to compare, virtually interact with, and purchase items. Consumers can use satellite navigation systems that not only direct the user to a selected destination, but also help locate nearby businesses and local attractions. These types of technologies empower their users, allowing them to manipulate their environments rather than being passive participants within the world. Consequently, public and private organisations have embraced these new tools to make use of the capabilities that these devices afford in a number of ways (Friedman, 2007). A similar transition is also occurring within the educational context. As a result, debate has ensued concerning the relevance and value of digital technologies within school environments, particularly considering the significant and continuous funding that is needed to sustain such an endeavour.

Purposeful use of technology occurs within the classrooms of individual teachers who have chosen to incorporate digital tools into their existing pedagogical practices (Angers & Machtmes, 2005; Ertmer, Gopalakrishnan, & Ross, 2000; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010). While Becker and Riel (1999) suggest that integrating digital tools into constructivist learning environments is most beneficial to student learning, research has demonstrated that technology integration often occurs within the continuum of teacher-centred to student-centred rather than in one category or the other (Ertmer et al., 2000; Gibson, 2001). As Ertmer et al. (2000) suggest:

> Perhaps, the description of exemplary practice included in the literature should be broadened to include more examples of how teachers adjust their constructivist practice to reflect real constraints and conflicting needs. It might

> also be useful to illustrate teachers at different points in their journeys of technology…to highlight strategies they have used to move forward -- to illustrate the path more so than the destination. By providing realistic visions of what others have achieved, teachers may be motivated to begin their own journeys toward exemplary technology use. Only by working within teachers' existing situations, can we truly expect best practice to be achieved. (p. 28)

From a personal perspective, my experience as an educational technology coordinator in the United States has driven me to pursue this line of research. Within this role, I was responsible for providing both technical and pedagogical support to middle school teachers as they made use of technological tools within the school setting. As I endeavoured to support these teachers in integrating technology into their classroom practices, I noticed that within the same school context, some teachers were extremely enthusiastic about incorporating digital tools into their teaching practices while other teachers expressed little interest. Over several years of working with many of the same teachers, I noticed the pedagogical practices of a few teachers shift as they increasingly incorporated digital technologies within their classroom activities while others continued to utilise the same teaching methods they had implemented for several years. I wondered why this occurred and how I might encourage teachers to begin using technological tools with their students to benefit their learning. As a result, I began to speculate that if I could determine what motivated teachers who chose to integrate digital technologies, perhaps I could use this knowledge to increase the technology use of other teachers at the school.

Consequently, I began to reflect on what technology integration looks and feels like for classroom teachers who make a concerted effort to incorporate digital tools on a regular basis. Several questions have stemmed from this thought process such as: What sociocultural and personal factors motivate teachers to integrate digital tools into their teaching practices? How do these factors interact with and relate to one another? With the variety of technical devices and applications that are available, which tools are teachers choosing to utilise and how are they integrating these?

Several recent studies have addressed some of these questions. Research has demonstrated that many experienced and beginning teachers do, in fact, make use of technology in their personal lives and within their classroom environments (e.g., Angers & Machtmes, 2005; Ertmer et al., 2000; Ottenbreit-Leftwich et al., 2010;

Starkey, 2010a). These studies found that digital technologies were used in a variety of ways to support the teachers' pedagogical practices and identified many sociocultural as well as personal factors that influence teachers' decisions to use technology (i.e., Bauer & Kenton, 2005; Becker, 1998; Ertmer & Ottenbreit-Leftwich, 2010). However, additional research was needed to identify the relationships between these factors and how teachers' activity changes over time; this study aimed to fill that gap.

Additionally, student perspectives must be considered in conjunction with teachers' practices to discover the impact that technology use is having on their experiences and learning. Over the past decade, proponents of the use of digital technologies in education have suggested that due to their high exposure to technology outside of the classroom, today's students are fundamentally different from previous generations in that they learn, respond, and communicate in distinct ways (Feiertag & Berge, 2008; Oblinger, 2004; Oblinger & Oblinger, 2005; Prensky, 2001, 2005). Given this and considering that improving student learning is the primary objective for integrating digital tools, questions arise such as: When students participate in teacher-planned lessons that include digital technologies, how are they interacting with these tools and what are they experiencing? What factors influence the way that students engage in lessons that include digital technologies? However, research studies rarely consider both teacher and student perspectives; often only one or the other viewpoint is considered within one context. Therefore, the objective of this thesis was to investigate the activities of teachers who frequently used digital tools within their classroom practices as well as to consider the perspective of the learners to elucidate features of technology integration which impacted on the learning that occurred as a result.

An interpretive multiple case study methodology was used to gather information from four technology-using teachers (utilising digital technologies often and in a variety of ways) and their students from two intermediate schools within the wider school community as they worked with digital technologies over the course of one school year. Data were analysed by examining individual cases within their broader school context and through the identification of themes which spanned at least three of the four cases. A constant comparative method was used to compare units of data with one another to discover recurring regularities within the data (Merriam, 2009).

Cultural-Historical Activity Theory (CHAT) was a logical theoretical framework to underpin and guide the research as this perspective focuses on the interaction of human activity and consciousness within its relevant environmental context (Kaptelinin & Nardi, 2006). Because teachers and students do not act alone, but rather as a part of a wider school community, CHAT was a valuable tool that allowed a comprehensive analysis of the activity within the historical and cultural setting.

This research was conducted in New Zealand between 2010-2012 at a time when a variety of digital technologies, such as cell phones and computers, had become ubiquitous household items (Grimley & Allan, 2010). A number of portable digital technologies such as smartphones and tablet computers had recently been introduced and were quickly being adopted by both students and teachers. In 2007, about half of students between 10 and 12 used the Internet for communication purposes such as social networking (e.g., Facebook and Bebo) or instant messaging, and about two thirds of these students also had access to gaming consoles within their home environment (Grimley & Allan, 2010). New Zealand schools had broadband or Ultra Fast Broadband (UFB) Internet access, a laptop scheme that provided government subsidised laptops to teachers, as well as an increasing number of data projectors and interactive whiteboards. Information and Communication Technology Professional Development (ICT PD) clusters, in which a group of schools worked together towards incorporating digital technologies in the classroom to support teaching and learning, were taking place in schools that had applied for government support. A revised curriculum had been introduced in 2007 which is underpinned by a social constructivist philosophy for education and allowed for a more adaptable school-based curriculum (Ministry of Education, 2007).

This thesis has been organised into 10 distinct chapters. Chapter 2 includes an examination of a selection of literature published through 2012 within two main areas of educational technology. The first section reviews the extensive research that has been conducted with teachers to shed light on what is known about personal and contextual factors that influence their use of digital technologies within the classroom environment. A second segment reviews what is known about school-age students' use of digital technology inside and outside of the classroom as this is likely to contribute to the way in which they interact with these tools during class activities. The

literature included in this review reflects both the perspectives of the researchers and the era in which it was written, providing a context within which this thesis is situated. The findings informed the methodological approach as well as the theoretical framework chosen within the current study.

A multiple case study approach was taken in order to gather detailed information about teachers' rationales for and methods of integrating digital technology within their classrooms. The methodological process and the theoretical framework are discussed within chapter 3.

Narratives from the four case studies are presented in Chapters 4 and 6. Chapter 4 highlights data collected from School A and provides a comprehensive account of the digital technology use within each of the two participating classrooms from the perspectives of both teachers and students. This process is repeated in Chapter 6 for data collected from School B. Chapters 5 and 7 follow on from the findings at each school with a detailed analysis of each of the two activity systems in which the participating teachers were active members. These chapters explore tensions and contradictions within each of the case studies as well as opportunities for transformative learning that occurred for each teacher.

The synthesised findings for each of the research questions are presented through the application of evidence that emerged from each of the case studies within Chapter 8. Chapter 9 draws together findings and analyses from four case studies within the context of existing knowledge about teaching and learning with digital technologies, identifies implications at the school and classroom levels, and explores avenues for future research. Finally, the implications for this work are explored in Chapter 10, as are the possibilities and promises of the use of digital technologies in educational classrooms.

Chapter 2. Literature Review

The introduction of computers and other digital technologies sparked anticipation within the educational community about how they might transform educational practices, and billions of dollars have been spent world-wide to place an array of digital devices into classrooms (Lai & Pratt, 2008; Niederhauser & Stoddart, 2001; Norris, Sullivan, Poirot, & Soloway, 2003; Partnership for 21st Century Skills, 2010). A great number of digital tools including computers, interactive white boards, and more recently tablet computers have been purchased for teacher and student use (Kennewell, 2005; Project Tomorrow, 2010). However, this has not necessarily translated into the *meaningful* use of these digital tools in learning activities; often teachers have incorporated them into their existing teacher-centred practices rather than developing student-centred philosophies and practices as many had predicted (Ertmer, 2005; Ertmer, Addison, Lane, Ross, & Woods, 1999; Gibson, 2001; Palak & Walls, 2009). After nearly three decades of financial support, district officials, local policymakers, and community members were anxious to see whether the financial investment has been worthwhile (Cuban, 2001; November, 2010); therefore research has focused on how the digital technologies have been used and the effect that they have had on student achievement (e.g., Lou, Abrami, & D'Apollonia, 2001; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011).

Research examining student learning gains and achievement have focused on the use of specific tools and most have shown minimal learning gains as a result of using technology with students (Azevedo & Bernard, 1995; Lou et al., 2001; Tamim et al., 2011). Therefore, many researchers have considered the potential of specific digital tools to be utilised within education (Gaver, 1991; Jonassen, Howland, Marra, & Crismond, 2008; Wijekumar, Meyer, Wagoner, & Ferguson, 2006). In addition, researchers have explored factors that influence the use of digital technologies in schools and have found that both environmental (contextual factors) and teacher characteristics (personal factors) contribute to teachers' decisions to utilise digital tools in their classrooms (e.g., Bauer & Kenton, 2005; Becker, 1998; Ertmer, 2005; Starkey, 2010b).

In addition to contextual and personal factors, the recent influx of digital technologies into our personal lives has created the notion that today's students who have used digital tools from a young age are fundamentally different from previous generations (Oblinger, 2004; Prensky, 2001, 2005). While there is debate about whether these assertions are valid, successful teachers consider the needs of their students (Hattie, 2003) and therefore are likely to consider their experience and expertise in using digital tools. The following sections will review relevant research that discusses contextual and personal factors which have been linked to the use of digital technologies in schools, methods of using digital tools, and teachers' perceptions of the distinctive attributes of 21st century learners that influence their use of digital technologies in the classroom.

Contextual factors affecting the integration of digital technologies

Each school has its own unique attributes that influence teachers' actions on a daily basis; this includes how digital technologies are utilised in classrooms (Becker, 1998; Sandholtz, Ringstaff, & Dwyer, 1997). Research studies have illuminated a number of contextual factors that have enabled or inhibited educators as they have endeavoured to integrate digital technologies into their classroom practices. Studies consistently report the similar contextual elements including access, training, aspects of the school culture, and time (Bauer & Kenton, 2005; Baylor & Ritchie, 2002; Becker, 1998; Ertmer et al., 1999; Means, 2010; Sandholtz et al., 1997; Smarkola, 2008). The following sections will review relevant research in each of these areas to provide a detailed understanding of how these factors influence educators as they attempt to integrate digital tools in their classroom practices.

Access

Teacher and student access to reliable digital technologies is frequently listed as the most influential consideration for teachers when deciding whether and how to use digital technologies within their classrooms (Becker, 2000; Norris et al., 2003; Palak & Walls, 2009; Scrimshaw, 2004; Smarkola, 2008). Within the CHAT framework, access to technology is a mediating tool in that differing levels of access to computers and other digital technologies can play an important role in the types of lessons teachers plan and implement. In 1998, Becker claimed that computers in schools were outdated and

needed to be upgraded to provide teachers with reliable access that could cope with the activities that they envisioned. Although this statement was made over 10 years ago, the dilemma remains. The difficulty is that technology is not a one-time purchase; computers and software need to be upgraded regularly in order to be dependable enough for teachers to feel confident enough and familiar with the programme versions to include them in lessons (Ertmer et al., 1999; Smarkola, 2008).

Several studies have supported the notion that the amount and type of access that teachers and students have to digital technologies impacts how they are used in classrooms (Bauer & Kenton, 2005; Ertmer et al., 1999; Miranda & Russell, 2011; Palak & Walls, 2009; Petko, 2012; Scrimshaw, 2004; Starkey, 2010b). Palak and Walls (2009) surveyed 113 teachers in the eastern U.S. and found that technology use correlated with the ratio of computers to students; teachers in classrooms with more computers per student tended to include digital technologies in their lessons more often and in a variety of ways. Similarly, Bauer and Kenton (2005) examined the classroom practice of 30 teachers also in the U.S. through questionnaires, classroom observations, and interviews and found that 47% of teachers reported that problems with equipment prevented them from using digital technologies in the ways that they desired. More recently, a study with teachers in Switzerland found that when computers that were available in the school were located within teachers' classrooms rather than in a central computer lab or mobile lab, teachers were more likely to use the technology (Petko, 2012).

Alternatively, studies by Ertmer et al. (2000) and Angers and Machtmes (2005) suggest that when teachers are highly motivated to teach with technology, they are not deterred by lack of access. Rather, they learn to use their allotted resources efficiently and find ways to obtain additional funding through grants or other sources. While lack of access may be a detrimental factor for some, some who are determined to teach with digital technologies find ways to overcome this barrier.

Training

As with any new innovation, the installation of equipment is merely the first step. Once this is accomplished, the use of digital technologies often depends on the training that is provided (Bitner & Bitner, 2002; Lumpe & Chambers, 2001; Sandholtz et

al., 1997; Scrimshaw, 2004; Smarkola, 2008). Effective training not only informs teachers how to use the digital tools, but also offers pedagogical guidance in integrating the tools within the existing curriculum (Jacobsen, Clifford, & Friesen, 2002; Mishra & Koehler, 2006; Zhao, Pugh, Sheldon, & Byers, 2002).

Several studies have revealed that both practising and pre-service teachers require more training in order to integrate digital technologies successfully (Becker, 1998; Ertmer et al., 1999; Kiridis, Drossos, & Tsakiridou, 2006; Scrimshaw, 2004). Survey results from teachers within the U.S. established that an ongoing training programme was the most influential factor at the school level that affected technology use (Scrimshaw, 2004). In another U.S. study, both pre-service and experienced teachers who completed a questionnaire expressed the importance of training on their use of digital tools (Smarkola, 2008). Student teachers felt that they were unprepared to use digital technologies with students and expressed interest in professional development or a teacher mentor who could help in this area. Experienced teachers also communicated that the training that had been provided directly influenced their intentions for learning when teaching with digital technologies.

Research has identified characteristics of professional development that have had the most significant impact on teacher use of digital technologies in their classroom (Kopcha, 2010; Lawless & Pellegrino, 2007; Martin et al., 2010; Mouza, 2011). Lawless and Pellegrino (2007) suggest that the following are essential components of successful technology integration training: they are longer in duration; provide access to new technologies for teaching and learning; actively engage teachers in meaningful and relevant activities for their own individual contexts; promote peer collaboration and community building; and have a clearly articulated and a common vision for student achievement. Similarly, Martin et al. (2010) found that when professional development included lessons that were modelled for teachers, a specific connection to each teacher's practice, and collaboration and community building, teachers' lesson plans which included digital tools were higher in quality. Finally, in a study conducted in the U.S., teachers were able to focus on problems and issues directly applicable to their own classrooms (Mouza, 2011). As a result, they became more comfortable and knowledgeable using technology and spent more time teaching technology-enriched activities in their classrooms. Additionally, some researchers

suggest that training should include curricular support which helps teachers integrate digital technologies in specific ways within their teaching areas (Bitner & Bitner, 2002; Mishra & Koehler, 2006).

Appropriate training has been linked to changes in pedagogical practices as well as to student learning gains when using reading and mathematics software (Harris & Hofer, 2011; Hedberg, 2011; Means, 2010). In a case study conducted with six schools in Australia, teachers who participated in a professional development programme on the use of interactive white boards demonstrated changes in their pedagogical practices, had moved to more sophisticated and student-centred methods of use, and identified new affordances of the boards after receiving the training (Hedberg, 2011). Additionally, a qualitative research study with primary and middle school teachers in the U.S. found that teachers whose students showed significant gains in mathematics and reading scores had received more formal training than those in schools who showed little or no gains (Means, 2010). Finally, both experienced and pre-service teachers who had received training in the use of technology to support learning activities were more reflective and thoughtful of their choices of digital tools to support their learning than they were prior to the training (Harris & Hofer, 2011; Sardone & Devlin-Scherer, 2010).

Educational leaders within the New Zealand context have recognised the need for training and addressed this in 1999 with the introduction of the Information and Communications Technology Professional Development (ICT PD) School Clusters Programme (Ham, 2009). According to the Ministry of Education, the ICT PD Clusters were "aimed at increasing teachers' Information and Communication Technology (ICT) skills and pedagogical understandings of ICTs, at increasing the use of ICTs for professional and administrative tasks in schools, and at increasing the frequency and quality of the use of ICTs in schools to support effective classroom teaching and learning" (Ministry of Education, 2013, p. 1). In this three-year programme, members of an expert school work with teachers and administrators from the other schools within the cluster to explore and foster innovative use of digital technologies in the classroom to support teaching and learning. Results from pre and post surveys of teachers involved in the programme have indicated that teachers report increased confidence using technology in a variety of ways, the ability to integrate technology

more often, and an increased use of digital technologies to enable quality learning as a result of participating (Ham, 2009). However, the basis of these data were self-reports and were conducted immediately after training was completed. Further research is needed to identify how specific elements of the programme influence participants as well as the long-term effects of the project.

School culture

Many aspects of the school culture can impact the level of technology integration at the site. Ertmer and Ottenbreit-Leftwich (2010) propose that "each school, and even each team of teachers within a school (discipline or grade level based), has a set of norms that guides behaviours and instructional practices" (p. 265). Factors such as the availability of technical assistance, encouragement from the school administration, support from other stakeholders including parents, and collaboration with peers are have been consistently reported as significant features of the environment affecting technology use in schools (e.g., Becker, 1998; Lumpe & Chambers, 2001; Means, 2010; Norris et al., 2003; Palak & Walls, 2009; Scrimshaw, 2004; Starkey, 2010b; Zhao et al., 2002).

The availability of technical support is an important consideration for teachers when planning lessons that utilise digital technologies (Miranda & Russell, 2011; Palak & Walls, 2009; Scrimshaw, 2004). During the 2000-01 school year, over 3500 teachers in four states from around the U.S. completed what were referred to as "Snapshot Surveys" which gathered information about computer access and the use of technology with students (Norris et al., 2003). Results identified that teachers were more likely to use computers when technical support was available in a timely fashion to solve problems as they occurred. Another study involving district administrators, principals, and teachers in the U.S. had similar findings; the lack of reliable and prompt technical support was listed as one of the significant obstacles to the use of technology by teachers across all grade levels (Miranda & Russell, 2011).

The cultural climate also influences teachers' decisions to use digital technologies with students. The school culture is a compilation of the vision of the school administration, formal and informal policies and expectations for teaching and learning, and the collegial relationships within the school (Zhao et al., 2002) and is an

important consideration when examining technology use through the CHAT framework. Research has indicated digital tools are more likely to be included in school activities when their uses are clearly aligned with the school curriculum and mission (Parr & Ward, 2011; Staples, Pugach, & Himes, 2005) and suggests that a shared school vision is essential for successful technology integration (Flanagan & Jacobsen, 2003; Hew & Brush, 2007). Hew and Brush (2007) propose that a successful technology strategy is collaboratively created by both teachers and administrators and is then transferred to a specific school technology plan that guides technology use at the school. Clearly articulated goals can facilitate appropriate use and can lead to effective assessment of these activities (Lei, 2010).

Research has demonstrated that school administrators play a key role in teachers' integration of digital tools (e.g., Dawson & Rakes, 2003; Forkhosh-Baruch, Mioduser, Nachmias, & Tubin, 2005). According to Leithwood and Riehl (2003), leaders have two key responsibilities: providing direction and exercising influence. Teachers often perceive pressure from their principals and other leaders to incorporate technology into lessons which can be spurred by national or district policies demanding its use or the financial investment that have been made to purchase digital devices (Harris & Hofer, 2011; Hennessy, Ruthven, & Brindley, 2005; Wikan & Molster, 2011). However, principals can also offer verbal encouragement or support in the form of additional planning time, professional development, additional resources, and time to collaborate with their peers (Baylor & Ritchie, 2002; Groff & Mouza, 2008; Means, 2010; Ponticell, 2003). Specific attributes of school administration have been linked to teachers' integration of digital technologies. For example, questionnaire data collected from principals in the U.S. which examined the relationships between principals' technology training with the level of technology integration at the school found that those principals who had personally participated in 51 or more hours of training within the previous 12 months had significantly higher levels of integration at their schools (Dawson & Rakes, 2003).

In Smarkola's (2008) study mentioned above, case study data from nine experienced teachers indicated that many administrators provided aid in the form of access to training and purchasing computers for their classrooms as well as personal encouragement and they felt that this provided them with an environment in which

they were comfortable trying new lessons that utilised digital technologies. Baylor and Ritchie's (2002) data from across four U.S. states also found that the presence of a school principal who actively models technology use and rewards teachers who integrate technology was a strong predictor of technology use by teachers. Additionally, Anderson and Dexter (2005) surveyed principals and technology coordinators in the U.S. and determined that when school administrators were actively involved with technology (i.e., creating policies, using email), technology use at the school increased. Flanagan and Jacobsen (2003) note that many of the current responsibilities designated to school leaders are often shared with other members of the school community.

The use of technology may be cited as a priority through school policies and curriculum, but this may not align with other school and national policies that take precedence (Hardman, 2005; Hennessy et al., 2005; Somekh, 2008; Zhao & Cziko, 2001). When reflecting on schooling in the U.S., Schrum and Glassett (2006) state that "our schools exist in an environment that demands accountability and evidence based performance" (p. 41). In a number of studies in the U.S. and United Kingdom, high-stakes standardised testing negatively impacted on meaningful technology integration because teachers were concerned with covering the large quantity of prescribed curricula rather than ensuring that students were engaged in meaningful learning activities that were not assessed (Hennessy et al., 2005; Hew & Brush, 2007; Mouza, 2011). Somekh (2008) suggests that to resolve this issue, assessment must be aligned to new methods of teaching and learning.

New Zealand is relatively unique in that there has not been mandated national systemic standards-based testing at primary school level; therefore students have not traditionally been subjected to this form of standardised testing based on accountability goals. However, the introduction of National Standards in New Zealand in 2010 set clear expectations for students in Years 1 to 8 in the areas of reading, writing, and mathematics with the intent of helping schools better understand their students' learning needs through providing clear learning goals and information about students' progress and achievement (Ministry of Education, 2010). It is unclear how this initiative may impact on the use of digital technologies in New Zealand schools.

Another important aspect of the school culture within this context is the relationships and collaboration that occur between colleagues (Hadley & Sheingold, 1993; Murphy & Lebans, 2008; Zhao et al., 2002). Through survey data collected from teachers of grades 4 through 12 in the U.S., Hadley and Sheingold (1993) found that teachers who collaborated with others regarding their pedagogical practices with technology were more likely to integrate digital technologies than those who did not have connections. Similarly, case study research conducted in the U.S. by Zhao et al. (2002) with K-12 teachers within the U.S. indicated that social support from peers was key to the success of innovative use of digital tools.

While many teachers are internally motivated to use technology in their lessons, others seem to rely on outside support and encouragement to get started. In her research with digitally able beginning secondary teachers in New Zealand, Starkey (2010b) found that the new teachers valued support from experienced educators in or beyond their schools. These connections provided a forum in which they could discuss their ideas about teaching and learning and the use of technology. In addition, the experienced teachers were able to offer pedagogical support and guidance in using digital technologies that were available in the schools. Furthermore, Yamagata-Lynch (2003) found in her CHAT analysis that when teachers were not able to find individuals within their own school with which to collaborate on the development of lessons that included digital tools, they benefitted from collaboration with peers outside their school. Murphy and Lebans (2008) suggest that collaborative Web 2.0 resources are used as a hub for teachers to share and discuss progress, concerns, and their experiences with colleagues or other teachers from outside the school to support them in their use of digital tools. Furthermore, research has indicated that digital tools can support meaningful communication with parents (Hill and Tyson, 2009; Palak and Walls, 2009).

Clearly, many elements of the school culture have an effect on whether digital technologies are included in classroom activities and how they are included. Within the CHAT theoretical framework, the dynamic interplay between these relationships and cultural factors can be examined in depth (Yamagata-Lynch, 2003).

Time

The concept of time has many different realities that influence teachers' decisions regarding technology use. Research has demonstrated that adequate planning time in which teachers are able to learn how to use and implement digital technologies is essential to successful use with students (Angers & Machtmes, 2005; Becker, 1998; Lumpe & Chambers, 2001). Ertmer et al. (1999) suggest that the issue of time is ongoing because technology changes at such a rapid pace; therefore, lack of time to learn how to use new tools is a significant barrier to technology use.

Teachers may also perceive that equitable student access to digital technologies is an issue if class time does not allow a turn for everyone or if students are unable to finish projects in the time allotted (Bauer & Kenton, 2005; Ertmer et al., 1999; Lumpe & Chambers, 2001). In an effort to discover a method of dealing with this problem, Cattell (2006) conducted an action research project with her Year 4 students in New Zealand to trial different schedules for managing time on the one student computer she had in her classroom. Students worked either individually or with a partner and had a set or flexible time frame (either 30 minutes or unlimited time) to finish a project (e.g., create a bookmark). While she discovered that most students were more efficient when they worked with partners and had an unlimited amount of time to complete the project, individual differences such as skills with the software used influenced the benefits for each student. Managing time for a class of students on few computers is a reality for many teachers and exploring how this can be done most effectively is an important consideration when planning classroom activities.

As mentioned in the previous section, a number of teachers report difficulties finding enough time in the school day to plan and teach with digital technologies while still trying to meet other curricular demands (Becker, 1998; Ertmer, 2005; Hadley & Sheingold, 1993; Hardman, 2005). With the increased importance of meeting assessment requirements comes a focus on products rather than process in which teachers view technology as an add-on rather than a valuable tool through which they can teach the curriculum goals (Ertmer et al., 1999). This issue will be further discussed in the section regarding teachers' internal factors affecting technology use.

The issue of time has been examined in the context of CHAT. In a qualitative study of 51 elementary teachers in Crete, Karasavvidis (2009) discovered that over 40%

of teachers reported that time was a barrier to their daily use of collaborative learning on the Internet. Upon analysis of the data through the CHAT framework, a tension revealed that teachers who felt that they did not have enough time were responding to the cultural expectations that their overall goal should be to cover as much curriculum as possible. Therefore, their lessons focused on covering the content outlined in the curriculum as quickly as possible. Whereas teachers may have originally been primarily focused on helping their students learn, these teachers did not believe that they had enough time to both ensure student learning outcomes and cover the prescribed curriculum. In another study utilising CHAT, Yamagata-Lynch's (2003) examination of a professional development program in the U.S. revealed a similar tension; teachers who were not provided with release time to design a new unit which included technology experienced a dilemma around their use of time, that is between creating the unit and fulfilling other daily teaching responsibilities.

Finally, the process of learning to use technology as a tool to enhance the learning process for students can take a number of years (Sandholtz et al., 1997). As November (2010) points out, it has been demonstrated in both the business and educational fields that there are two distinct ways that digital technologies can be used. The first and most natural approach is to integrate digital tools within current practices and procedures for ease of use and the second phase involves a shift of empowerment to the user or learner. As detailed below, using digital technologies within student-centred environments is thought of as best, or effective, practice (Becker & Riel, 1999); however, teachers need time to progress to this type of teaching.

Personal factors

While contextual factors can be extremely influential in supporting or restricting a teacher's choice to use digital technologies, factors internal to the teacher also determine how these tools are utilised in the classroom environment. Knowledge and beliefs about content, pedagogy, and technology play essential roles as teachers strive to choose appropriate activities that will support the learning of content and skills (Mishra & Koehler, 2006; Pajares, 1992; Shulman, 1987; Starkey, 2010c). Within the CHAT framework, these internal attributes are one dimension of the complex activity system in which teachers plan and implement lessons. The following sections will

outline the roles of both knowledge and beliefs in teachers' decisions to use technological tools.

Knowledge

Teachers draw from a variety of knowledge bases when they engage in lesson planning and implementation (Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006; Shulman, 1986). Shulman's (1987) model of pedagogical reasoning proposes that both content knowledge about the subject matter to be taught and pedagogical knowledge of the methods and practices of teaching and learning are essential for effective teaching. However, instead of being considered individually, he suggests that truly successful educators show strong pedagogical content knowledge in that they understand what teaching approaches best match the content as well as how components of the content can be arranged most successfully.

Within the digital age, Mishra and Koehler (2006) have built on Shulman's model and consider technology knowledge, or skills and knowledge required to operate particular technologies, to be a third component distinct from pedagogical and content knowledge. They suggest that to use digital technologies successfully, technological knowledge must be considered independently of content and pedagogical knowledge to successfully incorporate technology into classrooms; the goal is to have knowledge of all three areas simultaneously which they have introduced as Technological Pedagogical Content Knowledge (TPACK). However, in a study that examined the role of pedagogical content knowledge in the digital age, Starkey (2010c) opposed the view that technology knowledge should be considered separately from pedagogical content knowledge. She found that pedagogical content knowledge that included knowledge of digital tools allowed six digitally able beginning teachers in New Zealand to select relevant teaching materials such as interactive web sites to support the learning of particular content. However, while the teachers could see the potential of technology such as Web 2.0 tools, they sometimes lacked the pedagogical content knowledge that would successfully enable them to integrate these tools into their teaching practices. As a result, the greater the teachers' depth of knowledge and confidence with the content as well as the methods of teaching the particular content, the more likely the teachers were to use digital technologies.

Whether or not technology knowledge should be considered independently of pedagogical and content knowledge, Ertmer and Ottenbreit-Leftwich (2010) consider knowledge to be critical to technology integration and suggest that "teachers need to understand the relationships between the affordances of a range of ICT resources and the skills, concepts, and processes of a content domain" (p. 260). However, knowledge alone is not the only internal factor that affects teachers' uses of technology in the classroom. Equally, if not more important, are their beliefs about teaching, learning, and the role of technology in the classroom.

Beliefs

The pedagogical beliefs that teachers hold are the foundation of their teaching practices (Pajares, 1992; Rokeach, 1968). While there is not an overarching definition that is widely accepted, Rokeach (1968) identified beliefs as "any simple proposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase, 'I believe that…'" (p. 113). Beliefs are based in the affective domain and are formed predominantly by personal experiences (Ertmer, 2005), making them resistant to change (Pajares, 1992). For example, teachers begin forming beliefs about teaching during their first experience as a student and these beliefs shape the way they teach when they enter the classroom as a teacher (Ertmer, 2005; Sandholtz et al., 1997). In contrast, Pajares (1992) defines knowledge as the factual understanding of a concept that can change as new information is received. However, the two are intertwined and beliefs underpin the perception through which knowledge is interpreted (Nisbett & Ross, 1980; Pajares, 1992). While teachers may gain new knowledge about pedagogy, technology, and content and recognise that new techniques may be more successful than their current practice, the underpinning beliefs are not immediately or easily changed (Nisbett & Ross, 1980; Rokeach, 1968).

Teachers' beliefs are especially relevant when investigating how teachers integrate digital technologies into their instruction (Angers & Machtmes, 2005; Ertmer, 2005; Ertmer et al., 1999). When teachers believe that an activity will have a positive impact on student learning, engagement, and/or motivation, they will find ways to incorporate digital technologies into their teaching praxis (Gibson, 2001; Kiridis et al., 2006; Mueller, Wood, Willoughby, Ross, & Specht, 2008). In one study conducted with

teachers from the eastern U.S., the strongest predictor of technology use at the classroom level was teachers' belief regarding the instructional benefits of technology (Miranda & Russell, 2011). Additionally, Hennessy et al. (2005) found that teachers were resistant to using technology merely because it was encouraged or expected; instead they wanted to ensure that the technology added value to their instruction to benefit student learning.

Best practices of teaching with digital technologies have been identified by Becker and Riel (1999) who stress that integrating digital technologies within a constructivist learning environment is most beneficial to student learning. In their view, technology best practices include 1) designing activities around teacher and student interests rather than entirely on curriculum; 2) assigning collaborative projects in which skills are taught and practiced in context; 3) concentrating instruction and assessment on students' understanding of complex ideas rather than skills; 4) teaching students how to self-regulate their own learning; and 5) learning along with students instead of being all-knowing. However, these recommendations were made over 10 years ago and results from more recent studies have suggested that progress has been sluggish at best in moving toward these student-centred practices (Moss et al., 2007; Mouza, 2011; Petko, 2012). In one recent study, Mouza (2011) reported that reluctance to use technology in student-centred ways was attributed to beliefs about student deficits, prescribed curricula, pressure from standardised testing, and limited resources.

In an ethnographic-case study in the U.S., Angers and Machtmes (2005) studied three exemplary middle school science teachers in-depth to explore what beliefs, contextual factors, and practices led to a technology-enriched curriculum. The researchers found that all of the teachers had a personal interest in digital technologies and often manipulated external factors to achieve their integration goals by spending extra time preparing for lessons, applying for grants, and opting to participate in professional development. All three teachers believed that a student-centred approach was the most effective way to teach their students and digital technologies were seamlessly integrated to create an environment in which students had choice in activities, worked cooperatively, and set their own goals. However, a specific underlying motivation was not identified; it is unclear in these cases whether

the belief in the effectiveness of the constructivist approach was merely facilitated by digital technologies or whether the teachers' perceived value of digital technologies caused a pedagogical shift in their beliefs.

A common belief is that the emergence of technology will facilitate a constructivist approach and that by using digital technologies, teacher beliefs and practices will shift from teacher-centred to student-centred (Dexter, Anderson, & Becker, 1999; Sandholtz et al., 1997). The Apple Classrooms of Tomorrow (ACOT) study was a primary example of this, as teachers who had little to no experience with digital technologies learned not only to use them effectively with their students, but over time changed their practices to make the best use of digital technologies within a constructivist environment (Sandholtz et al., 1997). However, the ACOT study was completed in the 1980's before digital technologies were infused into almost every facet of life and teachers and students may not have had as many pre-existing conceptions about how digital technologies could and should be used. In addition, external factors such as access were not issues since an ample supply of computers were provided to teachers and students for home and classroom use.

While some studies may show that technology can create a situation in which pedagogical shifts are possible, other research contradicts this finding. Through the use of interviews in 20 schools in the U.S., Dexter, Anderson, and Becker (1999) examined the teaching practices of 47 teachers from schools with a reputation for using technology. They found that only 10 of the teachers were considered to be substantially constructivist and 22 were weak constructivist. The remaining 12 used teacher-centred approaches. All of the 32 teachers who were considered to use constructivist approaches reported that their practices had changed over the period of time that they had been in the classroom. Teachers overwhelmingly reported that although technology had facilitated their changes in practice, the changes in beliefs had been due to a reflection on their teaching practices rather than the availability of digital technologies for classroom use. Thus, digital technology in itself does not appear to be the catalyst for change.

Similarly, Ottenbreit-Leftwich et al. (2010) recently investigated eight case studies in which they compared Becker and Riel's (1999) best educational technology practices with the actual beliefs and practices of teachers who were awarded

recognition for the use of technology in their classrooms. They found that although teachers used digital technologies for the benefit of the students in a variety of ways, a student-centred environment was not necessarily created. In these cases, teachers' beliefs were based on their instructional goals regardless of their beliefs regarding pedagogy; technology was used as a method to support the identified learning goals. The authors acknowledge that a limitation of their study is that many of the teachers held a personal interest in digital technologies and that much could be learned by examining the beliefs and practices of classroom teachers who may not have such an interest.

Another recent study of 12 teachers from the U.S. selected based on their award-winning technology practices as well as their student-centred practices found that these teachers' beliefs and attititudes about the significance of technology to student learning was one of the most influential factors enabling them to integrate technology (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). The teachers reported that these beliefs facilitated their use of technology, motivating them to devote additional time and effort to enact their student-centred beliefs. These teachers implemented student-centred curricula despite technological, administrative, or assessment barriers, suggesting that these contextual factors are secondary to teachers' internal beliefs.

These studies illustrate that while best practices may exist, the majority of classroom teachers choose to integrate digital technologies in alignment with their current pedagogical and epistimological beliefs (Ertmer et al., 2012; Kim, Kim, Lee, Spector, & DeMeester, 2013) which frequently fall within the continuum of teacher-centred to student-centred rather than in one category or the other (Ertmer et al., 2000; Gibson, 2001). Many teachers feel that there is value in teaching with digital technologies (Ertmer et al., 2012; Smarkola, 2008); in this case, they will find a way to utilise them in their classrooms regardless of their pedagogical beliefs (Beetham, 2007; Judson, 2006; Ottenbreit-Leftwich et al., 2010). The limitations of many of these studies, however, is that they collect data from one point in time, rather than over a longer period, and it is difficult to determine whether teachers' espoused and enacted pedagogical beliefs are static or shift over time. Clearly, more research should examine how pedagogical beliefs affect the methods through which teachers use

digital technologies to reach their teaching and learning goals and whether these practices transform over time.

Affordances of digital technologies

The term affordances refers to properties of a tool that support specific activities as perceived by the user (Gaver, 1991). When teachers and students use computers or other technological devices, they recognise specific uses for the tools based on their past experience with them, social norms, and cultural meanings (Gaver, 1991; Pea, 1993; Wijekumar et al., 2006). Therefore, teachers may choose to use specific digital tools in their classroom that they perceive will align with their pedagogical practices and beliefs. In addition, learners are accustomed to using digital technologies in their lives outside school for many everyday uses such as social networking, blogging and gaming (Greenhow & Robelia, 2009b); therefore they have preconceived ideas as to what affordances are being provided which may be different than the intent of the teacher (Pea, 1993). In order to maximise the influence of such technology on students' learning, sound instructional strategies must be used (Coley, Cradler, & Engel, 2000) and teachers must provide learning environments in which the tools align with the goals of the lesson (Wijekumar et al., 2006).

There are multitudes of ways that teachers and students currently use digital technologies in the classroom including communicating and collaborating with others, searching the Internet for information, and utilising software such as word processors and electronic gradebooks. Research has demonstrated that teachers often initially make use of digital tools in ways that enhance their own productivity and pedagogical practices (Kirschner & Erkens, 2006; Lai & Pratt, 2008). However, as teachers become more familiar with digital tools, they may begin to see new ways to utilise these tools within the classroom in more student-centred ways (Moss et al., 2007; Sandholtz et al., 1997). The following sections describe how technology can be used both as productivity tools and as cognitive tools designed to improve higher-order thinking skills.

Productivity tools

When digital technologies are first introduced into classrooms, they are often integrated into teachers' existing practices in order to increase productivity (Kirschner

& Erkens, 2006; Lai & Pratt, 2008; November, 2010). Examples of this include using email to communicate with parents, electronic gradebooks to tabulate grades, and presentation software such as PowerPoint™ and Prezi to transfer information from a traditional whiteboard to a projected image. While tasks may become faster and lessons are often thought to be more engaging for students when digital technologies are used in this way, the thought processes of learners are virtually the same as they would be without the technology (Kirschner & Erkens, 2006).

At times digital tools are introduced with the intent of changing classroom practices, but instead are used to increase productivity or reinforce teachers' current pedagogical practices (Kennewell, 2005; Moss et al., 2007). For example, Interactive White Boards (IWBs) have been purchased worldwide because school leaders perceive them to have the potential to increase interactivity. A large-scale initiative in the U.K. brought about an influx of IWBs in 2003 and 2004 with the hopes of creating an interactive and student-centred environment (Moss et al., 2007). Research by Moss et al. (2007) indicated that instead of changing teachers' practices, the introduction of the boards reinforced a transmission style of whole class teaching and reduced interactivity to what happened at the board. However, these educators enjoyed using the IWBs because they perceived these boards that enhanced their teaching by allowing them to project dynamic rather than static images and therefore provided more interesting modes of presentation to their class. Also within the U.K., Kennewell (2005) had similar findings and suggested that the IWBs were reinforcing traditional pedagogies because they were typically controlled by the teacher and only when they are manipulated by the students themselves do they become an interactive tool.

The use of digital tools to increase productivity can be useful in that it can increase efficiency, facilitate better communication, and increase motivation (Lai & Pratt, 2008). Additionally, teachers are often more comfortable with this type of use and these experiences can increase their self-efficacy, an important factor in determining whether teachers utilise digital tools with students (Smarkola, 2008). In addition, studies have demonstrated that when teachers use the digital tools over time, they begin to see new affordances for the tools (Crook, Harrison, Farrington-Flint, Tomás, & Underwood, 2010; Sandholtz et al., 1997). For example, Crook et al. (2010) found that teachers in the U.K. began to recognise that digital tools supported new

forms of classroom interactions and pedagogical practice such as flexible working spaces, new ways of orchestrating and monitoring activities, and the virtualisation of established and routine practices.

Digital technologies may also be used by students primarily to increase productivity. Software such as word processors and drill and practice software targeting literacy and mathematics skills are commonly used with school-age learners (Campuzano, Dynarski, Agodini, & Rall, 2009; Niederhauser & Stoddart, 2001; Project Tomorrow, 2010). Studies in the U.S. have indicated that students participating in 1-to-1 laptop programmes who are able to write using word processors have increased writing scores over those who have not had access to laptops (Silvernail, Pinkham, Wintle, Walker, & Bartlett, 2011; Suhr, Hernandez, Grimes, & Warschauer, 2010). However, there have been mixed results when examining the effectiveness of drill and practice software; while some use of these types of software have seemed to be effective, other studies have shown no difference between using this type of software and traditional methods (Campuzano et al., 2009; Li & Ma, 2010). More recent research has examined the possibility that specific affordances of the tools may lead to its success and has demonstrated that software games designed to increase students' literacy skills often do not provide affordances that would contribute to their usefulness as learning tools such as tracking student progress, offering specific feedback, or adapting to suit student needs (Lovell & Phillips, 2009). However, educators often choose to use these types of digital tools simply because they believe that they increase learner motivation and engagement with the activity (Ertmer et al., 1999; Millstone, 2012; Ottenbreit-Leftwich et al., 2010).

Mindtools or cognitive tools

In recent years there have been several researchers who have studied how digital technologies can be used to teach students higher-order thinking skills through the use of what they have called 'mindtools' or 'cognitive tools' (Jonassen et al., 2008; Kim & Reeves, 2007; Kirschner & Erkens, 2006). Cognitive tools refer to "technologies, tangible or intangible, that enhance the cognitive powers of human beings during thinking, problem solving, and learning" (Jonassen & Reeves, 1996, p. 693). Examples of cognitive tools include written language, calculators, and more recently, digital

technologies. Cognitive tools seek to engage and empower students (Jonassen & Reeves, 1996; Kirschner & Erkens, 2006). To accomplish this, they enhance or extend the cognitive power of the user by providing a way to off-load laborious lower-level tasks in order to free up processing for higher-level tasks such as decision making and problem solving, a concept known as distributed cognition (Kim & Reeves, 2007). According to Kim and Reeves, a cognitive tool "is a cognitive partner that interacts with learners to construct knowledge, bringing its expertise to activities" (2007, p. 228). Through forming a joint learning system with the tool and the activity, learners are able to think with the technology in a way that is not feasible without it (Pea, 1993). Technology can provide assistance with what it does best such as quick processing and retrieving of information while the learner applies higher level cognitive processing skills, such as evaluating information and offering creative solutions to tasks.

In recent years, researchers have investigated how digital technologies such as Internet-based primary sources, collaborative Web 2.0 tools, and concept mapping software offer affordances that can be utilised to facilitate higher-order thinking skills (e.g., Kirschner & Erkens, 2006; Lim & Tay, 2003; Ritchhart, Turner, & Hadar, 2009; Tally & Goldenberg, 2005; Yang, 2009). While these studies generally describe the affordances of specific tools which is beyond the scope of this review, Jonassen et al. (2008) have identified eight types of activities in which teachers can integrate digital technologies into their classrooms to facilitate what they call high-level meaningful learning. These include: 1) *investigating* in which the Internet and mobile technologies are used to gather and evaluate information for open-ended research projects; 2) *experimenting* in which students use microworlds, simulations, and virtual worlds to experiment with an artificial environment that they would not have access to otherwise; 3) *supporting writing* in which concept maps and presentation software is used to enable students to articulate their ideas and share them through visual means and Web 2.0 tools allow students to write collaboratively and share their writing with a public audience; 4) *modelling* in which students are able to model their knowledge, complex systems, difficult problems, as well as their own thinking and experiences; 5) *community building* in which students are involved in online communities that include their peers, parents, experts and others and facilitate co-construction of knowledge; 6) *communicating* in which students communicate in online environments synchronously

or asynchronously to gather or share information and ideas; 7) *learning by creating* in which students combine their creativity with ingenuity to generate products such as movies, music, and architectural designs; and 8) *visualisation tools* in which students are able to see visual representations of information that cannot be seen otherwise.

While integrating digital tools in this way is identified by some as effective practice (Becker & Riel, 1999), this type of integration requires teachers to envision how these affordances can be used with their students in order to make use of them in classroom activities to facilitate learning (Wegerif & Dawes, 2004). When new hardware and software is introduced into the classroom setting, it is traditionally used to support productivity and to enhance the user's existing practices (Kennewell, 2005; Moss et al., 2007). However, as proficiency increases, new affordances of the tool may be recognised; in which case, teachers may begin to shift their beliefs and practices to align with this new use (Crook et al., 2010; Sandholtz et al., 1997).

Students in the digital age

Within the Westernized world and beyond, many of today's youth have engaged with digital tools from a young age. While each generation exhibits unique characteristics, some suggest that the qualities of 21st century school-age children are directly related to their experiences with digital technologies (Feiertag & Berge, 2008; Oblinger, 2004; Prensky, 2001). Known as Millennials, the Net Generation, or digital natives, these students are continuously connected and have access to vast amounts of information and digital tools through mobile technologies and the Internet (Erstad, 2003; Grimley & Allan, 2010; Selwyn, 2006). Because of their experiences with technology, some posit that these youth have developed characteristics and expectations unique from previous generations of learners and that educators must take these differences into consideration in the classroom (Oblinger, 2004; Prensky, 2001, 2005, 2012).

Recent studies have confirmed that the majority of young people have a high level of access to digital technologies in their home and school environments (Grimley & Allan, 2010; Luckin et al., 2009; Spires, Lee, Turner, & Johnson, 2008). Grimley and Allen (2010) found that 93% of New Zealand students aged 10-12 from a variety of socioeconomic backgrounds had access to a computer and the Internet on a regular

basis at home, school, or the library. In another study conducted in the U.K. in which over 2600 Year 8 and Year 10 students completed usage surveys, over 90% of students used email outside of school and 74% had at least one social networking site (SNS) account (Luckin et al., 2009). Other research has indicated that school-age children utilise communication tools such as cell phones and SNSs such as MySpace, Bebo, and Facebook to keep in touch with and elicit emotional support from their friends (Feiertag & Berge, 2008; Greenhow & Robelia, 2009b).

While evidence has not been found that the students themselves have changed, Prensky and others argue that digital natives are fundamentally different from previous generations in that they learn, respond, and communicate in distinct ways (Feiertag & Berge, 2008; Oblinger, 2004; Prensky, 2001, 2005). They suggest that these learners are used to receiving information very quickly and therefore expect prompt feedback from both their peers and their teachers (Prensky, 2001). Additionally, Prensky (2001) maintains that digital natives prefer random access (e.g., hypertext) and are likely to parallel process and multitask. However, these ideas are primarily assumptions made from informal observations rather than rigorous research. While there is evidence that digital technologies have become extremely widespread and that many children are using these devices from a very young age, there is not definitive confirmation that today's youth are significantly different from preceding generations. However, the views of Prensky and others are well-known and must be considered within this context as it is likely that teachers are aware of and consider these claims when making decisions to integrate digital tools into their classroom practices.

In recent years, some have questioned the validity of the digital native claim and have proposed that this young generation of digital natives may not be as skilled using technology as others assume (Bennett, Maton, & Kervin, 2008; Helsper & Eynon, 2010; Kennedy & Judd, 2011). In a study conducted in the U.K., Helsper and Eynon (2010) found that more important than the age at which users began using the Internet was the amount of time that they had been engaging online and that the breadth of Internet use was the most important fact in determining whether or not a user could be considered a digital native. Feiertag and Berge (2008) suggest that while some students display advanced technological skills, they are primarily proficient only with

the technologies they need or want to use and do not independently choose to use technologies to enhance their own learning. In the Luckin et al. (2009) study mentioned before, only a few students surveyed had created blogs, added to wikis, or listened to podcasts. During focus groups with students in the second phase of the study, those who had used Web 2.0 tools often reported that they had learned how to do this in school and that their experiences with this technology had been motivating. This suggests that while hardware and Internet-based programmes may be available to students outside of school, these young learners will not necessarily find and make use of these autonomously. A study conducted with 17 to 19 year-olds in the U.S. confirms this idea as students reported that they often learned how to use a digital tool in school (i.e., video editing), but were inspired to explore the topic much more in depth at home because of their personal interest in the tool (Greenhow & Robelia, 2009a).

In another study that surveyed over 600 students in the U.K., Selwyn, Potter, and Cranmer (2009) found that students were generally passive in their use of digital technologies and that their engagement was "perfunctory and unspectacular" (p. 919). These young learners reported that they received some instruction on how to use digital technologies from friends, family members, or teachers (Browne, 2006; Marks, 2009), but prefer to learn through the "trial and error, ask a friend" approach (Starkey, 2010a, p. 248). However, nearly 300,000 American students participating in the Project Tomorrow (2010) survey in 2009 reported that they would like to see three elements of technology in education: social-based learning using communication and collaboration tools; un-tethered learning in which learning experiences transcends the classroom walls; and digitally-rich learning in which relevant digital tools, content, and resources are key to learning.

While students may not be engaging in remarkable activity with digital technologies outside of schools, these findings suggest that they are interested in using these tools within the educational setting. Although models have been developed to make sense of the ways in which adults engage with digital technologies (Whitton, 2011), additional research is needed to determine factors which impact on school students' engagement with digital technologies. An investigation of students' experiences during learning activities which include digital technologies would assist

educators in planning activities that build on students' strengths and prior knowledge while also developing new skills.

Teaching students in a digital world

Due to the extent of students' outside activity with digital technologies, some researchers are concerned that a 'digital disconnect' has developed as a result of students being asked to leave their devices at the door (Arafeh & Levin, 2003). In response, one rationale for integrating digital technologies is to engage and motivate students who are otherwise having to 'power down' when they enter school (Oblinger, 2004). In fact, a study with over 4000 middle school students in the U.S. supported this view from the students' perspective as they requested that teachers do more to engage and stimulate them during learning activities (Spires et al., 2008). Despite this perceived need, other results have shown that lessons which utilise digital technologies only for motivational purposes are less likely to help students meet intended learning goals (Zhao et al., 2002). However, a study conducted with middle school students in the U.S. (aged 12-14 years) found that when students participated in a web-based learning module on Africa, their motivation for the topic significantly increased following the use of the technology and led to increased learning when compared with students who had learned the material through the traditional textbooks (Moos & Honkomp, 2011). While engagement and motivation are key to successful teaching (Hattie, 2003), educators should be mindful that they do not necessarily equate to increased or deeper learning.

Teachers choose to integrate digital technologies into their teaching to support a range of learning goals. While the teaching of curricular content is often a perceived need (Becker, 1998; Ertmer, 2005; Hadley & Sheingold, 1993), skills such as critical thinking and information literacy have become more important in recent years (Leu, Kinzer, Coiro, & Cammack, 2004; November, 2010). Research has demonstrated that there is a need for developing students' media literacy skills as they are not creating quality products independently or most efficiently using online resources (Judson, 2010; Kimber & Wyatt-Smith, 2010; Lai, 2005). Additionally, these young learners need explicit guidance navigating the abundance of information available on the Internet as their searching skills have been less than spectacular (Lazonder, Biemans, & Wopereis,

2000). In addition, helping students become proficient with digital tools has been a goal for some teachers as well (Watson, 2001).

As teachers integrate digital technologies into their classroom activities, they attempt to meet their students' needs. However, there may be moments when trying to meet students' technological needs creates tensions during learning situations. This is illustrated in an action research study in New Zealand that was completed in conjunction with one of the ongoing ICT PD clusters. In the study, Stotter (2006) examined learning outcomes when groups of year 10 students used different tools when completing research projects. While one group first completed a research project with paper-based materials and books, the other used technology-based resources such as concept mapping software and the Internet. During a second research project, the groups exchanged resources. During the process the teacher and the researcher attempted to scaffold learning for the students by providing guidance in the form of just-in-time learning for both technological and researching skills. While students willingly accepted assistance when working with books and paper, they resisted aid when using the digital technologies, even when their researching skills (rather than technological skills) were being questioned. As a result, the final products were of higher quality when the students used books and paper. These results demonstrate that students as well as teachers may be influenced by the notion that the learners are more proficient with digital tools simply because they use these devices on a regular basis outside the classroom; this may result in resistance to assistance such as was reported in this study. Additionally, there is a possibility that teachers inaccurately believe that students are more proficient than they actually are and therefore require less assistance when utilizing digital tools; results from the Stotter (2006) study suggest that this could be detrimental to students' learning.

A final factor to consider is that best practices of the use of technology in education suggest a student-centred approach (Becker & Riel, 1999). While discussion in a previous section outlines how this approach may be difficult for teachers, students also may resist this type of instruction as it may be different from their prior experiences in the classroom (Åkerlind & Trevitt, 1999; Groff & Mouza, 2008). Groff and Mouza (2008) suggest that technology-based projects often require students to complete open-ended tasks, collaborate with others, direct their own learning, and

assume new leadership roles which may be unfamiliar to students and do not align with traditional positivist beliefs that have been reinforced through traditional classroom activities and assessment (Kennewell, Tanner, Jones, & Beauchamp, 2008). Through a CHAT analysis of data collected from two primary schools in Singapore, Lim and Chai (2004) found that students do not always take up opportunities for autonomy, but that a number of activities and tools can support students as they engage in higher-order thinking including introductory sessions with new digital tools, organisers and checklists, and dialogue among participants. These new roles can also be empowering for students as Rambe (2012) found that students were given opportunities to demonstrate technical problem solving to their peers, altering their role from passive recipient of information to resources of information themselves. Åkerlind and Trevitt (1999) suggest that to support students in this transition, teachers should provide opportunities for students to: clarify for themselves their existing concepts and goals for learning; be exposed to alternative models, both from teachers and their peers; and consider whether their learning goals are being achieved and whether these goals will lead to desired outcomes such as employment, high grades, and entrance to further study.

Students who are given the time to adjust and adapt to a student-centred learning environment that includes digital tools demonstrate evolved perspectives of how technology can be used for learning (Levin & Wadmany, 2006; Tierney, 1996). After participating in a three-year programme in Israel in which they were immersed in a technology-rich learning environment, students whose teachers used the technology in student-centred ways viewed technology as a learning tool, an informational base which can help with a given task, and as a medium through which they were able to negotiate meaning through interaction, interpretation, and collaboration (Levin & Wadmany, 2006). Interestingly, within the same study, in classrooms in which teachers' practices were less constructivist in nature, students viewed technology as a mechanism rather than an intellectual partner. Similarly, findings from the ACOT study suggested that while students initially perceived digital tools as useful primarily for typing reports, by the end of their four-year participation in the study they were creating nonlinear multimedia representations of their thinking (Tierney, 1996).

This research demonstrates that when integrating digital technologies in classroom practices, there are many student attributes to consider in order to make the best use of these tools for learning. While teachers are often motivated to make use of technology to motivate or engage their students (Zhao et al., 2002), there are many additional factors to consider that may affect the success of the lesson such as students' technical abilities, media literacy skills, and their expectations of their roles in the classroom (Åkerlind & Trevitt, 1999; Leu, 2002).

Conclusion

Many educators have taken time to accept, learn about, and integrate digital tools into their everyday classroom practice; therefore many studies in the past 20 years have closely examined factors that have contributed to teachers' use of digital technologies in their classrooms (e.g., Bauer & Kenton, 2005; Becker, 1998; Ertmer, 2005). These have identified several contextual factors that can affect the way that teachers use digital technologies such as access to technology, time to implement and learn about digital technologies, training in how to use and integrate digital technologies, and attributes of the school culture (Becker, 2000; Hadley & Sheingold, 1993; Lumpe & Chambers, 2001). Furthermore, teachers' knowledge and beliefs about appropriate pedagogy and the ways in which digital technologies can support these have been associated with this decision-making process (Ertmer, 2005; Ottenbreit-Leftwich et al., 2010; Smarkola, 2008). In order to integrate technology successfully, teachers must identify affordances of the tools that support their beliefs and practices.

Besides these factors, successful teachers consider the needs of their students when making decisions regarding how to integrate digital technologies into their teaching. Students today have extensive experiences with technology which shape the way that students learn and interact with the world (Scrimshaw, 2004; Selwyn et al., 2009). This awareness may be taken into account as teachers consider how to best meet the needs of these students.

While current research has identified a number of elements that influence teachers' integration of digital technologies, there is a need for a careful examination of the relationships between these factors and how they come together to underpin teachers' decisions to use digital devices with their students. This study addresses the

need to investigate the activities of teachers who have demonstrated frequent use of digital tools within their classroom practices. Within the current digital age context, this study intends to more fully understand the reality for teachers who choose to include these tools in their regular routine as well as the impact on the learning that occurred as a result.

Chapter 3. Methodology

This thesis explores teachers' motivations, rationales and methods of integrating digital technologies into their teaching practice as well as the role of the context and conditions under which these are utilized. Students' experiences using digital technologies within classroom activities are also explored. An interpretive multiple case study methodology was used to gather data from four distinct classroom settings across two schools through teacher and student interviews, observations, think alouds, focus groups, and the examination of artefacts. Cultural Historical Activity Theory (CHAT), as the theoretical framework, enabled an analysis and interpretation of data. The experiences of four teachers and their students from two intermediate schools within the wider school community, working with digital technologies over the course of one school year are identified. The current chapter outlines the rationale and implications for utilising these approaches as well as the techniques and procedures applied.

The research questions

The first two research questions below relate to teachers' choices and methods of integrating digital tools within their classrooms while the third question is concerned with the experiences of students within these classrooms. Finally the fourth question is associated with sociocultural factors within the activity system which motivate teachers to incorporate digital tools within their teaching practices.

1. *Why do teachers integrate digital technologies into their teaching practice?*
2. *How do teachers integrate digital technologies into their teaching practice?*
3. *What do students experience as they participate in lessons that integrate digital technologies?*
4. *What underlying processes within a system influence teachers' choice and use of digital technologies in their classrooms?*

Qualitative research

An interpretive multiple case study approach was identified as the most appropriate method for exploring the experiences of intermediate teachers and students as they integrated and used digital tools in the classroom setting. This approach enabled the day-to-day realities of teachers and their students to be fully

explored for an in-depth understanding. The goal of the study was to make sense of how and why teachers chose to integrate digital technologies into their classroom practices rather than simply describing what they did on a daily basis. Additionally, the perspectives and actions of students were an important consideration as their actions contributed significantly to the outcome. The primary objective of qualitative research is understanding how events happen within their natural setting (Merriam, 2009); essential for studying the classroom environment within which both teachers and their students worked toward a common objective. In addition, qualitative researchers consider human behaviour to be dynamic and changing, therefore often study phenomenon in depth and over an extended time period (Johnson & Christensen, 2008). Activity within classroom settings is often in a constant state of flux, therefore qualitative methods were used in each classroom over the course of an entire year to capture a comprehensive understanding of the rationales and practices which transpired. Conducting research within the authentic context of the classroom environment provides a rigorous examination of events from an outsider's point-of-view. Finally, the interpretive nature of qualitative research assumes that there are multiple realities which are socially constructed by the researcher (Merriam, 2009) which allows for a thorough interpretation of participants' experiences within their broader school context through the lens of CHAT.

Theoretical Framework

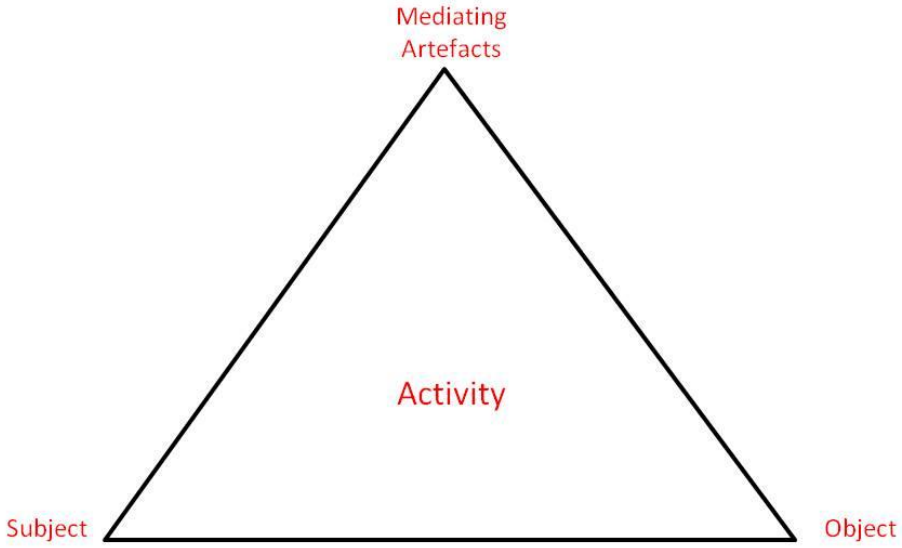
Activity theory was built on conceptions of activity first theorized by Vygotsky (1925/1982) and developed further by Leont'ev (1974) and Engeström (1993, 2001). The roots of activity theory are deeply embedded in Russian cultural-historical psychology of the 1920's and 1930's led by Lev Vygotsky. They stressed the importance of two main ideas. First, they believed that the human mind develops with the purpose of successfully interacting with the world (Kaptelinin & Nardi, 2006). Second, they held the fundamental idea that the development of the human mind is social in its very nature; human beings are shaped by the culture they are immersed in, the language they use, and the social groups, organizations, and communities in which they live (Kaptelinin & Nardi, 2006). However, Vygotsky rejected the idea that culture and society directly shaped the human mind. Instead, he believed that it was through

purposive and culturally meaningful activity that consciousness emerged and developed (Vygotsky, 1978). In his view, individual development must be understood within the social and cultural-historical context within which it is situated (Rogoff, 2003), and as such he developed the concept of the zone of proximal development (ZPD) to foreground the critical role of 'others' in learning.

Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD) proposes that there is a gap between a students' developmental level when they work independently versus when they are helped by a more knowledgeable other. While those who are less competent can develop skills with help from adults or their peers, these more capable partners must have a level of expertise about the information being learnt and an understanding of how to assist their peer appropriately (Chaiklin, 2003; Ohta, 2000). The more knowledgeable partner shares knowledge with the student to bridge the gap between the known and the unknown, and in the process the student develops new understandings (Vygotsky, 1978). As Chaiklin (2003) points out, learning is dependent on the interventions of the more competent learner, and Vygotsky (1987) indicated that learners could be assisted appropriately through "demonstration, leading questions, and by introducing the initial elements of a task's solution" (p. 209).

Building on Vygotsky's work, his student Leont'ev introduced the basic structure of activity which was based on the notion that humans rarely interact directly with the world; rather, a vast number of cultural tools have been created that mediate activity such as language and physical tools (Leont'ev, 1978). The unit of analysis in an activity system is the activity itself in which an individual or group (subject) engage with the intent of working toward a goal (object). The model depicted in Figure 3.1 is a visual representation of this idea and is expressed as a triad between the subject, object, and mediating artefacts (Leont'ev, 1978). This was revolutionary in that it rejected traditional ideas that the subject and object could be understood only in relation to each other (Engeström, 2001). Instead, both subjects and objects were embedded in their cultural and historical environment and could not be fully understood without considering these perspectives. However, the model's limitation was that it focused on the individual.

Figure 3.1. Model of the first generation of Activity Theory

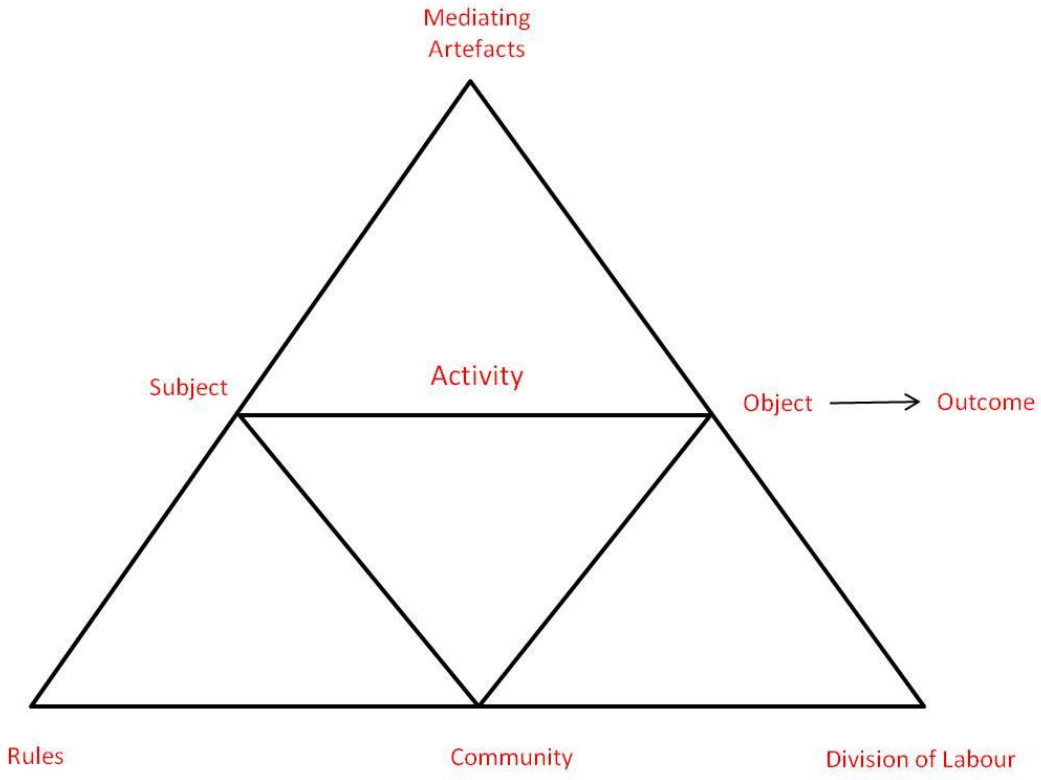


Leont'ev was interested in the idea that activities were often collective and that several individuals could be working toward an object in an organised fashion while their individual actions were seemingly unrelated. His example of a primeval collective hunt described the way in which different members of a tribe had different roles while hunting (e.g., scaring the prey and killing it) although their collective object of capturing an animal for food and clothing was met (Leont'ev, 1981). This distinction between activity and action was the basis for the second generation of activity theory developed by Engeström which included three hierarchical levels: the collective activity, individual actions, and automatic operations (Engeström, Miettinen, & Punamäki, 1999). The first level, collective activity, is driven by the object; the second level, or action, is an individual's activity toward a related goal; and the third level of operations are automated actions that are driven by the tools on hand (Engeström et al., 1999). Leont'ev stressed that the creation of tools led to the division of labour, or a situation in which a person's actions are motivated by one object, but directed to another. Therefore, Leont'ev believed that all activity could be understood more fully in the context of its cultural and historical roots from which the tools originated and developed (Kaptelinin & Nardi, 2006). In addition, Leont'ev noted that the development of the system was often spurred by the resolution of contradictions or discrepancies within the system (Kaptelinin & Nardi, 2006). Engeström later developed

a graphical model of this second generation of activity theory, more formally known as Cultural-Historical Activity theory (CHAT), which is the most common version used today (see Figure 3.2).

Most recently, Engeström has developed the third generation of activity theory within his research in working environments (Engeström, 2001). His approach is to utilize activity theory as a tool in these environments to raise awareness of contradictions and to stimulate change in order to resolve them (Sannino, Daniels, & Gutièrrez, 2009). This is achieved by examining multiple perspectives of the interacting activity systems of those individuals or groups who share the same object (Engeström, 2001).

Figure 3.2. Model of the second generation of Activity Theory



This research was concerned with understanding how variables within the system influenced each individual teacher within their own classroom activities rather than to stimulate change within the entire school system; therefore the second generation of CHAT was an appropriate theoretical framework. While there are

multiple activity systems present even within one classroom setting depending on the orientation of the subject (i.e., student, principal, etc.), the aim of this study was to understand the teachers' pedagogical approaches and motivations toward using technology. Therefore, it was important to focus on this aspect and to understand what it meant for the teachers. Multiple perspectives and documentation were woven together through the CHAT framework to situate each classroom teacher's activity both culturally and historically.

Transformative learning can occur for subjects within sociocultural contexts which create opportunities for development (van Oers, 2008). Contradictions and tensions within activity systems may simultaneously create disturbances and conflicts as well as generate innovative attempts to alter the activity (Kuutti, 1995). Change within the system occurs as a pragmatic response to the operational tensions between two features of a system; authentic activities are continually in the process of working through such contradictions (Bourke, Mentis, & O'Neill, 2013). In his work developing the third generation of activity theory, Engeström (2001) suggests that expansive learning takes place through this process and that often the new object is neither stable nor defined or understood ahead of time. Instead, the new forms of activity must be learned as they are being created, thereby creating culturally new patterns of activity (Engeström, 2001). The concept of expansive learning can be applied to the current study in which the second generation of activity theory is utilised; transformative learning occurred for teachers as they were motivated to alter their activity in response to tensions or contradictions within the activity system.

CHAT in the current study

In the present study, the second generation of CHAT was chosen as a theoretical framework through which to analyze rich data collected from four classroom settings. The primary goal of the research was to understand how variables within the system influenced each individual teacher within their own classroom activities rather than to stimulate change within the entire school system; therefore the second generation of CHAT was an appropriate theoretical framework.

Teachers are part of a wider school culture that includes relationships with members of the school community such as other teachers at the school, the school

leadership team, and parents of students. While all of these community members may have similar goals, each contribute their own personal beliefs about the most effective methods of meeting these objectives through the use of digital tools. Multiple perspectives and documentation were woven together through the CHAT framework to situate each classroom teacher's activity both culturally and historically.

Additionally, aspects of the environment have the potential to impact teachers' activity toward their objectives. Each teacher has personal knowledge of the affordances of each tool, whether or not support would be available when technical issues arose, and how many computers and other digital devices are available for use at any given time. These factors are considered within the CHAT framework.

A second focus of the study was on understanding student experiences as they engaged in the lessons that their teacher had designed and implemented. This was an important aspect to consider as students are not passive recipients of knowledge and significantly contribute to the outcome of the activity as well as influence the actions of their teachers. In the current case, each student had their own abilities, perceptions, and experiences; therefore it was necessary to look more closely at individual students' actions as defined in Leont'ev's hierarchy (Kaptelinin & Nardi, 2006).

Research design

This qualitative research was conducted in an interpretivist paradigm underpinned by the CHAT theoretical framework. Multiple case studies were the most appropriate methodology given the aims of the research and the questions that emerged. The following sections describe the process of selecting participants and the methods of data collection used within the study.

Multiple case study

A multiple case study methodology was used as it facilitated a thorough investigation of the complex multifaceted environment in which experienced teachers were situated as they worked toward their objectives. Yin (2009) defined a case study as "an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p. 18). Within their teaching practice, teachers are continuously making decisions about the methods through which they teach their

students, and many factors impact on these decisions. While this study is concerned with how and why teachers include digital technologies into their pedagogical practices, this phenomenon cannot be understood without considering teachers' underlying beliefs as well as the influences of the broader school environment within which they work. Therefore, several types of evidence including interviews, observations, think alouds, focus groups, and artefacts were gathered and compiled to create an in-depth "picture" of the phenomena as it occurred in four classrooms across two school settings (Merriam, 2009; Stake, 2005). Multiple cases were included in the study so that data regarding the integration of digital technologies from a number of classroom environments could be compared and contrasted to discover whether any common characteristics or conditions existed between the cases (Stake, 2005).

In the current study, each classroom case was examined as a bounded system located within a larger school setting with the goal of understanding how each of the components contributed to teacher's decisions to integrate digital technologies in their classroom activities (Stake, 1995). Johnson and Christensen (2008) suggest that multiple cases are desirable when the researcher believes that greater insight can be gained by studying several cases in one study. Within this study, four classroom cases were chosen within two distinct school environments as the goal was to construct a comprehensive understanding about the role of contextual factors on teachers' behaviours. The interpretive examination of the phenomenon through case studies allowed for a holistic, in-depth investigation that identified a range of variables, and highlighted policies, relationships, and cultural artefacts that underpinned teachers' decisions to incorporate digital technologies within their classroom practices. These were examined through the CHAT lens to discover how technology is integrated into users' actual social and material environments (Nardi, 1995).

Determining the number of cases when gathering data through case studies is influenced by many factors including availability and resources such as money and time (Johnson & Christensen, 2008). Merriam (2001) suggests that an adequate number of participants, sites, or activities are needed to answer the question that has been posed. The researcher must decide whether cases will be compared or if a deeper analysis of a smaller number of cases is more appropriate to gather the needed data (Yin, 2009). To answer the research questions in this study, it was necessary to

examine not only the classroom as a whole, but also individuals' experiences within the wider school setting. Therefore, four classrooms cases were examined in the present study as Yin (2009) suggests that two or three replications are suitable for multiple case studies. The teacher in each classroom was the main focus of each case while data were also collected from students within the classroom. Two teachers were invited to participate from each of two participating schools so that the wider school context could be understood from multiple perspectives. As a result, the study included two participating schools with two classroom cases within each school. Limiting the number of cases to four allowed the researcher to spend considerable time in each classroom over the course of the year.

Participants

Convenience sampling was used to identify intermediate schools based on their availability and willingness to participate in the research (Johnson & Christensen, 2008). Purposive sampling was employed to select teacher participants as distinct characteristics were identified in the population of interest and participants were chosen based on these distinct criteria (Johnson & Christensen, 2008). The goal was to find two participating schools with two teachers within each school who would be willing to participate. This was logical because CHAT is concerned with understanding the broader school context within which each teacher operated, therefore considerable time could be spent investigating each school environment and two distinct perspectives regarding that setting would provide an in-depth understanding of the school culture.

Research has shown that Year 7 and Year 8 students (10 to 13-year-olds) in New Zealand demonstrate high levels of technology use and utilize digital technologies outside of school for a variety of reasons (Grimley & Allan, 2010) which made the age group suited to the purpose of the study. Therefore, the principals of six intermediate schools in New Zealand which were easily accessible for multiple visits were sent a letter (see Appendix A) via email (in December 2010) asking them to participate in the study; two agreed to take part.

While schools were chosen based on their willingness to participate rather than their demographics, many aspects of the selected schools were similar (see Table 3.1).

School A had an approximate enrolment of 500 students while about 600 students attended School B. All schools in New Zealand are assigned a decile ranking that is designed to represent the socio-economic status of the community surrounding the school, ranging from 1 (very low socio-economic status) to 10 (high socio-economic status). School A had a decile ranking of 8 while School B had a decile ranking of 10. Each school had a mixed ethnic group of students, the details of which are displayed in Table 3.1.

Table 3.1. Demographic comparison of schools within the study

		School A	School B
Enrolment		500*	600*
Decile ranking		8	10
Student ethnicity	*New Zealand/European*	50%	69%
	Maori	20%	7.5%
	Pacific Islander	14.5%	3.5%
	Asian	13%	16%
	Other	2.5%	4%

*This number is approximate to protect the identities of participating schools

During a face-to-face discussion with each principal (December 2010), an information sheet (see Appendix B) which outlined the expectations for the study was discussed with the principal as well as the selection criteria for teacher participants. Each principal signed a consent form at that time (see Appendix C) and was invited to nominate two full-time teachers at the school who used digital technologies often and in a variety of ways in their classrooms. At this time the researcher stressed to the principal that it was not necessary that these teachers were expert technology users, but more importantly that they made use of digital technologies in their classroom on a regular basis. By January 2011, each principal had emailed the names and email addresses of two teachers who they thought would be willing to participate in the study. These teachers were then emailed a letter and information sheet by the researcher inviting them to take part (see Appendix D and E) and all four agreed to be included in the study in January 2011.

The four participating teachers had a range of teaching experiences (see Table 3.2). They had all been teaching for a minimum of three years when the study took place. The number of teachers' teaching experience and the number of years that they had been teaching at their current school were characteristics that potentially

influenced the way in which they interacted with other members of the school context and acted within the school culture.

Table 3.2. Teaching experience of teacher participants

	School A		School B	
	Helen*	**Fiona***	**Jack***	**Zoe***
Number of years teaching	3	23	9	9
Number of years at current school	2.5	11	4	4

*Pseudonyms have been assigned to protect the identity of all participants

The researcher met with the participating teachers before the school year began in January 2011 to discuss the aims of the study and the expectations of their role as participants; consent forms were also signed by each teacher at this time (see Appendix F). Students in each classroom were invited to participate in the research as well; therefore a classroom visit was arranged during the first two weeks of school to discuss the research with all students. This visit occurred in each classroom in early February 2011 and all students within each classroom were given a letter and information sheet as well as consent forms for them and their parents to sign (see Appendices G, H, and I). These were collected by the teacher and given to the researcher before the first observation took place. The return rate for student consent forms was consistent in three of the four cases as Table 3.3 displays. While it was not expected that every student would be observed or interviewed over the course of the study, this was done to ensure that it was possible to gather information from as many student participants as possible.

Table 3.3. Consent received from student participants in each classroom case

	School A		School B	
Classroom case	**Helen**	**Fiona**	**Jack**	**Zoe**
Students in classroom	30	30	30	30
Target students with signed consent	12	26	24	25

Data collection

As Stake (1995) observed, all data collected in the field should be guided by the research questions guiding the study. The purpose of the current case was to understand not only how and why teachers integrated digital technologies into their

teaching practice, but also the underlying processes that impacted this activity and how students experienced these lessons in the classroom. Therefore, it was necessary to gather several forms of data in order to accurately answer each research question; this is supported by Yin (2009) who emphasises the importance of collecting multiple forms of data to strengthen the validity of the study.

Within the current study, sources of data included: transcribed interviews with teachers; video recorded classroom observations and student think alouds as digital technologies were utilized and field notes taken after; physical artefacts including school and national policies and other school documentation (i.e., newsletters); and transcribed student focus groups.

Data were collected from the four classroom cases over the course of the 2011 school year. The in-depth data collection phase occurred over the first two consecutive terms of the year beginning in Term 1 in February, 2011. After the initial meetings with teacher and student participants, the researcher contacted each teacher via email fortnightly to schedule classroom observations during lessons which included digital technologies. Over Term 1 and 2, the researcher visited each classroom between seven and 10 occasions to gather enough information to develop a comprehensive understanding of how digital tools were being used in each classroom without burdening the teachers and students. During videotaped observations, both teachers and students were observed and students were sometimes asked to discuss their thought processes as they worked with technology. Field notes were written as soon as possible after each observation and were kept as part of the research documentation. When time permitted, the researcher engaged teachers in a brief (5 to 10 minute) audio taped conversation before or after the observation to discuss their use of digital technologies on that particular day. Over the course of Terms 1 and 2, physical artefacts were gathered from the school and Ministry of Education websites.

All four teachers participated in 60 to 90 minute in-depth audio recorded interviews in Term 2 to gather more information about their rationales for and methods of using digital technologies in their lessons. In addition, one 20 to 30 minute student focus group was held in each classroom also during Term 2 to find out more about students' experiences with digital tools both inside and outside the classroom.

At the end of the school year, each teacher was contacted during Term 4 via email to arrange one final session of data collection from each classroom. Therefore, each of the four teachers were interviewed and observed one final time during Term 4.

Throughout the study, the researcher maintained the role of observer-as-participant as the researcher primarily maintained the role of observer, but a relationship was formed with the teacher and students over time (Adler & Adler, 1994). However, this relationship proved to be beneficial. Initially, teachers were protective of their time and efforts, but over time all of the teachers willingly agreed to the additional participation at the end of the study and disclosed more of their personal opinions during in later interviews than they had initially.

The following sections outline the details of each of form of data collection used in the study and how they were carried out as part of the research process.

Interviews

According to Patton (2002), the fundamental purpose of an interview is to find out what is "in and on someone else's mind" (p. 341). Within the current study, both formal and informal interviewing was used as the primary method of uncovering teachers' perceptions of how they were able to make use of digital technologies in their classrooms and why they were motivated to do this. This enabled the researcher to gather data about events that happened when the researcher was not present and to understand the observed teachers' actions (Stake, 1995), especially when they were interviewed just after observed lessons.

During the extensive formal interviews with each teacher during Term 2, semi-structured questions were developed to answer the research questions posed (Merriam, 2009; Stake, 2010). At the time of the interviews, all of the teachers had been observed on at least three occasions before the interview occurred; therefore each interview included the same five main questions, but follow-up questions were tailored to each teacher so that specific questions about the observed classroom practices could be more fully understood. The questions were developed to more fully understand the underlying factors that motivated teachers in order to answer the fourth research question related to the CHAT theoretical framework (Seidman, 2006).

When time permitted, teachers were approached after observed lessons for a brief informal interview in which they were asked to explain the purpose for including digital technologies into the observed activity. These 5 to 10 minute interviews generally offered insight for the researcher into teachers' rationales for using digital technologies and allowed teachers to comment on their perceptions of the outcome of the activity. Occasionally these data were not audio recorded in which case they were integrated into field notes written after observations took place.

At the end of the year, teachers participated in a final 20 to 30 minute formal semi-structured interview in which they were asked to reflect on their use of digital technologies throughout the year and questioned regarding their future plans for technology use. This interview was designed to reveal whether the participants had altered their beliefs about how digital tools could be used effectively and whether they had encountered specific barriers or enablers to their technology use over the course of the year.

The number of interviews recorded for each participant is listed in Table 3.4 below. All interviews were audio taped and transcribed by the researcher as they were collected; they were later imported into NVivo 9 for data management and subsequent analysis.

Table 3.4. Data collected in each classroom case

	Helen	Fiona	Jack	Zoe
Interviews with corresponding dates *	Int 1 – 22 Feb Int 2 – 15 Mar Int 3 – 24 Mar Int 4 – 5 May Int 5 – 12 May Int 6 – 10 Nov	Int 1 – 4 Mar Int 2 – 17 Mar Int 3 – 31 Mar Int 4 – 12 May Int 5 – 14 Nov	Int 1 – 22 Feb Int 2 – 1 Mar Int 3 – 9 Mar Int 4 – 28 Mar Int 5 – 7 Nov	Int 1 – 27 Feb Int 2 – 6 Mar Int 3 – 31 Mar Int 4 – 3 Apr Int 5 – 29 Nov
Classroom observations with corresponding dates*	Obs 1 – 22 Feb Obs 2 – 4 Mar Obs 3 – 15 Mar Obs 4 – 24 Mar Obs 5 – 5 May Obs 6 – 26 May Obs 7 – 10 Nov	Obs 1 – 4 Mar Obs 2 – 17 Mar Obs 3 – 17 Mar Obs 4 – 7 Apr Obs 5 – 12 May Obs 6 – 26 May Obs 7 – 14 Nov	Obs 1 – 22 Feb Obs 2 – 28 Feb Obs 3 – 1 Mar Obs 4 – 3 Mar Obs 5 – 9 Mar Obs 6 – 23 Mar Obs 7 – 30 Mar Obs 8 – 4 Apr Obs 9 – 23 May	Obs 1 – 10 Feb Obs 2 – 28 Feb Obs 3 – 7 Mar Obs 4 – 24 Mar Obs 5 – 1 Apr Obs 6 – 19 May Obs 7 – 24 May Obs 8 – 29 Nov
Student focus group date	26 May	26 May	22 May	19 May

*All data were collected in 2011 **Key:** Int=Interview Obs=Observation

Observations and think alouds

Observations were conducted with the intention of complementing data collected during interviews, but also served to triangulate the findings (Merriam, 2009). While interviews offered valuable insight into teachers' rationales for using digital technologies with their students, much was learned from classroom observations that focused on the activity of both teachers and students as they worked with digital tools. A classroom visit was arranged with each teacher about every two weeks. During each of these visits, the researcher aimed to view a lesson from start to finish in which digital technologies were utilised; therefore the duration of observations varied from 45 minutes to 2 hours each. The goal of each observation was to identify teacher intentions for the objectives of the activity and to ascertain student perceptions of these objectives and how the student participants strived to meet these. Each classroom was observed on seven to 10 occasions over the duration of the study (see Table 3.4).

In order to understand their online cognitive processes during classroom activities, students were asked to participate in think alouds as they worked with digital technologies (Ericsson, 2006). Think alouds consist of the participants talking through their thought processes during a learning activity and are valuable in that they provide insight into thinking that teachers and students may be unable to express during interviews (Ericsson, 2006). During classroom observations, selected students were questioned about what they were doing or were asked to verbalize their thought processes as they worked with digital technologies independently. Additionally, students were observed and occasionally questioned about their activity as they worked collaboratively.

Both teachers and students were monitored and videotaped through the duration of lessons that included digital technologies in the classroom. Each recording began at the introduction of the activity and concluded when the session ended. The teacher was recorded during the introduction of the activity and when direct instruction or interaction with students occurred. Videotaping continued as students worked in groups or individually during each lesson. The researcher aimed to gather data from as many students as possible; therefore, students were chosen to be observed based on whether they had previously been viewed and if parental consent had been given. The researcher focused on one group or student until she was able to ascertain the students' perception of the learning intentions for the task and how the student was progressing toward these objectives. Over the duration of the lesson, the researcher aimed to observe as many students as possible given the aforementioned criteria.

Notes were taken during each observation and were used to record detailed field notes as soon as possible after each session. Videotaped sessions were viewed a minimum of twice after they were recorded to capture as many details as possible from the data, which were added to initial field notes. Noteworthy dialogue of teachers or students that was particularly relevant was transcribed verbatim into the field notes. This allowed the researcher to add additional details to field notes that may have initially been missed. All field notes were imported into NVivo 9 for data management and subsequent analysis.

Student focus groups

Focus groups were organized in each classroom during Term 2 with a convenience sample of three to four students selected by the teacher (see Table 3.5 for details regarding focus group participants) (Johnson & Christensen, 2008). The researcher met with one group of students from each classroom for 15 to 20 minutes at a time that did not interfere with classroom instruction (i.e., before school or during morning tea). The purpose of the focus groups was to gather information about students' experiences with technology in the classroom and in environments outside the school setting; this served as another method of triangulation as well as offering insight into students' perspectives of technology use within the classroom (Stake, 1995). Rather than interviewing students individually, focus groups were organized because of time constraints and for the purpose of collecting "high-quality data in a social context where people can consider their own views in the context of the views of others" (Patton, 2002, p. 386).

Table 3.5. Participants in student focus groups

	[Helen] Student Focus group A	[Fiona] Student Focus group B	[Jack] Student Focus group C	[Zoe] Student Focus group D	Student Totals
Year 7 female	3	0	2	0	5
Year 7 male	0	0	1	0	1
Year 8 female	0	3	1	3	7
Year 8 male	1	0	0	0	1
Total number in student focus group	**4**	**3**	**4**	**3**	**14**

Collection of artefacts

Artefacts, while underused in qualitative research, can offer information or insight significant to the research questions (Merriam, 2009). In the current case, a CHAT analysis required the investigation of relevant policies and procedures that guided each teacher's classroom activity. Therefore, several different school-based and Ministry of Education documents were collected to gain further understanding of national and school policies around the use of digital technology that set expectations for digital technology use in schools. Artefacts that were examined are outlined in Table 3.6 below.

Table 3.6. Artefacts collected and analysed

	School A	School B	National documents
Type of artefacts collected	Newsletters written by the school principal School curriculum Information found on school website School action plan that was displayed in the staff room	Newsletters written by the school principal School curriculum Information found on school website	New Zealand Curriculum Ministry of Education website outlining National Standards

In New Zealand, *The New Zealand Curriculum* serves as a framework for teaching and learning that underpins the entire national educational system. The purpose of this curriculum as expressed in the foreword of the document is to "ensure that all young New Zealanders are equipped with the knowledge, competencies, and values they will need to be successful citizens in the twenty-first century" (Ministry of Education, 2007, p. 4). As outlined in the national curriculum, each school is expected to design their own school-based curriculum "so that teaching and learning is meaningful and beneficial to their particular communities of students" (Ministry of Education, 2007, p. 37). As a result, both the national standards and New Zealand curriculum documents were analysed as they set specific expectations for teaching and learning.

Other formal and informal documents that were included in analysis were pages found on the school websites and school newsletters that were written fortnightly by each principal. Expectations around technology use at the school level were reflected by information found on the school website which included school policies and values as well as links to educational websites for students. In addition, school newsletters that were written by principals primarily to update and inform parents served also as a method of communicating accepted classroom practices including the use of digital technologies. At School A, a visual representation of the school action plan was displayed in the staff lounge; therefore aspects of this which included digital technologies were recorded and included in analysis.

Data analysis

As Merriam (2009) points out, "the process of data collection and analysis is recursive and dynamic" (p. 169). Therefore, ongoing analysis was conducted on each classroom case throughout the data collection process and was completed after all data had been collected. Yin (2009) suggests that computer-assisted tools are used to code and categorize great amounts of narrative text; therefore all data were imported into NVivo 9 for analysis. Individual case studies were initially analysed through a CHAT lens and later a cross case analysis identified themes across case studies.

Individual case study analysis

The primary goal of the individual case study analysis was to explore and interrogate the research questions within the context of each individual case study. Therefore, all data collected were inductively analysed in order to make meaning of and interpret the information gathered in light of the research questions (1, 2, and 3) outlined earlier (Merriam, 2009). In addition, data were analysed deductively through the lens of CHAT to make sense of the fourth research question.

Interviews were transcribed by the researcher soon after they were recorded and notes were kept throughout the data collection process to track emerging findings. A case study database was created as suggested by Patton (2002) within NVivo 9. Interview transcripts, field notes, focus group transcripts, and artefacts from each case were read through a number of times and a constant comparative method was used to compare units of data with one another to discover recurring regularities within the data (Merriam, 2009).

During the first phase of analysis, data from each case study were examined for content that portrayed *how* each teacher made use of digital technology in his or her classroom and *why* they were utilising these tools. According to Stake (1995), "the search for meaning often is a search for patterns, for consistency, for consistency within certain conditions, which we call 'correspondence'" (p. 78). Therefore, the recurring regularities that emerged from the data were categorised in order to bring each unit of data together again in a novel way (Merriam, 2009). All data were read through several times sentence by sentence and categories were refined to best represent the findings; each unit of data were coded within these categories. Once all

data were coded into categories, similar categories were grouped and placed into themes (Creswell, 2007). Additionally, a table was created for each case that outlined variables of interest within each observed classroom lesson in an effort to organize raw interview and observation data into a cohesive structure (see Appendices K through N). The same process was followed in each case to make sense of students' experiences. An example of the categories that emerged in one case and data that was found in each category can be found in Appendix J.

When the researcher was satisfied that saturation had occurred, in which new information was not being mined from the data that increased understanding of the phenomenon (Creswell, 2007), narratives were written for each classroom case (see Chapters 4 and 6). Each case study aimed to answer the first three research questions as outlined above.

Finally, the researcher returned to the data within NVivo 9 to conduct a deductive analysis of the data that aligned with the CHAT framework. Categories pre-determined by the theoretical framework served as a guide in which to consider data which were related to aspects of the school and classroom environment that motivated teachers to utilise digital tools in their classrooms. Data organized in this way was employed to guide thinking while writing a CHAT analysis of each case study see Chapters 5 and 7).

Cross-case analysis

A cross-case analysis was completed to aggregate data across the four cases and as a means of constructing a general explanation that fit all of the individual cases (Yin, 2008). Data from all case studies were brought together to build abstractions across all four cases and to search for emerging patterns and themes (Merriam, 2009).

Data analysis across the cases followed two distinct processes both within and out of context in an effort to answer each of the four research questions. Initially, themes were compared across cases to determine which, if any, categories could be found across multiple cases that answered each of the four research questions. Categories that occurred in three of the four case studies were combined. Next, raw data from interviews, observations, artefacts, and student focus groups were re-examined line by line out of the context of the individual case studies to identify

themes directly from the data that may have otherwise been overlooked. Conclusions were drawn as a result of the analysis and synthesis and reported in Chapter 8.

Ethical considerations

The research gained ethical approval by the Faculty of Education Human Ethics Sub-Committee of Victoria University of Wellington. There were several ethical consideration including: maintaining confidentiality of the identity of all participants including schools, teachers, and students; accurately reporting the perspectives and experiences of all participants; and ensuring that all participants were familiar with the aims and objectives of the study so that they were comfortable with the research process.

The identities of all school, teacher, and students participants were kept confidential. Schools were simply assigned letters A and B while teachers were each given the opportunity to choose their own pseudonym. Student participants that were referred to by name in the text were assigned a pseudonym during data analysis. A high level of confidentiality was required to protect the teacher participants from any potential employment or personal repercussions that might occur as a result of being open and honest throughout the data collection process. Similarly, sensitive data were collected from each school context; therefore the schools' identities were kept confidential to prevent a negative impact resulting from information published. In addition, protecting each school's identity was imperative in preventing the reader from making presumptions about the findings because of their own knowledge of the school. Confidentiality was discussed with all participants during initial meetings and was also included in information sheets and consent forms.

The researcher did not know any of the participants prior to the study; therefore during initial meetings with teachers an attempt was made to develop a professional relationship by sharing background information about the researcher and the study. The purpose of this was to demonstrate to teachers that the researcher understood that teachers were busy and aimed to make the research rewarding for them rather than a burden. This effort seemed to be successful as all teachers maintained regular contact with the researcher and shared insightful information during interviews and observations. The researcher maintained an observer-as-participant role during

classroom observations; there were occasionally situations in which the researcher actively participated in classroom activities (i.e., was asked by the teacher to judge a presentation) (Adler & Adler, 1994).

Informed consent was gathered from all participants including school principals, teachers, and students, and the students' parents or guardians as all students were under 16 years old. Each participant was informed that: they would not be identified by their name in any report of the findings; pseudonyms would be used for confidentiality; all data collected was confidential; and they were permitted to withdraw from the study at any time if desired. Additionally, only student participants who had returned a consent form were approached during classroom observations and they were always asked for permission before they were closely observed or asked to participate in think alouds or focus groups.

Once interviews with teachers had been transcribed, their individual transcripts were sent to them for review to ensure that they felt that their views or beliefs about a concept were accurately represented. Additionally, individual case studies were sent to each teacher to check for accuracy before submission as well as to share findings with each teacher after they had donated so much of their time to the process. Teachers responded positively to these reports and described them as informative. No teacher required a change in the written analysis.

All digital files were securely stored on a password-protected computer and hard copies of video tapes will be kept in secure storage for five years after the conclusion of the study before being deleted or destroyed.

Validity, reliability, and trustworthiness

Qualitative research seeks to describe and make sense of dynamic and changing human behaviour through naturalistic methods. According to Merriam (2009), "research studies must be rigorously conducted; they need to present insights and conclusions that ring true to readers, practitioners, and other researchers" (p. 210). Validity and reliability within qualitative research ensure that the research is plausible, credible, and trustworthy (Johnson & Christensen, 2008). Within the current research, a number of strategies have been used to address issues of analytical trustworthiness including truth value, applicability, consistency, and neutrality as suggested by Lincoln

and Guba (1985). These strategies allow researchers to increase the rigor of their qualitative studies and permit readers to assess the value of the findings of qualitative research (Krefting, 1991).

As Yin (2009) suggests, a 'chain of evidence' was maintained throughout the research process in the current study so that an external observer is able to "trace the steps in either direction (from conclusions back to initial research questions or from questions to conclusions)" (p. 122). In addition, specific steps were taken over the course of the study to ensure the credibility, transferability, dependability, and confirmability of the findings (Lincoln & Guba, 1985) including: triangulating various data sources; member checking; providing rich, in-depth descriptions; and considering the researcher's perspective.

Triangulation

A variety of data sources were collected throughout the research to more fully understand each complex case study. While this was essential to a thorough understanding of the dynamics of each classroom case, it also served to triangulate the data (Johnson & Christensen, 2008; Yin, 2009). The use of multiple sources of data including interviews, observations, think alouds, focus groups, and artefacts strengthened the validity of this research as multiple interpretations were considered, compared, and consolidated into one comprehensive representation of each case.

Member checking

As previously described, member checks were conducted with participants throughout the research process in order to strengthen internal validity, or credibility (Merriam, 2009). During the data collection process, teacher participants were emailed transcripts from all interviews so they could verify that what they had said accurately portrayed their experiences and beliefs. In addition, case study findings were emailed when they were written to ensure that teacher participants could recognize their experiences in the researcher's interpretations.

Rich descriptions

Rich, thick descriptions of the setting, participants, and findings served to guarantee transferability (Merriam, 2009) and truth value (Krefting, 1991). According

to Krefting (1991), the researcher's job is one of representing those multiple realities revealed by informants as adequately as possible. Direct quotations from both teacher and student participants as well as descriptions of classroom activities modified from field notes ensure that "someone in a potential receiving context may access the similarity between them and...the study" (Lincoln & Guba, 1985, p. 125). Much care was taken to ensure that the detailed descriptions of case study settings and participants were supported by adequate evidence to ensure transferability and applicability (Krefting, 1991).

The researcher's perspective

An important factor to consider when critiquing the credibility, dependability, neutrality, and integrity of qualitative research is the perspective of the researcher through which the entire research process has been planned and carried out (Krefting, 1991; Merriam, 2009). This affects each step of the process including attention to particular pieces of literature during the planning process, the creation of research questions, the methods that are chosen to carry out the research, and the interpretations of data which become the research findings. In this section I explain my personal professional background and what led me to New Zealand to pursue the current research.

My tertiary training after high school included four years of practical instruction on how to teach elementary students. After graduating, I moved to Las Vegas, Nevada where I worked as an elementary teacher in a suburban area for three years. In 2002, I completed a Masters of Education degree which focused on preparing teachers to become technology coordinators at the primary and secondary levels. After seven years of teaching, I was asked to become the technology coordinator where I worked with administration and teachers to integrate technology into the curriculum, facilitated and conducted technology professional development for staff, and maintained the site technology plan.

Throughout my teaching career, I was interested in integrating technology into classroom instruction in a way that was meaningful for students and facilitated learning that would prepare students to become active members of their communities. While my time as a technology coordinator was rewarding, I became more and more

frustrated by some teachers' apparent reluctance to use digital technologies with their students and by other teachers' decisions to use digital tools only to support their teacher-centred practices. I became interested in finding out why teachers who did integrate technology used it in the way that they did. In addition, I wanted to learn about how students experienced activities that included digital technologies in a world where digital tools have permeated into every facet of life. As a result, I moved to New Zealand to pursue a PhD that would help me to understand these various phenomena, in part because of the outstanding reputation of the New Zealand educational system.

Throughout the process of completing this research, a number of factors have impacted on my ability to carry out the research. First, being an American has meant that I have had to learn about the intricacies of the New Zealand education system through my experiences during data collection and from document analysis rather than experiencing these as a practicing teacher. Additionally, I came to New Zealand without personal connections and contacts as I had in Las Vegas; therefore, participants were somewhat difficult to find as the study was fairly involved and did take a significant amount of their time.

As I have spent my working life as a practitioner, the research process was a new experience for me and has been challenging at times. I have spent considerable effort removing myself from the role of a technology coordinator (i.e., allowing problems to occur rather than offering technical assistance) and learning to observe the nuances of each situation from a distance. I decided to use CHAT as a theoretical framework early in the process because my personal experiences in the classroom have taught me that teachers are motivated by many different factors, and I feel that CHAT provides a way of explaining this. The entire process has resulted in a more in-depth understanding of the behaviour of teachers and students when digital technologies are integrated into classroom practices and I look forward to using this knowledge in my future professional life.

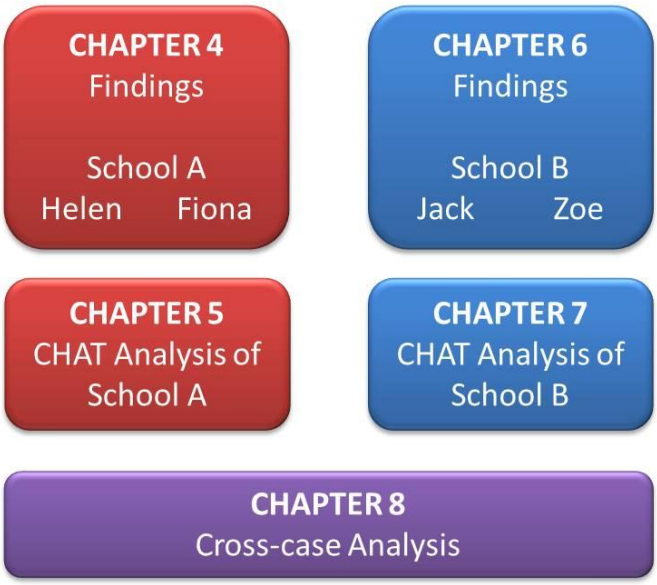
Presentation of results and analysis of data

The four case studies described in this thesis represent two schools (School A and B) and four teachers and their classroom environments (School A, Helen and Fiona; School B, Jack and Zoe) which were examined to understand teachers'

motivations for integrating digital technologies into their teaching practice, how they accomplished this, and what factors underpinned these decisions. In addition, this research investigated students' experiences as they participated in these teacher-planned lessons. Data collected during teacher interviews, classroom observations, student 'think alouds', and student focus groups provide detailed accounts and perspectives of the activity systems. Document analysis of national and school curriculum, school newsletters, and school websites also provided contextual information about the school environment in which each classroom case was situated. Understanding the environment within which a teacher operates is an essential part of unravelling the dynamics of each classroom setting as a unique activity system.

Presentation of the results and analyses are presented visually in Table 3.8 below. Chapters 4 and 6 will contain in-depth findings from School A and School B, respectively. These will be followed by Chapters 5 and 7 in which the findings from each school context and the teachers within that context are analysed through the CHAT framework. Within Chapters 4 and 6, the two school settings will be described prior to each of the individual classroom cases within that school. Physical characteristics of the school that have been identified as instrumental in each case will be discussed. In addition, aspects of the school environment such as school leadership, policy, and professional development will also be described.

Figure 3.3. Presentation of results and analysis of data



Following the school context, the details of the two classrooms within the school will be identified. First, attributes of the teachers and students as part of the classroom context will be discussed. The next section will focus on the following two research questions: *Why do teachers integrate digital technologies into their teaching practice?* and *How do teachers integrate digital technologies into their teaching practice?* Data collected primarily from teacher interviews revealed teachers' rationales for utilising technology, and both interviews and classroom observations provided details regarding how each teacher integrated digital technologies into their teaching practice.

The third section of each case will examine the research question: *What do students experience as they participate in lessons that integrate digital technologies?* Data from observations, 'think alouds', and student focus groups were analysed to offer insight into students' experiences with digital technologies in and out of the classroom and how they interacted with these tools within the school setting. A summary at the end of each case will synthesise the most significant features of the classroom case within the school context.

Each of the case studies will include a figure summarizing aspects of classroom lessons viewed during observations that align with each of the research questions. Aspects recorded in the figures include:

- teachers' **rationales** for using digital technologies within each lesson to inform Research Question 1;
- teachers' **methods** of integrating digital technologies within each lesson to inform Research Question 2;
- observations of **student experiences** as they worked with digital tools to inform Research Question 3; and
- environmental factors evident during lessons involving digital technologies that impacted on the lesson in an effort to uncover **underlying factors** within each system to inform Research Question 4.

Additionally, the same details of each teacher observation are included as Appendices K, L, M, and N.

Chapters 5 and 7 include a CHAT analysis of both the school environment and classroom environments within each school setting. Through this analysis, the activity

of each classroom teacher (the subject) within the environment in which the teacher was acting was examined to clarify the fourth research question: *What underlying processes within a system influence teachers' choice and use of digital technologies in their classrooms?* Within this section, tensions that occurred within each teacher's activity system are explored as well as transformative learning that transpired over the course of the school year as a result.

Finally, the key ideas which emerged from both the findings and the analysis of each case study were compared to identify similarities and differences between the four cases. Qualitative data from in-depth interviews and classroom observations were managed and systematically analysed using NVivo 9 to synthesise evidence around particular concepts or variables of interest that emerged. An analysis of the integrated data included examining each of the research questions across all four cases. Within Chapter 8, the synthesised findings for each of the research questions will be presented through the application of evidence that emerged from each of the case studies.

Chapter 4. Case Study Findings: School A

The purpose of this chapter is to report case study findings from the first two classroom cases located in School A. Within this chapter, the setting of School A will be described prior to each of the individual classroom cases (Helen and Fiona). A summary at the end of each case will synthesise the most significant features of the classroom case within the school context.

School A: School context

The intermediate school in which case studies A and B (Helen and Fiona, respectively) were situated was in a suburban area of New Zealand and was rated decile 8. The student population was just over 500; the school had 18 regular classes, each with one regular classroom teacher, and four specialist teachers. Each class was comprised of 27 to 31 students; half in each class were Year 7 students (aged 11-12) and half were Year 8 students (aged 12-13). As a general rule, students had the same teacher over their two-year period within the school. Classrooms were clustered in teams of three, according to student need, in which teachers and students worked together and supported each other throughout the year. As stated in a school newsletter written by the principal, "Changes we have made for the start of the year are the clustering of students with special abilities and students who learn in different ways (e.g., dyslexia)." Both of the classrooms participating in the study were in these 'special' clusters and their particular student populations will be described further in each classroom case.

School A had access to a variety of resources and technological tools intended for teacher and student use. Each teacher was provided with a laptop under the Ministry of Education TELA scheme (i.e., government subsidised laptops for teachers) which had been leased by the school for classroom as well as personal use. In addition, each classroom was equipped with a mounted data projector that could be connected to the teacher laptop; it had a special feature that allowed a static screen shot to be projected while the user worked on something else.

Each classroom had one desktop computer set up for student use. In addition, every cluster of three classrooms had access to 21 portable computers (a mix of

laptops and netbooks) and each team decided how the computers would be divided among them. In both of the classrooms observed in this study, the teachers had decided to divide the computers equally between each class, resulting in each classroom having seven portable computing devices at all times (three laptops and four netbooks) in addition to the teacher and desktop computers. Wireless Internet access was available throughout the school so students could connect to the school network and the Internet on all of the available computers.

Additional technology tools such as listening posts had been purchased for some teams and were shared by the three classrooms in each cluster. Fiona had access to and had used a listening post with her students from the beginning of the year while Helen received one about halfway through Term 2. Each class had exclusive access to at least one digital camera and had shared access to audio and video recorders. Some of the laptops also had the ability to record audio and video footage.

The school library had been equipped with a laptop and projector set up in the middle of the room for group demonstrations, and this facility was available to be checked out for blocks throughout the school day. There were also eight desktop computers in the library for student use; one master and three slaves had been set up in two opposite corners of the room. One set of headphones or speakers was connected to the master computer in each corner.

A number of online tools had been introduced to facilitate teaching and communication. A school website had been created with links and information for students, staff, and parents. Links to a variety of tools and pages were easily accessed including links to the school's Twitter page, classroom, group, and special event blogs, and a form where parents could register to receive school newsletters via email. There were also several links to a variety of skill-based mathematics resources and games. In addition, a number of resources could be found on the website itself including contact information for all staff, downloadable documents with literacy and numeracy activities, school policies, and all the school newsletters from the current school year. A link to a survey regarding student owned devices on the main page of the school website was an indication of an ongoing discussion about allowing students to bring their own digital devices to school and connecting them to the school network.

A link on the main page of the school website connected users to a simple sign-

on system that had been set up the previous year and once logged in, students could access a variety of online tools such as Google Apps, the school Learning Management System (LMS), their school email, and their e-portfolio system. Each teacher had set up a classroom blog where text, pictures, videos, and widgets could be posted.

Technical support at School A was generally provided by the Deputy Principals (DPs), outside contractors, or other teachers. Each DP was responsible for supporting a portion of the software used by the school and during one lesson in Helen's room, one of the DPs was observed assisting students who had problems logging into the e-portfolio system. When technical issues arose with the computers, the other DP was either called to classrooms to find a solution, or a student was sent to his office with the computer that he fixed when possible. Technical problems beyond his expertise were solved by contractors who came to the school one day each week. Teachers were also expected to complete some technical tasks themselves such as re-imaging their own laptops at the end of the previous year.

School leadership

The administration at the school was led by an established and well-known principal who had a particular interest in educational technology. During the year the study took place, the principal presented a paper regarding School A's use of digital technology at an international leadership conference. As previously mentioned, each of the two DPs was responsible for the support of certain aspects of technology use in the school and one of the DPs in particular was technically competent and was known as the "go-to guy" by the teachers in this study when technical issues arose. As a result, the use of digital technologies was strongly supported and encouraged by school leaders at this particular school which was evident during interviews, observations, and analysis of the school website. Fiona commented on the importance of this as she discussed her progress using digital technologies in the previous few years:

> I think it stems from having somebody at the top who is very proficient with ICT and very switched on. Because she [the principal] sort of drove a lot of it and helped us get where we are. (Fiona, Interview 3)

Helen reported that the school leaders worked with teachers at School A to decide how digital technology could best be used to support student learning at the

school. Specific goals regarding technology use were set and all teachers were expected to reach these goals in the time frame outlined. For example, all students were to set up their profile in the e-portfolio system by the fourth week of school. Other goals were not as specific, such as the expectation that classroom blogs should be updated 'regularly.' While the school administration was flexible with these dates when technical problems arose, Helen and Fiona were still very aware of these requirements and did their best to meet them.

> We've got...MyPortfolio as well, so we're kind of overwhelmed with this stuff that we're expected to do...we're very lucky to have the amount of computers that we have permanently in the classrooms, but they might have increased, but so have the demands of what we're expected to do. And it's very difficult balancing that. (Helen, Interview 5)

One way that the principal demonstrated leadership in the use of digital technologies was by communicating directly with parents as well as teachers through school newsletters which were posted to the school website as well as emailed to parents fortnightly. Through this forum, parents were referred to the school website and Twitter account, which was frequently updated by the principal, to retrieve school and community notices and class schedules. In addition, parents were encouraged to utilise email when they had questions or concerns and for administrative reasons such as reporting absences or updating emergency contact information. Finally, they were informed that each teacher had been instructed to email weekly updates of class happenings.

Policy

The New Zealand Curriculum is the key document that is mandated for teachers in New Zealand "to set the direction for student learning and to provide guidance for schools as they design and review their curriculum" (Ministry of Education, 2007, p. 6). This New Zealand Curriculum provides a degree of flexibility while retaining a focus on values, principles, key competencies, and pedagogy. It describes each content area expected to be covered (e.g., English, mathematics, the arts) over the duration of the child's time in school. This focus reflects an emphasis on the cognitive processes underlying the learning identified as the key competencies (thinking; using language, symbols, and texts; managing self; relating to others; and participating and

contributing) (Ministry of Education, 2007, pp. 12-13). One section of the curriculum which outlines effective pedagogical practices is followed by a page which explains briefly how the use of digital tools can support these approaches. A suggestion at the end of the excerpt states that "Schools should explore not only how ICT can supplement traditional ways of teaching but also how it can open up new and different ways of learning" (Ministry of Education, 2007, p. 36).

Each school is required to create their own school curriculum based on the New Zealand Curriculum. A team at School A had written an extensive curriculum document that was underpinned by four learning areas including globalisation, sustainability, citizenship, and enterprise. Each learning area was the focus for six months so that over the course of their two years at the school, every student would participate in each of the four units. The school mission, which was posted on the school website, was closely linked to the key competencies, and the document outlined how each of the content areas was to be taught in the context of each learning area. The use of digital technologies was specifically mentioned in terms of supporting connections and as a method of gathering evidence of progress and achievement through the use of e-portfolios, but otherwise was not referred to specifically as part of the teaching and learning at the school.

The year that this study took place national standards and reporting guidelines had been introduced in reading, writing, and mathematics for all students in Years 1 through 8. This was a significant policy and legislative change that meant that teachers would be responsible for reporting to parents in writing twice a year to inform them how their child was progressing in relation to National Standards, as well as reporting this information to the Ministry of Education (Ministry of Education, 2010). This process involves collecting assessment data and other evidence (e.g., observation, portfolios) and then setting goals for each learner (Ministry of Education, 2010). In addition to participating in this process, the students at School A took part in two standardised assessments at the beginning of the year: the electronic version of Assessment Tools for Teaching and Learning (e-asTTle) and the Progressive Achievement Tests (PAT). These were designed to provide information regarding student achievement in reading, mathematics, and writing that can be used to inform learning programmes.

Professional development

The school had recently been involved in the Information and Communication Technology Professional Development (ICT PD) cluster programme, in which a group of schools worked together towards incorporating digital technologies in the classroom to support teaching and learning. It was evident from teacher comments and observations around the school that momentum had been gained regarding the use of DTs over the course of the three year involvement in the programme and that there was a desire to keep a focus on the use of technology. On one wall of the staff lounge was a large concept map outlining the 2011 School Action plan. One part that had been posted was entitled "Engage students, families, and community members through..." and had connections to many nodes below including several which listed technology goals. Some of the goals listed were as follows:

- Embedding and expansion of the use of our cloud applications – GoogleApps, Mahara, LMS, Blogs, Wikieducator
- Continue to support national development in this area by hosting visiting schools and accepting national training opportunities
- ICT leaders (Mahara, LMS, Blogs, Wikieducation) assemble team and write action plan
- Staff using email to communicate with students in the same way they communicate with adults
- Teachers to set up group email lists for class and syndicate notices only giving paper copies to families without emails
- Greater digital connection with families and the wider community.

A few of the nodes on the concept map had a red checkmark attached to them, indicating that the particular goal had been met.

In addition to the ICT PD cluster, Helen and Fiona participated in another professional development programme during the school year of the study because they were both teaching students with special educational needs. It was discovered during the end of the year interview that Helen had been especially influenced by this training which she describes below:

> Kids that have a range of learning needs benefit from a specific way of instruction, and that is kind of non-traditional. It's visual, it's short instructions.

> It's doing rather than watching. It's exploring rather than being told. It's all of those things that are part of my style anyway. (Helen, Interview 6)

Case Study A: Helen

The classroom

Helen was in her third year of teaching when she agreed to take part in the study. She was originally from the United Kingdom where she had received an undergraduate degree before coming to New Zealand to complete the Graduate Diploma of Primary Teaching. She had been teaching at School A for two and a half years and remarked on more than one occasion how much she enjoyed working at the school.

Helen was a skilled user of a variety of software tools in her personal as well as working environments. She maintained a personal Facebook account and had created a profile on the school's e-portfolio system as part of her participation in the ICT PD cluster the previous year. She felt comfortable using the software tools implemented at the school that she had learned herself or in training and was keen to learn about new web-based tools that could be used with her students. This was especially evident on the class blog on which she had posted text, pictures, audio and video clips, and a variety of widgets that demonstrated class projects and participation. In addition, she reported at the end of the year that she had attended the ULearn conference, a national technology conference in October, and "That gave us a lot of ideas which we came back and shared. And that gave me some ideas on how to use ICT differently" (Interview 6).

While she was an accomplished technology user, Helen was often frustrated and was unable to fix technical issues when they occurred. She often called on the DP to fix these issues when he was available or decided not to use the devices that day as happened in the library during a lesson when four of the eight available computers were not working properly:

> We turned the master computer on and it just made this buzzing noise and we couldn't get anything else out of it. And there's nobody around to sort it out. I don't know; turned it off, turned it on again and that's the limit of my expertise. (Interview 1)

Helen's students included 16 males and 14 females which included equal numbers of Year 7 and Year 8 students. As previously mentioned, Helen was part of a

cluster which included students with special educational needs. Within the class there were four students with special educational needs including one highly functioning student with autism, two students with Attention Deficit Hyperactivity Disorder (ADHD), and one student with an auditory processing impairment. Helen's comments indicated that the makeup of the class sometimes made it difficult for her to use digital technology in the way that she would like:

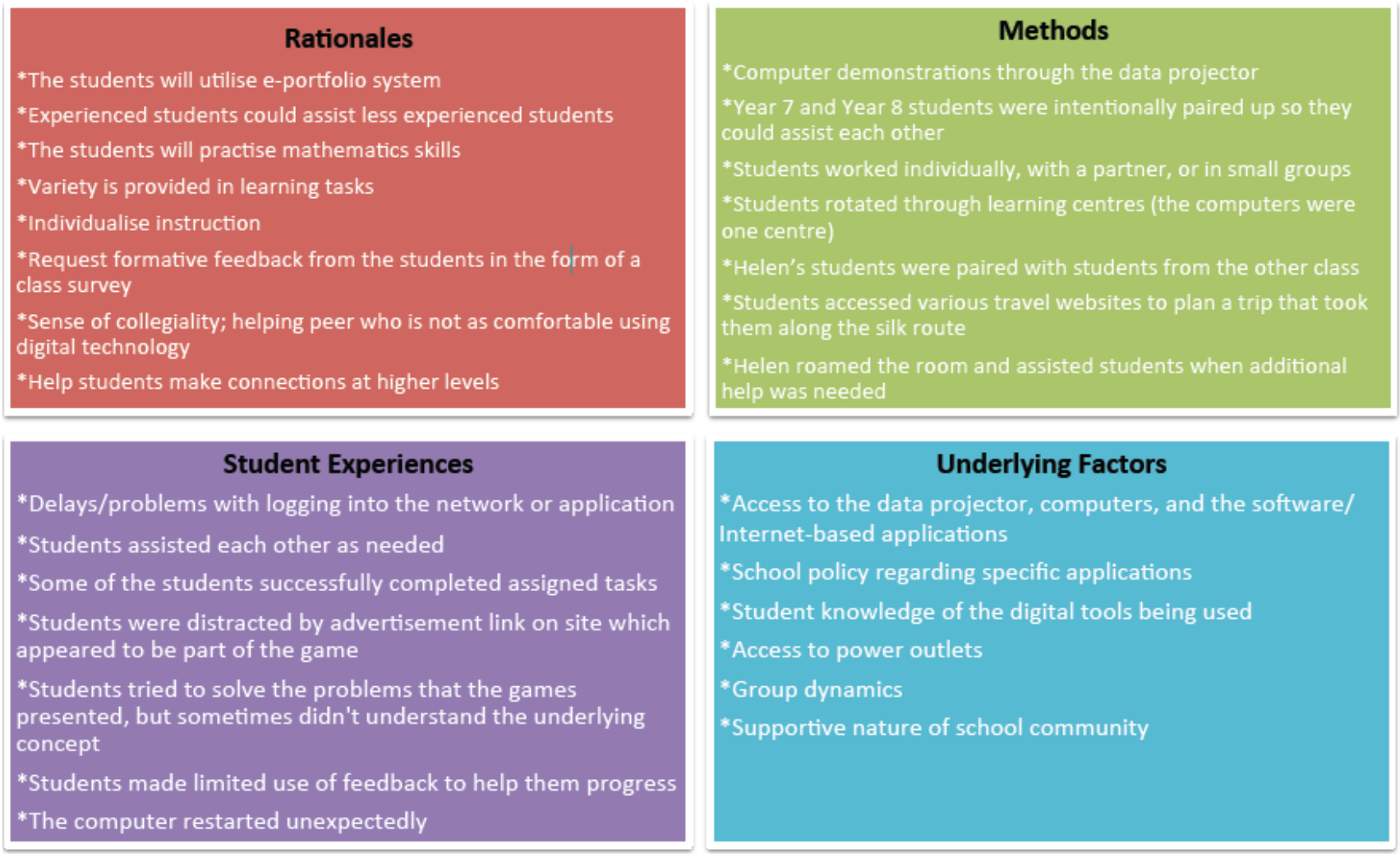
> Last year they would do individual things. This year I'm hoping to build up to WebQuests, but everything just seems to take longer in this class because of the special learning needs that I've got and their behavioural problems. (Interview 5)

The physical availability of technological tools and related features of the classroom had an impact on the way that Helen was able to use digital technologies with her students. There were eight computers plus her own personal laptop available for constant use, but as she had 30 students in her class, she needed to devise a plan for student use that was fair and reasonable for all students. In addition, power outlets were located in one specific area of the room, limiting student mobility when they were using the computers. Helen found that she had to plan ahead to charge the computers when she arrived in the morning or they would have to be plugged in while they were being used throughout the day.

Integration of digital technologies

Data collected during classroom observations and interviews suggest that digital technologies were used in Helen's classroom primarily to support her current pedagogical beliefs and practices. Key findings across all observations have been summarized in Figure 4.1 while details of each observation are located in Appendix K. Helen reported that she focused on best utilising online content as well as the collaborative nature of digital tools to build student skills in the key competencies and in specific content areas.

Figure 4.1. Key components across observations in Helen's classroom



Helen constructed her lesson plans on the school's LMS where they were available to students and parents to view at home. Here she had created a daily schedule for mathematics and literacy lessons where she listed objectives for different ability groups and could insert links to appropriate web-based games and activities to support the needs of each group. This was listed on the school website's "Procedures for Planning" page as an optional method of producing lesson plans and Helen preferred to complete her weekly schedule this way:

> The Ultranet [the school's LMS] is described as a virtual classroom. It's supposed to be a window into our classroom. I use it probably more than most people do. I do all my planning on there. I do it so that parents can see what is happening so that if students aren't here, they can tap in and see what we're doing and pick up our activities. (Interview 5)

However, she was unsure whether or not parents actually accessed the site.

Helen spent a considerable amount of time finding web-based games and activities that were appropriate for her students and suited their individual needs. She reported that she often searched the Internet to find not only interactive websites that the students could access themselves, but also for written documents that she could print off for the students. During observations, she was often observed rotating throughout the room while students were working in online environments to check their progress and to offer assistance when needed. She was aware that there was a balance between finding a game that the students enjoyed while also providing them with appropriate tools that enhanced their understanding. She expressed this when discussing an observed class activity in which her students worked in groups of four and had interacted with some estimation games that she had chosen for them to play:

> That was actually quite difficult for a lot of them...and I had to go around and explain to them exactly what they needed to do and give them some tips. But...that was really good because very often...if you let them choose their own level or choose their own game, then the focus is on what they're getting out of the game rather than making it challenging and what they're learning. (Interview 6)

Students were observed accessing interactive websites during the estimation activity and one other time over the duration of the study (see Appendix K). During the second observation, Helen had set up links to a variety of online mathematics games

on the timetable posted on the LMS which were accessible to the students. Students had been grouped by ability in mathematics and different links, which gave students practice with different skills, were listed under each group name. During this time, a pair of students worked together on a website where they were to find the greatest common factor for two numbers while another student worked on a subtraction exercise.

In previous years Helen had allowed students to complete individual research projects although she had not done so yet during the year that the study took place. She recalled that having access to digital technology such as laptops and the Internet had allowed students to work independently on projects without leaving the classroom:

> I had more independent learners last year and they would research things….I'd give them a scaffold and away they'd go, and they came up with some cracking presentations. (Interview 5)

Helen used her projector often throughout the day. She projected the daily schedule and the announcements each morning to help students focus on the day's objectives. During one observation, students worked in teams to answer estimation problems that were shown through the projector, allowing her to control the time that students saw each question. In addition, Helen demonstrated procedures through the data projector, such as how students were to login to their account through the school website. She felt that the visual nature of the data projector supported students' understanding of procedures and concepts. During class discussions, she would often do an impromptu search to find a YouTube video that illustrated a concept that students were having trouble understanding:

> We watch a lot of videos….like today we were doing puberty, and we were talking about IVF and stuff and it was really kind of difficult for them to grasp….And so I can just go straight on YouTube and find some information for them. And that's hugely helpful. (Interview 5)

Collaboration between students was highly valued in Helen's classroom. Students were generally placed in groups of two or three when they worked on a computer so that they could work on activities together. Helen used different methods of grouping students to ensure that they had experience working with a range of their

peers. During one activity she partnered students who were in the same ability group for mathematics. When students worked in the library to set up their e-portfolio profiles, Year 8 students were paired with Year 7 students. When students played estimation games in small groups, each group of students was chosen randomly. There was no evidence that collaborative skills were explicitly taught as students learnt in groups. In alignment with the key competency of relating to others, Helen felt that working cooperatively was an essential skill that students needed practise developing:

> It's sharing of knowledge amongst themselves and that's really good. It fosters really good teamwork, and work together so there's lots of those other skills that they have to have, cooperative skills. Those social skills that they have to get to grips with as well, and computers are quite a good way of doing that. (Interview 5)

Helen reported that one of the fundamental reasons for using digital technologies with her students was that it increased their engagement in classroom tasks. She felt that student learning improved when using digital technologies because they were more engaged in the activities:

> When they are on the computers, they're so engaged. I could read them a story and half of them will be asleep or dreaming about what they're having for that tea. But if I let them read it themselves on the computer in some kind of interactive way, then I've got a much higher percentage of kids being engaged with that activity. (Interview 5)

Communication tools such as email, the school LMS, and the class blog enabled Helen to connect with parents on a regular basis. She emailed parents a weekly newsletter which facilitated a direct line of contact where she could keep them informed of class activities and learning goals. She did this partially to comply with school policy, but also felt that doing so was beneficial:

> I know that the parents really appreciate that [weekly emails]. I do get a lot back about that in person and through reply emails. (Interview 5)

Besides corresponding directly with parents, Helen's students took turns posting to the class blog. At the beginning of the year, students posted an individual introduction about themselves and their families, and later on they posted class work such as poems they had written and pictures from class trips. While Helen was unsure whether or not students' parents accessed the blog, students were aware of a widget on the side of the blog that allowed them to see that people from around the world

were accessing the blog on a regular basis, which one student reported was “really cool” (Observation 3).

Helen also made use of digital tools to communicate with her students. She reported that she emailed students regularly; this was confirmed by one of the girls in the focus group who reported that she emailed Helen quite often. When she was away on an overseas trip, Helen contributed to the blog as a means of communicating with her students to remain in contact with them during her absence. Additionally, Helen was very concerned with students’ needs and concerns, so she used Google Docs to set up class surveys where the students could answer questions about their experiences in the classroom. After students were observed taking the survey, Helen discussed why these were important to her and why she preferred using technology to collect the information:

> I try and have a very open relationship with the students, and I find that they give you the most valuable feedback. If they are confident enough that you are asking for their opinions and you're going to treat them respectfully....I've just found...it helps them focus if they do it on the computer...But if they write it on paper, they know that they're handing that in to you. Whereas if they're doing something on the computer then they're sending it away, and...somehow they don't make that connection with the fact that you're going to be reading it. So I think it's easier for them to be honest. I definitely find it better and more valuable doing it on the computer. (Interview 2)

During the main phase of the study, Helen sometimes used specific digital tools primarily to comply with school guidelines regarding their use. The main example of this was the e-portfolio system used by the school. This tool had been piloted by one classroom the previous year and every teacher had set up their own profile and had contributed professional work and goals. During the year of the study all students were expected to use the e-portfolio. Helen had strong technical knowledge of the tool and could see value in using it for her own purposes. However, during three observations while using the e-portfolio system early in the school year, her stated objectives were task-oriented and in line with school policy regarding the tool (i.e., students must have completed their profiles by week 4). While she was keen to have her students participate in school-supported programmes, she struggled to use it in a way that aided student learning. However, she acknowledged that by being part of an innovative technological school, it might require her to participate without full

knowledge of the effects on student learning in the beginning in order to see the benefits later on:

> We're quite a progressive school and we're pioneering a lot of these things and you kind of have to develop them and try them and work out where they fit in. And I guess unless you're prepared to start down that road you'll never actually get anywhere. But maybe we're not far enough down the road to feel the benefits. (Interview 5)

Helen felt that it was crucial for students to have experience with digital tools in preparation for their participation in a 21st century world. When asked why they needed technical skills, she responded, “Because that’s the world of work. They have to be able to use a computer to get on in the world” (Interview 5). Helen’s perception was that the students came to her classroom with a great deal of experience with digital tools. Therefore, it was not necessarily that she taught them new skills, but rather that she provided them opportunities to practise using these tools in a variety of situations so that they would be prepared to use them when they had finished their formal schooling, particularly in their future jobs.

Helen met with the two other members of her syndicate twice a week to plan and share ideas. She reported that while the three team members did not particularly discuss how they used technology with their students, they often shared resources (e.g., worksheets and games that they had found online). This interaction provided additional tools that could be used with students in place of traditional materials.

Besides collaborating with her fellow teachers, Helen was observed sharing her time to assist others at the school that needed help. Because she was successful in using specific software tools such as the e-portfolio system, other teachers came to depend on her expertise. On at least two occasions during the study, Helen and her students took their laptops to other classrooms to support students as they logged on to the e-portfolio system and set up their profiles. In this way Helen shared her time and resources with other teachers who were working towards similar objectives.

During the follow-up visit during the fourth term, it was evident in student observations and the final teacher interview that Helen’s use of digital technology had evolved over the course of the year. She discussed this in her final interview during Term 4 when asked how her technology use had changed throughout the year:

> I think it's like anything, it kind of just evolves...I think I have consciously decided to do new things as I've found them. I'm using it less for regular rotations. Like...in mathematics, the group that's doing fractions, one of their rotations would be to go on and do fraction activities. And I've done those regularly last year and the first half of this year. And they've gone ok, but the kids will always choose the easiest thing that they can do. If they're given any option on level, they always go for the easy ones so they can get 100%. And then regularly kids will be on the wrong thing, or they'll go onto something and rather than sitting and figuring out how to do it, they'll just guess things. And I just…wasn't really sure that that's been very effective. So I've been trying to do different things with them. (Interview 6)

During this final interview Helen discussed how she had discovered a new way to use the e-portfolio in which she posted tasks that the students could access and work on in small groups. One activity that she had set up she referred to as the "Amazing Race" in which students worked with a partner to explore the silk route which tied into several curriculum areas. Using the e-portfolio system, Helen had set up a page with directions which students could copy to their own account. Students then worked on the task listed on the page which involved searching travel websites to find flights from New Zealand to different locations on the silk route. They were given a budget in New Zealand dollars and were required to use currency calculators to find out how much money they had in the currency of the country they were going so they could find a hotel room within their budget as well. Students recorded the flight information, currency exchange, and hotel location on the e-portfolio page. Helen explained why she thought this was a valuable activity for her students:

> I'm trying to get them, particularly the Year 7's, used to doing stuff on MyPortfolio. I'm trying to get them to work in groups, that's why I put people like [student name] with [student name]. They wouldn't normally work together. And I'm trying to get them to do those key competencies, the thinking, because some of the instructions were quite loose. (Interview 6)

To summarize, Helen integrated digital technologies into her classroom activities primarily to support her current beliefs and practices. She made use of software tools such as the LMS for planning and posting links to online activities for students and made use of the Internet to individualise instruction for all students. Students accessed interactive websites as an alternative way to practice mathematics and literacy skills and in Helen made use of the data projector often to provide a visual supplement to

her teaching. Students were often asked to collaborate when working with digital technologies and Helen often intentionally paired Year 7 students with a more knowledgeable Year 8 student so that students were able to assist one another while working. Digital tools were included in activities often in order to engage and motivate students. In addition, communication tools such as email and the class blog kept Helen connected with the students and their parents throughout the year. Some software tools, such as the e-portfolio system, did not naturally fit into Helen's pedagogical practices, but she designed activities around these technologies to comply with school policy. Generally, Helen believed that students needed to learn how to utilise digital tools in order to succeed in the 21st century.

Meetings with members of her syndicate provided a supportive environment where Helen and her colleagues were able to share new online resources they had discovered. Additionally, teachers at the school identified Helen as proficient with the e-portfolio and other tools; therefore they approached her for assistance when they experienced problems. Over the course of the year, Helen's use of digital technologies had evolved as she began to use familiar tools in new ways.

Student experiences with digital technologies

Four students from Helen's classroom who participated in a focus group reported that they had a range of experiences with digital technologies in and out of the classroom. These students reported that in the classroom they accessed the e-portfolio system, class blogs, and Internet-based games where they could "practise basic facts" (Focus group A) which was consistent with class observations. At the time of the focus group, which took place midway through Term 2, all four students expressed that they felt comfortable using technology in the classroom and accessed some of the tools such as the school email system and the class blog at home. Two of the four students in the focus group had personal Facebook accounts and a third expressed the desire to have one although her parents had not granted her permission to do so. The students reported using YouTube and game-based websites for entertainment purposes. During an observation, another student talked about her experiences creating a claymation video and uploading it to YouTube (Observation 1). She shared that she did not get much computer time at home as her three older

siblings were often checking their Facebook pages although she had her own iPod Touch that she could use.

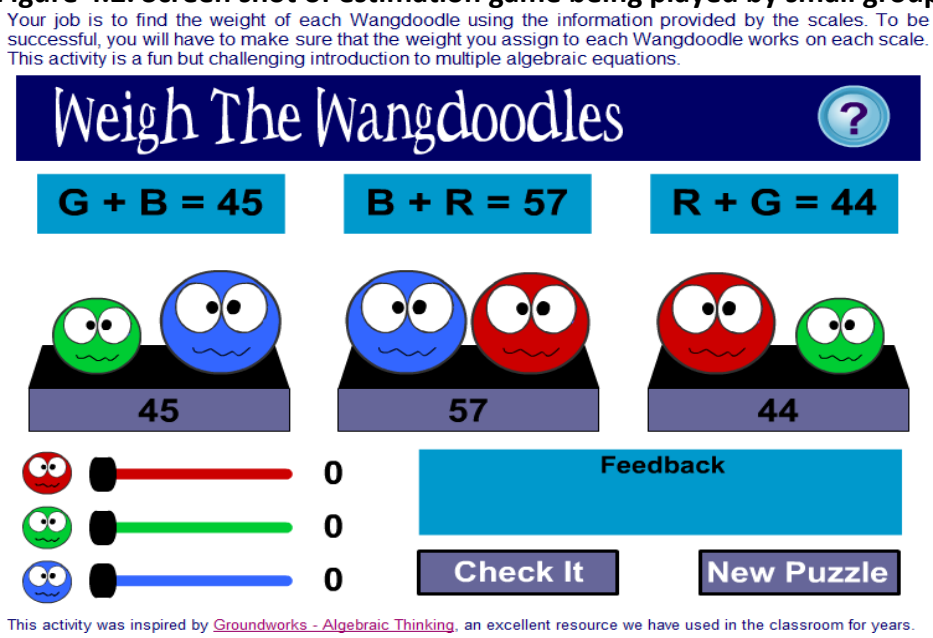
At the beginning of the year, observed students' actions suggested that they were learning how to negotiate the technical aspects of the hardware and software. During the first observed lesson, five students were observed having trouble remembering their passwords and logging into the computer and/or the e-portfolio site. During a lesson in which students accessed mathematics games through Internet-based sites, three students had some difficulty finding the links, then got distracted by an advertisement in the middle of the screen with a button labelled 'Play Game' that directed them away from the site (Observation 2). However, at the end of the year only one student was observed experiencing problems logging in, suggesting that students were more experienced using the tools commonly used in Helen's classroom.

As previously mentioned, Helen often planned activities in which students worked collaboratively. During every observation, students were observed asking for and receiving assistance from their peers as well as working together on a mutual task. During the focus group, one student remarked that she enjoyed group activities such as the estimation games because "It gets us working, getting interactive with the other students in class" (Focus group A). She later commented, "And the good thing about it is you're in a group, so people can help you." However, she later noted that this was not always successful "because every person has a different relationship with the kids in the class, so it depends on who's in your group. So if you get a person that you don't like, then sometimes it won't be as fun while you're working."

Observations and data collected from the focus group suggested that group dynamics impacted activity for some observed students when they worked collaboratively. As students answered estimation questions being projected on the data projector in groups of three or four, some group members were observed participating more than others. When discussing the activity, a student in the focus group reflected that "I had probably taken over because I like being in charge" (Focus group A). Later on, when three students worked together to solve a puzzle to earn points for their team, one student had played before and knew what to do to solve the puzzle, while the other two did not. The experienced student demonstrated to the other two students, and one of the other students began manipulating the game to

solve the puzzle. The two students who appeared to understand the game solved several of the problems together with the help of feedback from the game itself, earning several points for their team (see Figure 4.2). However, the third student in the group, although she was watching, was not actively participating. She revealed later, “I have no idea how they work it out” (Observation 5).

Figure 4.2. Screen shot of estimation game being played by small group

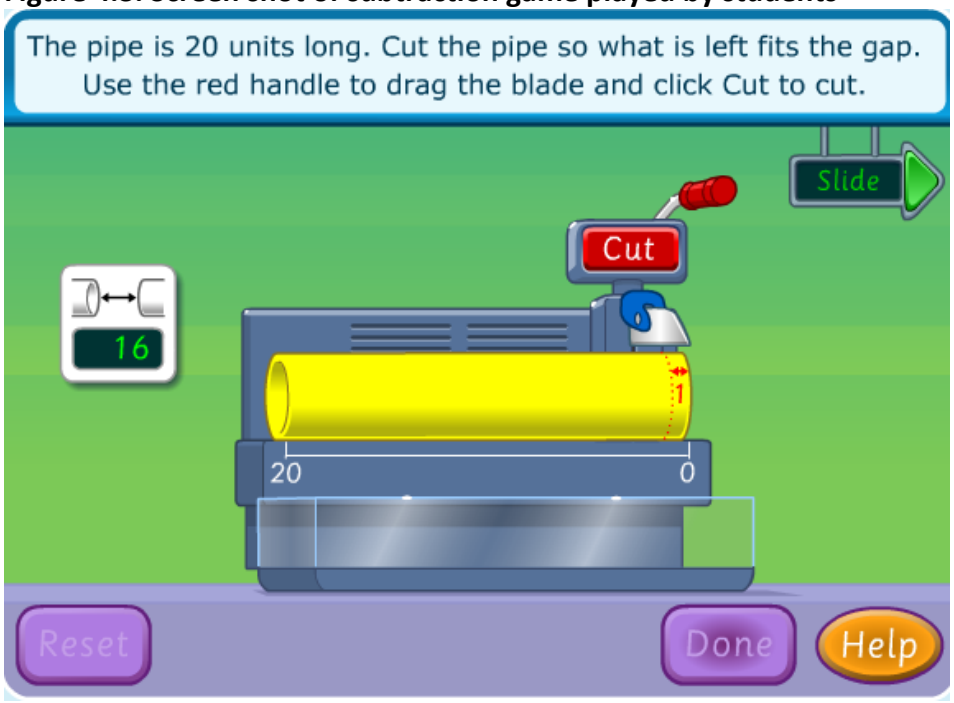


Helen often circulated through the room to provide guidance to students during observations. As students were observed setting up their e-portfolio profiles, four of them who were sitting together, each with their own computers, assisted each other in getting logged in to the computer and the e-portfolio site (Observation 3). However, once logged in, none of them appeared to know what to do next. At that point, Helen checked in on the students and was able to verbally guide them to the next step in setting up their profile. On another occasion, two girls who were playing an Internet-based mathematics game were answering questions about the greatest common factor for two numbers with 80% accuracy. However, when asked by the researcher how they were calculating the answer, they reported an inaccurate method (the difference between the smaller number and the larger number). Shortly after, Helen stopped to talk to the girls to check their progress; she asked them how they were progressing and asked them to verbalise their method of solving the problems. Upon

hearing their explanation she was able to identify their misconception and immediately provided students with direct instruction to correct their misunderstanding.

Helen often gave students limited directions because she believed that the students were experienced technology users and while they might have trouble, “There's always a kid sitting next to them that can do it, so they very much sort themselves out” (Interview 5). This was often the case as observations revealed. One student was observed manipulating a mathematics game which involved using subtraction skills to decide how to cut pieces of tube for a water slide to the proper length (see Figure 4.3). He was playing independently and was not able to answer correctly, so after a few minutes he went to get another student and together they realised what the game required and were able to play successfully (Observation 2). This teamwork was also apparent when Helen took her students to the neighbouring class to help them set up their e-portfolio profiles.

Figure 4.3. Screen shot of subtraction game played by students



At times technical issues affected the time that students were able to interact with online activities, which was one of Helen’s voiced concerns:

> The amount of time it takes them to log onto anything. Ten, 15 minutes at the start of a session. If you're doing a rotation and that rotation is half a block, 10-15 minutes is a third of that, and that's fairly disastrous. (Interview 6)

Besides the extended login time, one pair of students was observed experiencing unexpected restarts and another was unable to access the class blog due to Internet issues.

The four students in the focus group and two students who were questioned while they worked with on the class survey reported that they enjoyed communicating with the teacher through email and the class surveys. One student was asked what the survey was about during an observation and reported, “It’s about just to see how she’s doing and if the students feel like they’re fitting into the class” (Observation 3). Another student completing the survey commented that, “It’s good because we could have a better class” (Observation 3). One student in the focus group reported that she communicated with the teacher and other students via her school email often and three of the four students reported that they accessed the class blog at home and shared it with their parents.

Students in the focus group were asked if they would choose the computer over books, paper, and pencil if they were doing the same activity. In response, two students reported that they would choose the digital technology while the other two students said they would choose a more traditional form, although one added, “But I do like the computer as well” (Focus group A).

In conclusion, students from Helen’s class who participated in the focus group reported a range of experiences with digital technologies inside and out of the classroom. While some students were observed having technical issues early in the year, these were not as apparent during the final interview, suggesting that students had become more proficient at the technical aspects of the tool. Students who were observed and interviewed shared that group dynamics influenced work done collaboratively, although students were observed assisting each other on several occasions. Finally, Helen’s practice of roaming the classroom to check students’ progress allowed her to identify gaps in knowledge and provide guidance to students as they worked with digital technologies.

Case Study B: Fiona

The classroom

Fiona had been teaching at School A for 11 years when she volunteered to take part in the study. She had been a teacher for 23 years and believed that her role as a teacher had evolved over the course of her time teaching:

> I can no longer do what I used to do which was sit and read for ages from a book, write up something on the board, get them to copy it down, go away and learn it, and then give it back to me in a test. That's not what I do anymore, you know, which is what I was taught to do when I first went teaching. (Interview 3)

At the time of the study Fiona was comfortable using technology for a variety of purposes, although she reported that her familiarity with digital tools had developed significantly over the course of the previous three years. During an interview, she shared that her participation in the ICT PD cluster had been, "Absolutely key to learning what to do. Because when we first started all I'd ever done was word processing" (Interview 3). During the study, Fiona maintained her own personal Facebook account as well as her own account within the school's e-portfolio, emailed students and parents on a regular basis, and made frequent use of her computer and data projector. One wall in the classroom was covered with images that had been taken with the class digital camera as students participated in activities throughout the year.

While her knowledge of digital technology had grown over the previous few years, Fiona still recognised that she had much to learn and appreciated assistance offered by students, a teacher aide, other teachers, and the DPs. She reported that:

> I'm not technically minded enough to solve some of my own problems. I'll try, but if I can't, then I just go to other people because that's the way it goes. There are several of the staff who are really good who will help us out. (Interview 5)

The class culture reflected this as well and during class observations, Fiona was receptive to student help and insight regarding technical issues (i.e., one student informed her that the wireless on one of the laptops was switched off rather than broken).

Fiona's students included 14 males and 16 females; half of the students were Year 7 and half were Year 8. The class was part of one of the clusters at the school that

included students with special educational needs and three of her students in the room had special needs. The range of special needs included one student with a mild intellectual disability, three students with dyslexia, one student with Aspergers syndrome, and one student with ADHD (some students had more than one disability).

Fiona remarked that when it came to the technical expertise of her students, “there are various proficiencies in the classroom as well as various proficiencies of parents” (Interview 3). She reported that students shared their experiences early in the year and she consciously created “an atmosphere or climate in the classroom where they feel ok to ask and they feel ok to get help. And if I model, ‘I don't know what I'm doing here, can someone help me?’ then they don't feel so bad about asking that as well” (Interview 3). However, many of her students were quite skilled with technology and she encouraged them to share their knowledge with others.

There were many digital tools in the classroom that Fiona utilised on a regular basis. There were nine computers available in the classroom at all times including seven portable (netbook and laptop) computers, one desktop computer, and her TELA laptop which Fiona normally kept on her desk but let students use when needed. The TELA laptop was connected to a data projector that allowed Fiona to freeze and project a screen shot while she completed another task on her computer. Fiona also had access to a listening post that students were observed using several times throughout the study. The class was allocated a digital camera which was used during one class visit to take pictures for the class blog. Limited power outlets around the room dictated where children could sit while using the portable devices when they were not charged.

Integration of digital technologies

Fiona integrated digital technologies into her classroom practices in a variety of ways. As mentioned earlier, Fiona’s beliefs about teaching had changed over the previous years. While she had started her career teaching primarily through direct instruction, she no longer considered this to be the best method of supporting the learning of her students. This influenced the way that she used digital tools in her classroom. She recognised that digital technology could support her teaching practice, but was still negotiating exactly what her new role entailed:

> I don't actually like the word facilitator because I think it takes away the kind of relationship that you need to build up with kids this age. They don't learn just because there's a computer in front of them. They learn because you make it meaningful for them to do it. We'll use the technology, but it's always got to be used for something. There's got to be a purpose. No point in sticking a kid in front of a computer and expecting them to learn…So you still have to direct a lot of it, I think. (Interview 3)

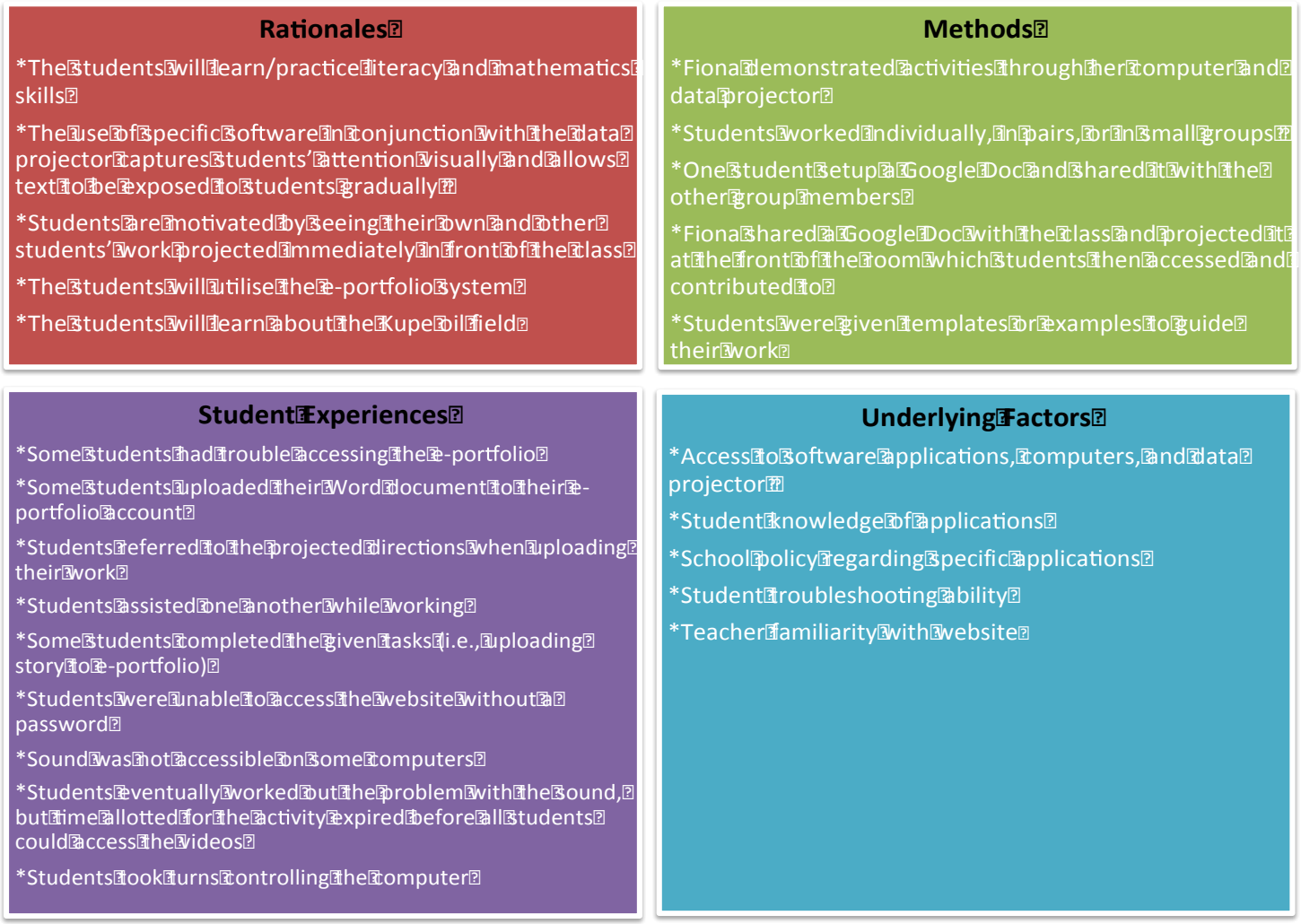
As a result, Fiona utilised digital tools both to support teacher-led lessons and student-centred activities. She utilised tools such as her TELA laptop and data projector during much of the school day in order to transfer many activities that she had previously done on the board to the computer and data projector. For example, she was observed leading whole class activities such as daily grammar lessons which she had typed in Microsoft Word or in Google Docs and projected to the front of the room (see Figure 4.4 and further details in Appendix L). Most students copied the exercise into their traditional paper notebooks, but the document could also be shared with students who had difficulty writing. During another teacher-led literacy lesson she used a reading programme called CSI that had been purchased by the school with built in tools that allowed her to reveal the screen a bit at a time and click on words to display definitions. During these teacher-led lessons, Fiona reported that she used digital tools to provide students with visual stimulation which she felt would motivate and engage the students in the activity.

Fiona also made use of digital technology to give students more choice and control over their own learning. She believed that when given a sense of agency, students were more engaged in the learning tasks:

> It's all part of them controlling what they can do. They're way more excited about using computers to research something of their own choice if they're given a framework where they know that they've got to come up with something. It's very motivating that they know that they can use a computer to find out for themselves. It's not just stuff that's given to them by their teacher. (Interview 3)

When teaching in this way, Fiona believed that students needed support such as a template or framework to follow. For example, during a French lesson she showed students a PowerPoint which featured characters from The Simpsons television show along with the French word for his or her position in the family (e.g., Bart, brother).

Figure 4.4. Key components across observations in Fiona's classroom



She posted the PowerPoint online and told the students that they could use the template to create a PowerPoint with members of their own family as an optional homework activity. In response, several students created their own presentations and were observed showing them to the class. One student in the focus group who did not have PowerPoint at home reported that she had completed the assignment in a Word document.

When engaging in research projects in which they learnt content on their own, students were encouraged to use different methods of organising and presenting their information. For example, Fiona reported that she had assigned students a project in which they compared New Zealand culture to the culture of another country and were permitted to present what they had learnt in any form such as a PowerPoint presentation or a movie that they had created in a programme such as Windows Movie Maker. She was comfortable allowing students to utilise tools that she was unfamiliar with herself and encouraged them to help each other learn how to use new digital tools. Through this use of technology she worked to instil a sense of agency in her students, as her opinion was that, “You've got 29 other teachers in the class. And that's what you say to them” (Interview 3).

Fiona believed that digital technologies could benefit those who learnt in different ways or had learning disabilities. Fiona had encouraged the parents of Michael (pseudonym), a student with dyslexia and ADHD and who gave informed consent for the study, to purchase a laptop for him to use at school which he used during most activities and was connected to the Internet through the school’s wireless capabilities. Michael used his laptop frequently by the second term of the school year. Fiona was observed sharing documents such as the daily grammar activity with him on Google Docs so he could complete the activity without having to copy from the board as his dyslexia often made it physically difficult for him to write. She explained that Michael was able to participate in class activities and even to go beyond her expectations when he used his laptop:

> The other day, for example, when we did a statistics graph, I was able to say to him, right, now you've taken your tally chart information, now we need to put that into a graph. So I just went away from him and left him with his computer. I said, let's just see whether he can find something. And I turned around 5 minutes later and he had it all done there on a pie graph. (Interview 3)

During literacy activities, Fiona believed that having his own laptop allowed Michael to focus on the content of his work rather than the mechanics of writing. She encouraged him to use the spelling function and practise his keyboarding skills using a software programme that helped him learn how to touch type.

Digital tools were used by Fiona to individualise instruction for each of her students. During the first term, she was trialling Mathletics, a mathematics website, with five of her students that allowed her to choose specific activities for each student that targeted skills she knew they had not mastered. Fiona also utilised informational printouts for each student that were created from the results of standardised mathematics and literacy tests which she could use to identify skills that students needed additional help with:

> Online assessments such as e-asTTLe, and PATs give you detailed information for next steps…it's all very precise. So you get that information and it's handy because it helps you as a teacher give them their next steps. And I like that because I think that's how they make progress; if they know where they've gone wrong, they know what they've got to do. (Interview 3)

Internet-based tools such as Google Docs allowed Fiona to provide immediate feedback to students as they worked. She would often set up a Google Doc and share it with her students who would all type in their responses as the document was being projected at the front of the room. Fiona felt that it was beneficial for students to see each other's work and at the end of the lesson would read through students' responses at the front of the room, correcting the grammatical and spelling errors. She also made use of online games where students could practise mathematics or literacy skills and were given immediate feedback on their responses. In addition, Fiona felt that email allowed her to respond to students' questions and work more quickly than if she were to only mark work that they completed in their assignment books.

Fiona believed that her students needed to be visually stimulated because of the environment in which they were developing:

> I just think that if the kids are so much part of a visual world, they don't have the same facility, like somebody like me who did not grow up even with a television....These kids don't sit down with a book and just read it. They wait to look at a movie and they get the information that way. Or they Google something, or they're on YouTube, or they're looking at their Facebook, social

> networking sites, you know….So I think that you have to recognise that that's their primary window on the world. (Interview 3)

As a result, she used the data projector during a large portion of the school day to capture students' attention and to keep them engaged. Her perception was that this allowed her to meet the needs of the learners while still teaching in a way in which she was comfortable:

> If you start off with a whole class focus using a computer, after a while the kids are engaged because it's up there on the screen because they're all visual learners these days, you know. They're used to looking at something to get information from it, so it kind of focuses them in on that. (Interview 1)

Fiona believed that the students in her class were interacting with digital technology outside of the classroom and that she could engage students and make activities more relevant for them through the use of technology:

> If you're an older teacher like me, you have to be relevant to the kids. If you don't, if they don't see you as relevant to their world, they don't necessarily respect the person in front of them...What they respect is your attempts to enter into their world with them. And I think, and then you pull them into yours. They don't realize it, but you're sucking them in! You're going to learn! You don't know this, but you're learning! (Interview 3)

As a result, she believed that part of her job was teaching students how to use these tools effectively. She relied on the more experienced Year 8 students that had been in her class the previous year to teach the Year 7 students how to use some of the digital tools she knew they were familiar with. For example, during one observation Fiona directed a pair of students (one Year 7 and one Year 8) to take pictures of each student with the digital camera that could later be used in class projects. Later on, the Year 8 student was observed showing the Year 7 student how to load the pictures onto the computer and then how to print them. On another occasion, Fiona was observed explicitly showing the students how she was accessing files from her computer and where to save files in the school server before launching into the main part of the lesson. She reported later that day that these little bits of instruction helped student build their technical skills.

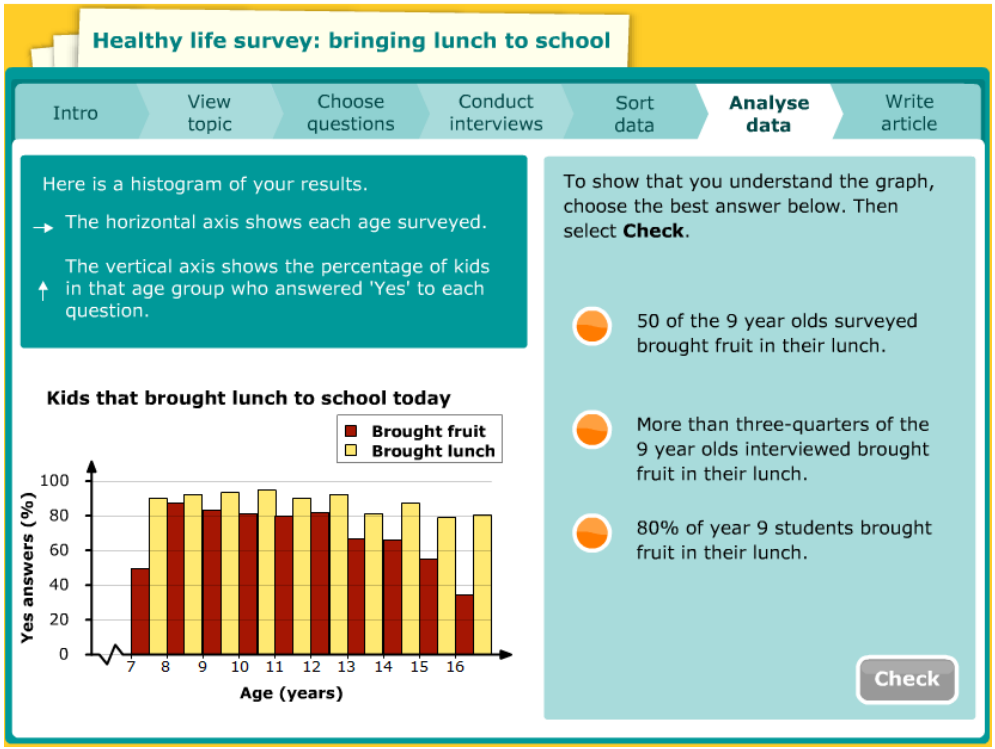
Fiona believed that it was important that students were taught basic literacy and mathematics skills. As a result, she integrated digital technologies into teacher-led

skill-based lessons and gave students time to access Internet-based sites that provided opportunities for them to practise specific skills. This was done through the use of Internet-based programmes such as Google Docs as well as online mathematics and literacy activities. During one observed lesson, Fiona set up a document in Google Docs, shared it with students, and projected it at the front of the room. Each group of four to five students were given one netbook or laptop to share between them. During the first part of the lesson, students identified strong verbs in the document by taking turns highlighting them in a paragraph within the document as the rest of the class watched. Then students rewrote phrases within their groups to include strong verbs and typed them at the bottom of the document. One example was demonstrated by a group who rewrote 'a lion stalking his prey' as 'the lion crouched down low, eyeing his prey suspiciously'.

Students often had time during mathematics rotations to interact with an Internet-based website designed to give them practice with a skill. On one occasion some students were observed using a learning object on the Ministry of Education website where they were interpreting data and reading graphs (see Figure 4.5). When Fiona used websites such as this, she provided a link on the mathematics timetable in the school LMS and demonstrated to students how to interact with the activity before they accessed it themselves.

Collaboration was an important aspect of Fiona's teaching, and she reported that digital technology promoted interaction between her students in a variety of ways. She valued activities in which students worked together and she reported that "if they get a chance to see other people's up on the screen, then they get a few ideas for themselves as well. So it's very motivating for them" (Interview 2). Fiona often asked students to work in pairs or small groups with the expectation that they would be able to help each other when they had problems as well as complete activities together. Applications such as Google Docs were used to facilitate collaboration when students were across the room from one another or outside of the classroom. Fiona herself collaborated with the other two members of her syndicate on a regular basis where she reported that they discussed methods of integrating digital technologies into their lessons.

Figure 4.5. Screen shot of "Healthy Life Survey" learning object



Fiona recognised the potential of digital technologies to facilitate communication with her students and their parents. She checked her school email at home to provide feedback to students regarding their homework and to inform parents of their child's progress. The class blog featured pictures and information about class activities as well as links to student work in Google Docs. She emailed parents a class newsletter weekly to inform them of what had been happening in the classroom. In addition, Fiona completed her weekly plans in the school LMS which could be accessed by students and parents outside of school:

> That's [the school LMS] what the parents access in order to see what's happening in the school. So we have to use it and so I embed my planning in it so the kids can see what we're doing tomorrow… and I've hyperlinked some of the work to that so that they can see what work we need to do and they can have a head start on it if they want to. (Interview 3)

During the year Fiona took sick leave and was not able to teach for six weeks. However, she reported during her final interview at the end of the year that she was still able to be involved in classroom activities by emailing her students and completing her plans in the school LMS while she was away.

There were some occasions when Fiona used digital technologies primarily to comply with school policy. For example, when interviewed during Term 1, Fiona reported that she found the e-portfolio system as a useful repository for student work, but felt that it was somewhat complicated and time-consuming for the students to use. Instead, she preferred that they emailed their assignments directly to her or to upload and share them with Google Docs. However, she was aware of school policy requiring student use of the e-portfolio system, so she persisted in ensuring that she met these requests. During one observation Fiona provided students the time to type stories that had previously been written in their assignment books in order to upload it to their e-portfolios. By doing this, she enabled the students to meet the requirement of uploading work by the set date. On one occasion, Fiona reported that Helen and her class had come over to help students with the e-portfolio system.

Later in the year, Fiona continued using the e-portfolio system and reported that her syndicate had been working with the principal to trial methods of using it to benefit student learning. The students had been creating presentations in a web-based tool called Prezi and then embedding links to the presentations in their e-portfolios. The principal had worked with the students and the teachers to develop a system in which students would be able to consciously evaluate the level of their thinking:

> We've been trying to see how we can use it [the e-portfolio] in a variety of ways for the kids to demonstrate the level that they've reached with their thinking...like what is within the Prezi that demonstrates that you're using more sophisticated thought. (Interview 5)

She was still frustrated with the technical issues she and her students encountered when using the e-portfolio, but it was evident that Fiona was attempting to use it to benefit students' learning rather than just to be sure that she was fulfilling school policy.

There were times when Fiona was discouraged when lessons involving technology did not go as planned. She reported numerous issues such as unreliable wireless access, problems with links on the school LMS, and changes that had made it difficult uploading pictures to the class blog. She discussed one difficulty that she had encountered when integrating an interactive website into her mathematics rotations:

> The size of the screen for the Lenovos [netbooks] doesn't bring up some of the maths games…And that's an issue that we just can't do anything about I don't think...this morning it completely wrecked my mathematics lesson because I had my group who were going to go on computers and I had my group I needed to work with and the group I wanted to give an explanation to. And instead I was dealing with the kids with the Lenovos...and it was just an awful, awful lesson as a result. (Interview 1)

While problems such as this were common and sometimes led to Fiona having to adjust her plans, they did not deter her from using digital technology. In fact, she reported at the end of the year that the troubles had persisted, but as she and the students had become more familiar with specific tools such as the e-portfolio, she had been utilising it more.

To review, Fiona reported that her pedagogical beliefs and practices had changed over the previous few years and that she was still navigating her role in the classroom. In some ways, she made use of digital technologies primarily to enhance teacher-led lessons, as when she used the data projector and Google Docs to visually stimulate students and promote interactivity. However, she also began promoting a sense of agency in her students by allowing them to have some choice and control in some learning activities that included digital technologies. Fiona believed that she was better able to provide immediate feedback to students through email and shared documents and she was able to individualise instruction through detailed testing results and websites such as Mathletics where she could assign specific tasks to students. Interactive websites were used by students to practice basic skills on a regular basis. At times, Fiona included digital technologies in her lessons primarily because she felt that they were more motivating and engaging for students than traditional materials. She encouraged the parents of some of her students with special educational needs to provide a personal computer for their children because Fiona believed that these students would especially benefit from having constant access to these tools.

Students in Fiona's classroom often worked collaboratively when using digital technologies in the classroom. At time, Fiona asked students to assist each other, but only when she was confident that the assistant was skilled with the tool. Email and the class blog were used to facilitate communication with both students and parents. Specific tools, such as the e-portfolio system, were used primarily in compliance with

school policy, but by the end of the year Fiona was taking steps to integrate this into her classroom practices more effectively. Finally, technical issues were frustrating for Fiona, although she experienced these less as she became more familiar with the hardware and software within her classroom.

Student experiences with digital technologies

Three students who participated in a student focus group reported that they used digital technologies in a variety of ways in the classroom and at home. All three students described uses of digital technology in the classroom which were consistent with teacher interviews and observations. The students reported using digital tools such as Google Docs, the e-portfolio system, the class blog, Internet-based sites where they practiced mathematics and literacy skills, researching information on the Internet, and presenting their findings through software such as PowerPoint. At the time of the focus group interview in Term 2, the three students stated that they were all familiar with tools such as Google Docs and could access it at home successfully in order to complete homework and two of the three accessed interactive websites at home such as Mathletics where they could practice mathematics skills. In addition, two of the students had their own personal Facebook account and reported that they uploaded their own pictures onto the site. All three of the students played Internet-based games and communicated with others via email. Their comments indicated that they were capable users of technology and one student reported, “I sort of help my mum because she doesn’t really know what to do on the computer” (Focus group B).

During the whole class lesson in which students practised writing with descriptive verbs, 20 of the 30 students in the class contributed at least one sentence to the shared Google Doc and all students had hand-written at least one sentence in their notebooks. While students were working on their sentences, one student shared that, “I like to see other people’s work up on the screen because it gives me some ideas” (Observation 4). Additionally, when asked if it was helpful that Fiona went through and corrected the grammar in each of the sentences at the end of the lesson, one student in the focus group said, “I reckon it is sometimes because otherwise if they don’t know, then it will probably just stay like that and if we had to print it out it

would come out wrong. And if it was a good copy it wouldn't be very good" (Focus group B).

Two students working together on an Internet-based mathematics digital learning object were able to manipulate the site effectively and were observed asking for help and assisting each other when they were unsure about what to do. They took turns controlling the mouse and progressed through the activity successfully, reading and answering each question. The two students reported that they knew what to do because Fiona had shown them the website the previous day (Observation 3). Students' desks were placed in groups of four to six and during most activities conversation could be heard throughout the room. Many of these discussions involved one student asking another for assistance, such as when students had typed a story into a Word document and were uploading it to the e-portfolio site. Students were able to access directions that Fiona projected at the front of the room throughout the activity (Observation 5). However, one girl who was ready to upload her work first referred to the board and then asked the person beside her for help when she encountered an issue; eventually she was able to upload her document.

At times, technical issues prevented some students from using digital tools as intended. For example, eight students encountered difficulties when they were sent to the library to access the virtual field trip with the teacher's aide. A teacher password was needed to access the site, so the students had to wait for Fiona to come down and enter her password before they could access the informational videos (Observation 6). Then, the sound on the videos did not appear to be functioning. At that point, two of Fiona's students began troubleshooting and finally realised that because each set of four computers included one master and three slaves, only the master had a sound output. They solved this by connecting the headphones to the master computer and began to listen to the video one at a time, but by that stage their time in the library had expired and the students returned to the room after only one of them had listened to the entire video.

Fiona's students demonstrated their learning through presentations and reports that were often completed through the Internet and presentation software; this was observed during classroom visits and verified by students in the focus group. The three students in the focus group reported that they had recently done research on

globalisation and its effects and one girl was in the process of typing up an explanation on non-renewable and renewable energy. One student also explained why she enjoyed seeing other students' presentations, such as the French lesson in which students used French terms to describe their own families:

> It's quite good because we get to know some things about the people, like if they have pets...and other things like that. (Focus group B)

During an observation in Term 4, eight students successfully presented PowerPoint or Prezi presentations with in-depth information about their experiences spending a day at work with a member of the community.

Fiona believed that her students with special educational needs were able to make significant progress through the use of digital technology which was supported with evidence from observations. Michael, the boy with his own laptop, was observed completing the daily grammar activity in a shared document while Fiona monitored his progress on her own computer across the room. He also began sharing information through digital movies that he had created such as one which compared Samoan and New Zealand culture as well as an instructional video on how to make croissants. During Term 2, after Michael had used the computer for about a month in the classroom, he shared with the researcher that he enjoyed creating computer-based projects where he could share information with Fiona and other members of the class. In addition, Fiona reported that she had noticed a significant increase in Michael's writing since he had been using the laptop.

The three students in the focus group reported that they enjoyed classroom activities that included digital tools, although these were different from their regular uses at home. One student explained the difference between her use of computers at home and at school:

> Well, I kind of just play games and everything [at home]...at home for me it's more fun than learning. But at school it's more like work. You have to type things up, check those photo messages on your Gmail, and like, MyPortfolio things. So it's kind of more like work at school and then fun stuff at home. But...with the school websites that we can go on, it's like also learning more as well at home. (Focus group B)

While she initially expressed that school use of technology was more like work rather than fun, this student differentiated between home and school learning through the

same activity, and by doing so, identified learning at school as work. However, she then went on to discuss how much she enjoyed the Mathletics website where she was able to compete against people from all over the world in mathematics games. These comments suggest that lessons that utilised digital tools in Fiona's classroom provided this student with experiences and technical knowledge that she may not have gained outside the classroom but would very likely be useful to her in the future.

Finally, some students were involved in the decision-making process regarding technology use at the school. One student in the focus group was a member of the student council at School A and reported that the group had recently had discussions with school leaders about the pros and cons of bringing their own digital devices to school. She came across as confident and well-informed as she explained the process and discussed the feedback that the students had given to the principal:

> What we were saying was that there were some guidelines for it so that the teachers have to lock it up during morning tea and lunchtime and stuff. And they're our responsibility so if anything happens, we have to take responsibility for it, but if it's locked up and it gets stolen, then they take responsibility…And it doesn't change anything at home, so all it does is add an app to it and check if there's any viruses…so you can get onto anything at school like you would on the computers. But then if you go home, everything's back to normal. So with the blocked sites that we can't get onto at school, we can when we get home. (Focus group B)

Focus group students from Fiona's classroom reported that they used digital technologies for a number of reasons and distinguished between home and school use. During classroom observations, students participated in activities which included digital tools and were observed contributing work to shared documents. In addition, observed students worked together successfully during collaborative activities. Students in the focus group reported that they were able to demonstrate their learning through presentations and reports that included digital technologies. While technical issues sometimes prevented students from using digital tools in the way that Fiona had anticipated, at times they willingly engaged in troubleshooting activities to attempt to solve the issue.

Chapter 5. CHAT Analysis of School A

The classroom case studies described in the previous chapter reflect the varied learning experiences of teachers and students in two classrooms within one intermediate school context. In the current chapter, these cases will be analysed and interpreted through the lens of second generation Activity Theory, also known as Cultural Historical Activity Theory (CHAT). As discussed in the methodology chapter, CHAT provides a framework that facilitates the examination of the dynamic interplays in each classroom case within the wider school context. In addition, CHAT offers a method of exploring the dynamic structure and process of activity in the context of the complex setting within which it is situated and takes into account the role of cultural artefacts which have been introduced into the system. Finally, CHAT offers a lens through which problems or issues between components of the system can be examined.

Through the CHAT analysis, the current study examines the activity of each classroom teacher (the subject) within the environment in which the teacher was acting, enabling specific elements to be discerned. Within School A, all teacher-led activity was directed toward the ultimate goal of increasing student learning and each teacher's motive in incorporating digital technologies into his or her teaching practice was in part to contribute to this objective. Such activity was directed towards the students as the primary focus. The activity system of School A highlights teachers' own pedagogical and content knowledge and beliefs as well as their technical expertise and experiences which were directed towards increasing students' use of digital technologies; the study shows that these are key factors in determining how they integrated digital technologies into their teaching practice. Furthermore, efforts to include digital technologies was influenced by cultural artefacts such as access to and characteristics of hardware and software, technical support, and physical attributes of the classroom such as the location of power outlets. Members of the community such as other teachers, the principal, students' parents, and teacher aides all shared the same goal of improving student learning and in some cases worked alongside the teacher to achieve these goals. Additionally, the CHAT analysis shows how teachers are influenced by the New Zealand Curriculum and policies which they consider when designing classroom lessons. The division of labour considers the different roles that

members of the community fulfil in working toward the object. Finally, student attributes that influenced the activity when digital technologies were used included their own technical knowledge and experiences as well as their beliefs and expectations regarding appropriate use of digital tools within the school environment.

The analysis of each case study within the CHAT framework in this chapter addresses the research question: *What underlying processes within a system influence teacher's choice and use of digital technologies in their classroom?* First, a concise description of the school context will be explored using a CHAT framework. This will be followed by an analysis of each classroom case which will include a description of the contradictions and tensions to highlight potential issues within the system and an analysis of each of the factors that impacted on each classroom teacher's motivations for integrating digital technologies into classroom activities. Within each case analysis, factors which influenced each participant's activity will be organised and presented in a table. This analysis will provide an informed understanding of how all of these aspects underpinned teachers' decisions to incorporate digital technology within their learning environments as well as the processes that occurred as they did so. These steps will be repeated in Chapter 7 in relation to School B.

School A

All activity at School A was focused toward the ultimate goal of student learning, and there was a strong emphasis on the inclusion of digital technologies to assist in meeting this objective. Both Helen and Fiona demonstrated a commitment to incorporating digital tools within their classroom activities; while some of their rationales for doing this aligned with their own beliefs, characteristics of the school culture also affected these decisions. School leadership, recent participation in the Information and Communication Professional Development (ICT PD) programme, school and national policies and curriculum, and teacher roles and responsibilities within their community were all significant aspects of the sociocultural context that acted on Helen and Fiona as they worked within their own classrooms. This section will describe each of these factors and their historical development within the school.

School leadership headed by the principal of School A simultaneously provided support and exerted pressure on teachers to integrate digital technologies in their

regular routines to supplement traditional classroom teaching. The principal's personal involvement in the use of digital tools at the school level such as posting notices on the school Twitter feed, sending school newsletters to parents via email, and presenting at an international leadership conference on the school's use of technology served to demonstrate technical ability as well as communicate expectations for use. Additionally, the allocation of one technology-related area to each of the Deputy Principals (DPs) ensured that all members of the administration were actively involved in the integration process and that they provided a considerable support system for teachers at the school. This also served to communicate the importance of making use of digital tools from the administration as a united front as opposed to coming chiefly from the principal. Later in the year the principal's active involvement with Fiona's team in developing effective uses for the e-portfolio system revealed awareness that teachers required assistance in making the best use of the tool and commitment to ensuring that they received this help. Both Helen and Fiona's comments throughout the study confirmed that they perceived these activities both as essential to the evolution of the integration process but also as additional directives to incorporate digital technologies within their classroom activities.

An important factor contributing to the historical evolution of the use of digital technologies at School A was the participation in the ICT PD cluster the three years prior to the study. Over the course of the programme, the school staff had been introduced to several new digital tools and both Helen and Fiona reported that their technical expertise had developed as a result of participating. Evidence at the school indicated that although the programme had officially finished, effort was being made to ensure that skills learnt during the process were not lost and forgotten. For example, in the ICT PD cluster the year preceding the study, teachers had created and maintained a personal profile on the e-portfolio system; the following year when the study took place, all students were expected to use the tool. Involvement in the professional development meant that the use of digital tools had become a priority at the school, and the activity of the school administration as described in the previous paragraph demonstrates that they aimed to maintain a strong focus at the school level.

Over the course of the three-year participation in the ICT PD programme, considerable time and money had been invested in purchasing a range of hardware

and software, conveying commitment from school leadership to provide adequate resources as well as verbal support. While these tools enabled Helen and Fiona to make use of digital technologies in their classroom practices more often, both teachers reported that as they received more tools, the expectations of what they were to do with these increased. This was in part due to the creation of a number of school policies and procedures around the use of digital tools that served to ensure that the digital technologies that had been purchased were used integrated into classroom activities.

A number of policies at School A guided the use of digital technologies in the classrooms of both teacher participants at the school. Specific guidelines regarding specific tools that had been introduced during the ICT PD cluster such as the e-portfolio system and classroom blogs set expectations for their use that may or may not have aligned with learning objectives in Helen and Fiona's classroom. However, the teachers were conscious of the fact that regardless of whether they were able to integrate these into their classroom activities in a meaningful way, they and their students were required to use them. Additionally, Helen's acknowledgment that she had been involved in the decision-making progress in relation to these policies suggested that she had a vested interest in complying with the regulations. A visual display of the school action plan in the staff room served as a constant reminder of the school goals and reinforced expectations for the use of digital technologies to support these objectives.

The school curriculum document communicated goals for students in relation to content and skills and the four overarching units of citizenship, sustainability, globalisation, and enterprise emphasized an inquiry-based approach. Activities designed by both Helen and Fiona related to these topics signify that they were aware of these standards. While specific content and skills relating to reading, writing and mathematics were embedded within these four thematic areas in the curriculum, the inquiry-based approach was not utilised during all activities. Additional expectations of objectives related to content and skills for students at the school were conveyed to some extent by information and links posted on the school website and National Standards. The content displayed on the school site included many links to mathematics and literacy websites and activities, signifying that student achievement

in these academic content areas were valued within the school culture. This was reinforced with specific software that had been purchased or endorsed by the school to target specific literacy and mathematics skills such as the CSI and Mathletics programs used in Fiona's classroom. In addition, National Standards which were introduced the year of the study required that students met specific criteria in the areas of reading, mathematics, and writing which reinforced the importance of these subjects. Teachers therefore spent time teaching mathematics and literacy skills in isolation as well as including inquiry-based instruction as outlined in the school curriculum document.

At School A, school-wide participation in the ICT PD cluster and the desire to abide by school policies served to draw teachers together and resulted in a collegial school culture in which staff members voluntarily assisted one another when technical and implementation issues arose. Within the school environment, teachers realised that they were working toward the same object of student learning and that occasionally school policies temporarily required the adjustment of this objective. When teachers were asked to use specific digital tools that were somewhat familiar but they lacked the knowledge or confidence to train their entire class to use the tool, other teachers such as Helen took on the role of instructor and offered their time and effort to ensure that the objective was met and that everyone was able to return to their primary focus of student learning.

Evidence from Helen and Fiona's case studies indicated that school leadership, recent participation in the ICT PD programme, school and national policies and curriculum, and new roles and responsibilities that resulted within their community acted on both teachers as they worked in their individual classrooms. However, these contextual factors interacted with Helen and Fiona's own personal knowledge and beliefs differently. The following sections describe tensions that occurred in each of the activity systems within which each individual teacher worked and a description of the interplay and relationships that occurred within each.

Case study A: Helen

Many contextual and personal factors in the system within which Helen operated influenced her decisions to use digital technologies within her classroom practice (see

Table 5.1). While her primary concern was meeting the needs of all of her students to ensure their success in their future roles in society, her activity was also motivated by other factors including her understanding of the digital tools that were available at the school, school policy, the needs of stakeholders within the system, and her role in the school community.

Table 5.1. Significant components of the system within which Helen operated

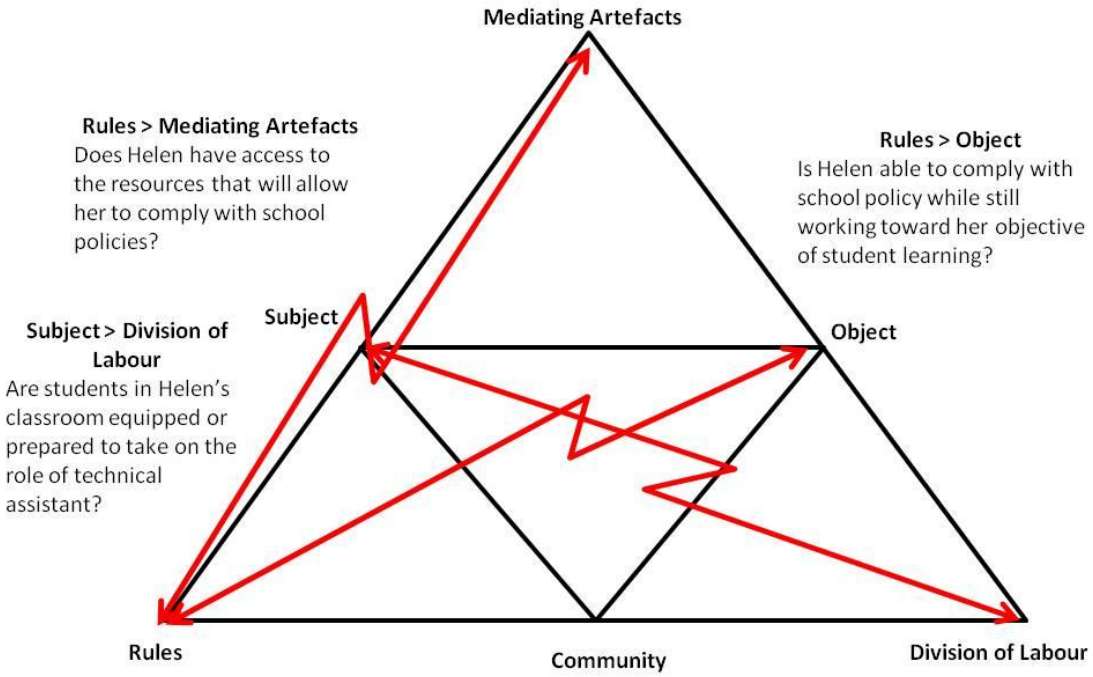
	Factors that influence Helen's activity toward the object
Subject	Helen, an intermediate teacher • Proficient technology user • Believes that students engage more with digital tools than traditional materials • Believes that students are proficient users of digital technology • Believes that students are successful collaborators • Attended ULearn conference
Object **Outcome**	Student learning Prepare students for their future jobs and life in a digital world
Mediating artefacts	• 9 desktop, laptop, and netbook computers in the classroom • 8 desktop computers that are available in the library • A mounted data projector • A classroom digital camera • Wireless access to the Internet that can be unreliable • Limited power outlets • IT help 1 day per week • Help from the Deputy Principals when needed
Community	• Students • Parents of students • Principal and DPs • Other teachers at the school
Division of Labour	• Helen shared and received ideas about how to use technology with members of her team • Helen's students assisted each other while using digital technologies • School administration who had roles regarding technical assistance
Rules	• National and school-specific curriculum • School policy regarding technology use • Recent participation in the ICT PD cluster • Participation in the 4D training throughout the year • National Standards

Tensions that created learning opportunities for Helen

The in-depth analysis of the activity system uncovered three primary tensions which affected progress towards supporting student learning, the object of activity (see Figure 5.1). Several underlying factors contributed to tensions within the system.

The first of these tensions occurred between the rules and the object of activity when Helen was unable to match specific tools with student learning. A second tension between the rules and the mediating artefacts led to the expansion of the activity, in which Helen modified the activity to make the best use of the digital devices that were available to her and her students. Finally, a third contradiction occurred between the subject and the division of labour as a result of a disparity between Helen's perception of students' skills and their actual abilities. The next sections will explore these contradictions in detail.

Figure 5.1. Tensions between components of the system within which Helen operated



Tension between the rules and the object of activity

School policies mandated the use of specific tools such as the e-portfolio system. As previously mentioned, Helen had contributed to the creation of these policies and therefore was committed to implementing these programmes with her class. However, while Helen was familiar with the tool and maintained her own profile on the e-portfolio system, she was unsure how she could incorporate the programme into her teaching practice in a way that would support the learning of the students in her classroom. During classroom visits throughout the first half of the year, a tension became apparent between the school policies that required her to use specific tools

with her students (e.g., the e-portfolio system) and her understanding of how to use those tools to benefit student learning. Helen possessed technical expertise of the e-portfolio, but her perceptions of the affordances of the tool were not matched with her pedagogical knowledge of teaching practices that would enhance the learning of her students. Therefore, Helen asked students to use the e-portfolio primarily to fulfil school policy rather than to enhance her students' learning. This was made apparent when she reported task-related rationales related to the e-portfolio itself when using the tool early in the year.

During the researcher's final classroom visit during Term 4, Helen's use of the e-portfolio site had demonstrably changed. Rather than focusing on task-related outcomes revolving around the tool itself, Helen had begun to perceive how she could use the e-portfolio site in a way that aligned with her own practices and pedagogical beliefs. She reported that professional development in which she had participated throughout the year had provided her with new ideas of how to integrate the tool into her teaching practices. She began creating student accessible pages in the e-portfolio system with content-related tasks for students to complete. She reported that she created open-ended tasks so her students could practice the key competency of thinking and she put them into groups to encourage students to collaborate with peers that they would not normally choose to work with. Although her initial compliance had led to tension within Helen's activity system at the beginning of the year, over time she had altered her own thinking about the tool that allowed her to meet the requirements set by school policy while also using the tool in a way that fit with her own pedagogical beliefs and practices.

Tension between the rules and the mediating artefacts

As described in previous sections, school policy stipulated the time frame in which Helen and the other teachers at School A were to use some of the technological tools that were available to them. Specific timelines regarding the use of the e-portfolio and the blog were in place, and Helen was aware that failing to meet these requirements would create conflict with the school administration. However, Helen believed that the available resources, specifically the number of computers available to her and her students, did not facilitate the level of use that was requested. Over the

duration of the study, Helen employed a number of different pedagogical approaches to successfully teach her students how to use these unfamiliar tools with the number of computers that were available. At the beginning of the year, Helen did not yet recognise how tools such as the e-portfolio system could be integrated into her practices; therefore her activities surrounding the tools were task-based lessons that focused on the application itself and were unrelated to other classroom activities.

During the first lesson in which she introduced students to the e-portfolio system, Helen's intent was to increase the number of computers that students could work with simultaneously so that more students could complete the task of setting up their profile in the shortest time possible. Therefore, Helen was motivated to make use of the school library which contained eight student computers and had space where portable computers brought down from the classroom could also be utilised. While she had expected that many of her students would successfully complete their profiles during this time, unexpected technical problems resulted in fewer students completing the task than she had hoped. While one of the DPs came to the library to offer assistance, only a few students were able to set up their profiles during the 90 minutes in the library and Helen remarked after the lesson that she had hoped that more of the students would have been able to complete the task. Helen's belief that the lesson was unsuccessful affected her future decisions of how to design activities that included the tool.

During a subsequent lesson, Helen modified her method in an attempt to make the best use of the tools she had available. As part of the literacy rotations, she directed students to work in small groups, with one group on the computers with the goal of creating their profiles. Helen believed that students who worked in close proximity, but each with their own computer, would be able to assist each other to complete the task. Additionally, Helen was aware that one student had already completed her profile; therefore she placed her in a role of assistant to help the group of students as they worked. Helen commented afterwards that she was happy with the progress made, but was concerned that the student helper had missed out on other important work during the lesson.

In a later observation during the second term, Helen again changed her activity regarding the use of the e-portfolio. She still had not established a means of

supporting her practices with the tool; therefore her objective was to fulfil school policy in the shortest time possible. To do this, she decided to employ a direct instruction method in which she brought groups of students to the front of the room, each with their own computer, so she could demonstrate how to upload work to their portfolios step by step. This resulted in all students in the group completing the task within a specific time frame while still using only the computers that were available in the classroom. Once all students in the class had completed the task over three sessions, Helen was able to assign students additional activities utilising the computers that were more in line with her own beliefs about what would improve their learning.

Tensions between the subject and the division of labour

Helen was learner oriented in her approach and made use of her knowledge of her students' abilities to inform her teaching. While she relied on the results of standardised tests to provide aspects of students' mathematics and literacy skills, her knowledge of students' technical abilities was based on her previous classroom experiences. As a result, Helen believed that most of her students were capable technology users when they entered her classroom and that she could rely on them to assist each other when technical difficulties were encountered. In reality, observations suggested that often students were not as efficient using technology as she had presumed, and they did not see this as their role. At the beginning of the year, learners had trouble with their passwords, were distracted by advertisements on websites, and had difficulty utilising informative feedback received while playing online games. In all of these examples, tensions arose because the division of labour was not relevant for these students and although unintentionally assigned by the teacher, their role was not one of expert technician. Over the course of the year, evidence suggested that students developed their technical expertise through their experiences with the tools they used and therefore may have been more prepared to offer assistance at this time. However, this was a role that Helen placed them in without fully considering the implications for the students themselves.

A similar tension occurred during collaborative activities; Helen made the assumption based on her previous experiences that students who were placed together in groups would be able to work together successfully. However, as the

student in her class so aptly pointed out, the dynamics of the group influence its success. When students were grouped together, they were placed in a role in which they were asked to work alongside one another to reach a common goal. However, this role was not well-defined for students and therefore there were times when they were unable to enact this position effectively. An example of this occurred when students worked together on an online estimation game and while two boys within an observed group solved the puzzles, a girl who appeared to be engaged did not actively participate in the activity and reported that she did not understand how the other students calculated an answer. This issue created an underlying tension that affected the outcome for the learners.

All three of the tensions described above created a situation in which Helen was compelled to actively resolve or identify these within the system. As a result, she was able to interact with the system positively in order to resolve these issues. The following section shows how Helen operated within this system to challenge herself and her learners.

Transformative learning

Over the course of the year, Helen's conceptualisation of the object transformed. In the first two terms, she was primarily concerned with assisting students in building content-related knowledge with a focus on literacy and mathematics skills. However, by the end of the year, Helen viewed content-based knowledge as secondary to the processes associated with learning and her lessons reflected this transition. She was still developing her understanding of the teaching practices that would match her change in pedagogical beliefs; this shift underpinned much of her activity that is discussed within this section.

As the research has shown, Helen's use of digital tools available in her classroom environment was mediated by her beliefs and expectations about her teaching practice and her ideas around student learning and engagement. Helen reported that tools such as the data projector assisted her in meeting the needs of her students by allowing her to display concepts to students visually, enhancing their learning of content as well as their engagement in the activity. Observations early in the year demonstrated that portable computers used by students during maths and literacy

rotations provided students with an interactive environment as an alternative method of practising skills. Internet-based tools such as the school blog provided a location where Helen's students could share their own ideas and learning with parents and the wider school community, and also where Helen could communicate with the students when she was away from school so she could maintain a presence in the classroom. This demonstrated that Helen perceived specific affordances of the digital tools that were available to her and therefore incorporated them in a way that she believed facilitated student learning.

Over the course of the study Helen participated in professional development and attended the ULearn technology conference, both which provided her with alternative uses for digital tools that were different from the uses that were supported by the school culture. These uses focused more on processes than products and when Helen trialled these with her students she observed a positive change in her students' behaviour and learning. As a result, she adapted and changed her practice to incorporate these tools more frequently and comprehensively in her day-to-day teaching because: 1) she had increased knowledge of the affordances of the tool; and 2) these new methods had been presented to her as an acceptable model of teaching the students with special educational needs that were in her class. While she may have initially perceived that the socially acceptable model in the school (focusing on mathematics and literacy skills) was not successful with her students, she initially wanted her teaching practices to align with the expectations within the school culture. However, when the principal sent Helen to the specialized training and she was presented with a new method of teaching her students which was aligned to the needs of the learners in her class, she was able to modify her teaching practice without disrupting her commitment to school values. For example, early in the year Helen used PowerPoint as a presentation tool in which her students could demonstrate their knowledge of content, but at the end of the year she reported that in training she had learnt that PowerPoint could be used as a tool in which students could focus on learning to use the features of the application to create their own animations. Helen's new knowledge of how PowerPoint could be used in this way aligned with her belief that the focus should be on student processes while they learned rather than the end product of their learning. Therefore, her awareness of the affordances of this tool

allowed her to change her practices when making use of it to better support her students' learning.

The school LMS was identified as a secure environment and therefore Helen placed lesson plans and other information in the system for students and their parents to access in both school and home contexts. This practice enabled aspects of the classroom environment to be more 'open-source' in that usual teaching material that was normally held within the school domain could now be accessed by students from their homes and other locations. The implication of this on Helen's practice is that she was able to provide students with a blended learning environment where they could work in both face-to-face and online environments and therefore could communicate her expectation to both students and parents that learning would transcend traditional boundaries.

Technical issues were frustrating for Helen and she was aware that they impacted on students' time spent engaging with activities. However, a considerable amount of money had been spent on computers and other devices; therefore there were expectations that students would be using these technologies frequently. In addition, Helen wanted students to become technically literate as she believed that this was essential for students' future success and that these tools motivated and engaged learners. This caused her to alter her behaviour and the classroom arrangement in order to minimise the impact of technical issues when they occurred. For example, she reported that she asked students to log in to computers as soon as they entered the classroom so they would be ready for the first maths rotation after morning routines had concluded. After experiencing problems in the library when half of the available computers were not working, she changed her strategy of teaching students how to use the e-portfolio system as was previously described. Additionally, Helen altered her classroom layout which was noted by the researcher during the last observation. Helen reported that one of the reasons this was done was to create a place for a docking station so the portable computers could be easily charged, preventing unexpected shutdowns.

An awareness of individual student abilities motivated Helen to adjust her pedagogical practice for the needs of individual learners. In contrast to using subject knowledge as her guide to determining action, she used her knowledge of her students

to mediate what she would do, and why, in her teaching practice within the classroom environment. Her perceptions of students' technical abilities influenced the way that she introduced new digital tools. She believed that her students were skilled technology users; therefore she provided very little direct guidance to students when introducing them to new technologies. However, students' actions and comments suggested that while they had a range of personal experiences with technology, they occasionally struggled using the new devices or applications effectively. This resulted in a considerable amount of time and energy being spent by students learning to manipulate new tools rather than engaging with them in the way that Helen had intended. Therefore their engagement with the digital tools sometimes created a situation in which student learning of or practise with intended concepts or skills was minimised. Additionally, email and web-based student surveys were used as an additional line of communication in order to promote a personal relationship with students and to gather feedback regarding their needs. Evidence suggests that both Helen and her students valued this dialogue and that it offered insight for Helen as she planned learning activities.

Both the school curriculum and website conveyed information about culturally accepted methods of teaching and content-related knowledge and skills that students were expected to attain in their two years at the school. While an inquiry-based approach was the focus of the school curriculum, links to mathematics and literacy websites and activities on the school website indicated that these discrete content areas were valued within the school community. This message was noteworthy for Helen; just as she was motivated by school policy relating to digital technologies, she was also motivated to align her own practices with curricular goals. At the beginning of the year, she was primarily concerned with teaching mathematics and literacy-based skills and spent a significant portion of the school day asking students to participate in activities related to these content areas.

As previously discussed, Helen's participation in a specialised professional development programme exposed her to a new socially acceptable model that could be applied to her diverse population of students. Rather than focusing on content-based teaching and learning, Helen altered her attention to thinking and collaboration processes. While these had been an important aspect of her teaching earlier in the

year and could also be found on the website and in the curriculum document as important aspects of student learning, there was a noticeable shift in her perception of the object. As a result, Helen's perception of the e-portfolio as a learning tool evolved from a repository for completed work to a virtual space in which students could collaboratively complete activities. This resulted in a modification in the way in which she integrated the tool; she began to post activities within the e-portfolio system where students could access information and record their own ideas. This supported the teaching and learning within her classroom rather than acting as an additional task unrelated to learning goals.

As part of the extended community in Helen's activity system, the needs of the parents of Helen's students were an important factor in Helen's decisions to use digital tools within her practice. Helen identified parents as important stakeholders and therefore ensured that she facilitated communication with them often; technology such as email, the LMS, and the class blog facilitated this communication. Positive feedback from parents regarding weekly informative emails encouraged Helen to continue this practice whereas uncertainty whether parents accessed her lesson plans or the class blog caused her to question the value of spending time on these activities.

Informal meetings that included Helen and other members of her team created an environment in which this small group of teachers could share ideas and online resources that they believed would meet the needs of their students. This served as a small sub-culture in which teachers who worked toward similar objectives could share their experiences and offer support in relation to their unique population of students with special educational needs. As a result, Helen was introduced to new tools that had the potential to facilitate student learning without investing the time and effort to find them herself. More importantly, Helen could discuss her use of digital technology with others who taught students with special educational needs and through these conversations received validation that her use of digital technologies was socially acceptable for the students in her classroom.

Within the wider school community, Helen accepted new roles and responsibilities when she assisted other teachers at School A comply with school policies related to digital technologies. For example, teachers such as Fiona and the teacher in the adjoining classroom recognised that Helen possessed the technical

expertise to instruct her students in using the e-portfolio system, therefore they approached her for assistance fulfilling these requests themselves. Helen's beliefs about her role in the community led her to offer these teachers direct assistance with the help of her students. Offering this support earned Helen respect within the community as she was willing to put her own priorities aside temporarily in order to contribute to the ability of the entire community to act in accordance with school policy. The process of taking all of her students to another classroom to assist another teacher and her students in creating profiles in the e-portfolio system resulted in lost learning time in her classroom, but also the possibility of increasing student knowledge of the tool. Helen's expectation of her students to assist another teacher in her attainment of school-based objectives indicated that students were being shifted between their role as the object and their role as a member of the community who could offer assistance to another member of the larger school community. However, this role may not have been relevant for Helen's students in achieving their own objectives.

Case study B: Fiona

Fiona's operation within her classroom at School A was mediated by a number of school-based and classroom-based environmental and personal factors. Table 5.2 outlines the aspects within her sociocultural context which impacted on her use of digital technologies in her classroom practices. The object of the activity system was the learning of the students in her class, and many student attributes affected the outcome of learning activities that included digital tools. As outlined in Table 5.2, Fiona's own beliefs and skills as well as her perceptions of the learners within her classroom were also key factors in determining activity. Mediating artefacts available within the classroom were considerations when deciding on implementation procedures. In addition, community members both had needs and offered assistance in working toward objectives. Finally, a number of policies and cultural expectations within the system as well as completion of the ICT PD training contributed to the use of digital technologies within Fiona's classroom.

Table 5.2. Significant components of the system within which Fiona operated

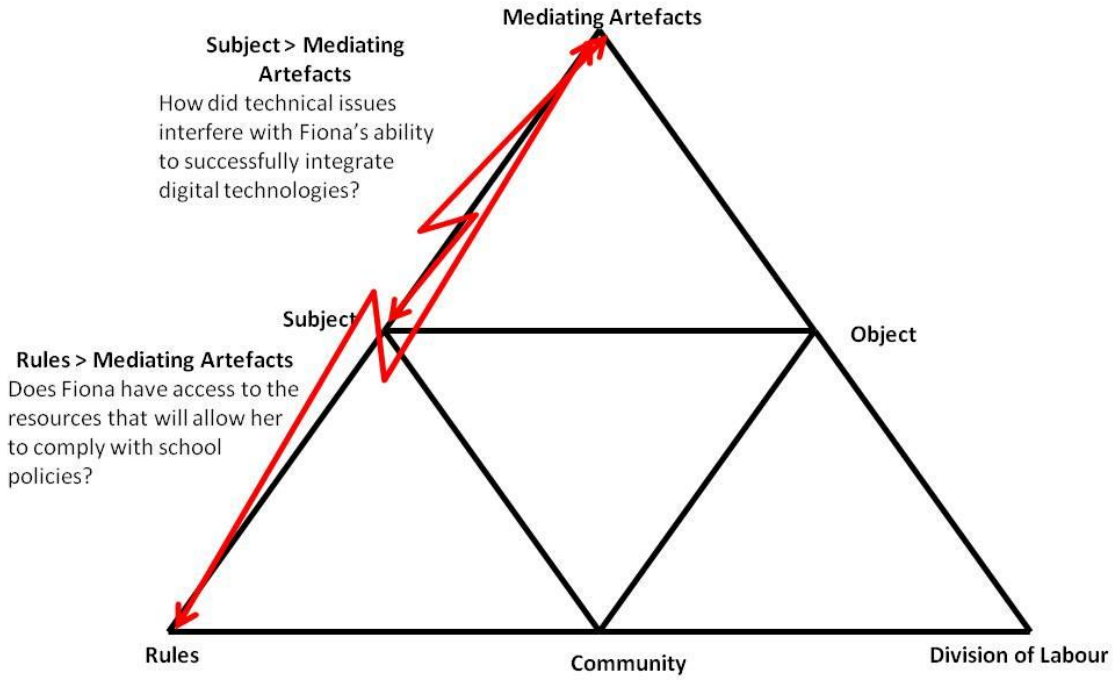
Activity Theory	Factors that influence Fiona's activity toward the object
Subject	Fiona, an intermediate teacher • Proficient technology user (this has developed in recent years) • Believes that students engage more with digital tools than traditional materials • Believes that students are proficient users of digital technology
Object **Outcome**	Student learning Prepare students for life in a digital world
Mediating artefacts	• 9 desktop, laptop, and netbook computers in the classroom • 8 desktop computers that are available in the library • A mounted data projector • A classroom digital camera • Programmes provided by the school (i.e., CSI software) • Wireless access to the Internet that can be unreliable • Limited power outlets • IT help 1 day per week • Help from the Deputy Principals when needed
Community	• Students • Parents of students • Principal and DPs • Other teachers at the school • Teacher's aide
Division of Labour	• Fiona shared and received ideas about how to use technology with members of her team • Fiona's students assisted each other while using digital technologies • Fiona worked with the principal and other members of the team to develop new ways of using the e-portfolio system • Teacher with designated IT responsibility assisted Fiona and her students • Helen assisted Fiona and her students in the use of the e-portfolio system
Rules	• National and school-specific curriculum • School policy regarding technology use • Recent participation in all three years of the ICT PD cluster • National Standards

Tensions within the activity system

The in-depth analysis of the activity system within which Fiona operated uncovered two primary tensions within the system (see Figure 5.2). The first of these tensions between the rules and the mediating artefacts occurred early in the year and became less significant as time progressed. The second tension occurred between the subject and the mediating artefacts as technical issues often prevented Fiona from

fully attaining her goals. These contradictions will be described in detail in the following sections.

Figure 5.2. Tensions between components of the system within which Fiona operated



Tension between the rules and mediating artefacts

Specific school policies in place at School A increased Fiona's use of some digital tools, but at times she struggled to comply with these requirements due in part to the availability of the digital tools that were available within her classroom. For example, Fiona was technically competent with the e-portfolio system and recognised the value of the tool, but believed that the number of computers available in the classroom limited the methods through which she could instruct students in its use. While she considered many of her students to be proficient technology users, she was aware that students were unfamiliar with the system and therefore wanted to ensure that she supported students in learning the technical aspects of the tool. However, with nine classroom computers available to a class of 30 students, she was unsure how to do this productively. While she often asked students to work together when making use of the computers during classroom activities, they were each required to log into their own account when uploading work to the e-portfolio system. Therefore, she believed that it would be most effective for students to have exclusive use of a machine in order to

complete the required task. In addition, there were three fewer computers available in the classroom at the beginning of the school year while they were being repaired which contributed to this tension. As a result, Fiona reached out to the community for help to attain the goal of ensuring that every student created a profile in the e-portfolio. In response, Helen and her students brought their portable computers to the classroom and assisted Fiona's students in completing the task.

Over the course of the school year, Fiona experimented with different methods of teaching students new aspects of the e-portfolio system. By Term 2 students had gained experience using the classroom computers and had successfully created their profiles in the e-portfolio system. Therefore, Fiona felt confident that she would be able to provide a scaffold to students rather than explicitly demonstrate how to upload work to the system. Therefore, she projected a list of explicit instructions and placed students in groups in which each student worked on an allocated computer to accomplish the task of posting stories to their e-portfolio profile. Since the students had previously written the stories and were simply copying these from their written notebooks to a Word document, the main focus was on the technical aspect of uploading the finished story to the e-portfolio system. While concerns remained regarding the length of time it would take all students to complete tasks in the system with the number of computers available, by the end of the year Fiona was confident that students could achieve the objectives without her assistance. Therefore, although Fiona would have appreciated having more computers available through the remainder of the school year, students' increasing confidence and familiarity with the system resulted in this being less of a concern as it had been earlier in the year.

Tension between the subject and the mediating artefacts

Fiona reported at the end of the year that technical problems were the most significant barrier when integrating digital technology because they prevented her students from fully benefitting from the activities that she had planned. There were often breaks in the wireless connection in the classroom and when this happened during an activity that depended on Internet access, Fiona had to quickly change the lesson or disregard it altogether. While this was a frustration for her, she also

recognised that it also discouraged students who were confident and ready to seamlessly integrate technology into their everyday school activities.

Other technical issues occurred because of Fiona's limited experience with some of the tools and as she became more experienced she was able to integrate them with fewer problems. Fiona's motive for using a learning object was to give one group of students time to practise a skill while she taught another group. However, when the learning object did not properly load on a netbook computer, Fiona reported that she was forced to spend her time working to solve the problem rather than working with the intended students. Later when she realised that the site could only be accessed on the laptops with larger screens, she could modify the environment to ensure that students who were accessing the site used laptop computers rather than the netbooks. In another situation, Fiona was informed by a student that the wireless access was turned off rather than broken; in the future this was a fix that Fiona could try herself before sending it out of the classroom to be examined. Similarly, as students became more familiar with the digital tools they were able to solve some of these issues themselves.

Transformative learning

As discussed in her case study, Fiona reported that her beliefs about how she could successfully teach her students had evolved over the previous few years. She had begun teaching more than 20 years prior to the study and reported that early in her career expectations of appropriate teaching behaviour focused primarily on teacher-centred approaches. However, over the course of her time in the classroom, new expectations had emerged. Fiona had been at the school during all three years of the school's participation in the ICT PD cluster at the school and reported that through the programme she had not only learned technical skills, but had also been exposed to new ideas about teaching and learning. This created new social norms at the school regarding appropriate teaching practices that involved digital tools. As a result, her beliefs about her role in the classroom transformed. However, during the year of the study after the professional development had concluded, Fiona's uncertainty when explaining her role revealed that she was still negotiating her practices in light of her new beliefs.

Within classroom activities, evidence indicated that digital tools were integrated into lessons with the primary intent of meeting the needs of the students in Fiona's classroom. Therefore, she selected from the available hardware and software which she felt aligned with student needs. At times, Fiona aimed to add a degree of control and interaction to teacher-led activities to engage students more fully in the learning task. Fiona's understanding of the affordances of particular digital tools and her beliefs about how she could incorporate them into her classroom practice to increase student learning led her to integrate these tools in specific ways. For example, students accessed a shared Google Doc and contributed their own sentences during teacher-led grammar activities to encourage student participation and to allow class members to view their peers' work. Additionally, Fiona used the data projector often to engage students visually primarily because of her perception that her students were accustomed to receiving information through a dynamic screen rather than through static books. Assessments given to students at the beginning of the year provided Fiona with information about their individual knowledge and skills and allowed Fiona to individualise instruction. The interactive Mathletics website supported this practice as appropriate activities could be chosen for each student that corresponded to previously identified gaps in knowledge. Fiona also considered appropriate feedback to be essential in supporting her students and the school email along with Google Docs allowed her to access students' work through the Internet and send them an email response immediately, even after school hours. Finally, Fiona encouraged some of the parents of her students who had trouble writing or had other special needs to provide a laptop as she believed that this would enable them to be more productive and to have access to alternative ways of presenting their ideas.

Fiona's methods of integrating digital technologies were supported by the cultural expectations of the wider school community. Programmes that had been purchased by the school or online resources which the school website linked to set a precedent for the way technology was expected to be used and the type of teaching that was considered to be acceptable practice. Fiona accepted this practice as suitable for her group of learners; therefore she used these recommended tools, such as the CSI programme, often with her students. However, this practice occurred primarily in the areas of mathematics and literacy, where there were specific expectations for

student achievement. When aligning her teaching practices with school curriculum which encouraged inquiry-based instruction, Fiona integrated digital technologies in a way which allowed her students more freedom and control over their own work and learning activities (i.e., presenting research in their chosen format).

Within the wider school community, parents were regarded as important stakeholders and Fiona's own beliefs corresponded with this idea. She aimed to keep parents informed of school activities; therefore she emailed home a weekly newsletter, posted lesson plans to the LMS, and ensured that students posted pictures and information on the class blog. School policies also contributed to Fiona's motivation for utilising some of these tools.

As previously described, school policy at School A mandated the use of particular tools such as the e-portfolio system and Fiona was aware that school administrators monitored this use. However, she also believed that it was essential that this activity also resulted in some benefit for students; therefore she attempted to integrate these tools into her existing practice. For example, Fiona made use of the class blog as a venue where students could post evidence of their learning and at the beginning of the year the e-portfolio was used primarily as a repository for traditional learning products, such as student-written stories. Fiona could see the benefits of these tools, but early in the year she believed that other digital technologies could serve a similar purpose more efficiently. However, she persisted in the implementation of the e-portfolio system because she wanted to comply with school policy. Later in the year, Fiona's work with her school principal to create authentic uses for the e-portfolio demonstrated that other members of Fiona's school community had similar concerns about the contribution of the tools to student learning. Therefore, faculty members worked together in pursuit of successfully integrating these tools to address this issue.

Fiona believed that her students were proficient digital technology users and there were situations in which she asked students to assist each other with tasks that involved digital tools. However, Fiona believed that her role was to ensure that students were capable of helping others before she gave them this duty. Her past experiences of teaching in which she was expected to pass knowledge to students and her understanding of pedagogical practices which had developed over her many years

of teaching underpinned the belief that she needed to be relatively certain of student competence before assigning them leadership roles. Therefore she provided students with direct instruction when introducing a new digital tool or only asked a student to teach another student how to use the tool when she was sure that they had previously successfully used it. The result was that students embraced the role of technician and trainer when they were assigned these roles and thus contributed to activity toward the object within the classroom. This enabled Fiona to spend more time on alternative activity toward the object and also empowered students; later they were observed offering assistance to Fiona during activities when problems were experienced. This changed the dynamics of the classroom and demonstrated to students that Fiona valued their expertise and abilities. In addition, as one student from the focus group reported, students who served on the student council were involved at the decision-making process regarding digital technologies at the school level, again providing them with some agency within their own school environment.

Finally, Fiona relied on members of her community, such as the other teachers in her team, to assist her in her activity aimed toward student learning. Participation in team meetings provided Fiona with new ideas and motivation to integrate technology in particular ways. This interaction provided validation for group members that their ideas corresponded with school expectations for use. A teacher's aide who worked in Fiona's classroom was able to offer help to students as well as supervise small groups who were sent to use the computers in the library. As previously mentioned, Fiona relied on members of her community such as Helen and the school administrators for technical support and assistance in complying with school policy.

Fiona acknowledged that prior to the ICT PD programme she rarely made use of digital technologies in her personal or professional life. Over her three-year participation in the training, she learnt how to operate many technical tools and affordances of the tools that aligned with her pedagogical beliefs. Many of the integration techniques that Fiona employed served to enhance the pedagogical practices that she had engaged in for many years. However, throughout the course of the year, it was evident that Fiona was beginning to re-think her role in the classroom from that of expert leader to one of facilitator. Therefore, when she or her learners came across digital technologies that supported these new beliefs, she was able to

begin to change her practices to match these. Evidence of this occurred in relation to inquiry-based activities in which students were given agency over the activities they chose to demonstrate their learning. Because school expectations regarding content learned through the inquiry-based approached were less structured than those regarding specific mathematics and literacy skills, Fiona was able to adjust her practice during these activities.

Chapter 6. Case Study Findings: School B

The purpose of this chapter is to report case study findings from the final two classroom cases located in School B. Within this chapter, the setting of School B will be described prior to each of the individual classroom cases (Jack and Zoe). Features of the school that have been identified as influential in each case will be discussed. In addition, aspects of the school context such as school leadership, policy, and professional development will also be outlined. Following the school context, features of the teachers and students within the classroom context will be discussed.

School B: School context

School B, an intermediate school in which Jack and Zoe (case studies C and D) taught, was a decile 10 school in a suburban area of New Zealand. The student population was just over 600 and pupils were spread across 20 classes; each class contained 29-32 students. Half of students in each class were Year 7 (aged 11-12) and half were Year 8 (aged 12-13). Most students were in one teacher's room during Year 7 and were moved into a different classroom for Year 8. In addition to the 20 regular teachers, there were six specialist teachers at the school. Classrooms were clustered in teams of five in which teachers and students worked together throughout the year.

There were a number of digital tools available for teacher and student use at School B. The school paid for the lease on TELA laptops for all full-time teachers to use at school and at home. All classrooms had a data projector or a mounted flat-screen television which could project an image from the screen on any of the computers in the classroom which were physically close enough to be connected.

Several computers were available for use within each classroom including three desktop computers and the TELA laptop. In addition, each team of five teachers had access to 15 laptops which Jack reported had been divided equally between all teachers so each classroom had access to three laptops at all times. As a result, there were usually seven computing devices available in the classroom and when more were needed, students were often sent to neighbouring rooms to borrow additional laptops. Additionally, the school had created an ICT suite in part of the library which contained 25 desktop computers as well as a large flat screen TV connected to one of the

computers. The space could be reserved by teachers on a first come, first serve basis. There were not strict limits on how much time teachers could spend in the space and within the study Jack utilised the suite regularly, and considerably more than Zoe. Although Jack used the ICT suite frequently, he mentioned that "the ICT suite is the thoroughfare to the library and that proves too much of a distraction at times with classes coming to and from the library when the kids are working" (Jack, Interview 4).

All computers within both the classrooms and the ICT suite were connected to the school network and the Internet through direct connections or wireless access that was made available throughout the school. Both Jack and Zoe mentioned that there had been trouble with these connections and that the school leaders had been advised by outside IT contractors to purchase a new server which had been done at the beginning of the school year. However, by the end of the year both teachers reported that connections were often still slow and unreliable.

The school owned several portable devices that teachers could check out for use by both teachers and students. Each classroom had a dedicated digital still camera for use and 25 digital cameras that were available for check-out in the library. Many of the laptops had built-in cameras that could be used to take both pictures and video clips. Each classroom also had a digital video camera and five additional video cameras could be borrowed from the library.

The IT Committee had been created in the previous years in part to include members of the school community in decision-making regarding school spending on digital technology. Jack and Zoe were both members of the committee and Jack mentioned at the end of the year that as a school, "We're putting a lot of our money instead of into buying laptops, into buying more video cameras and still cameras" (Jack, Interview 5).

A school website had been created which included information for both parents and students. School details such as contact information for staff members, information about the enrichment programme, and a listing of the board of trustees could be found along with a welcome letter from the principal. Additionally, school newsletters directed toward parents and written by the principal fortnightly could be accessed. Specific pages had been set up both for parents and students which listed many links to educational websites appropriate for each group. The parent page

included links to the Ministry of Education site, a site with information about Internet safety, and an international digital library while the student webpage contained links to educational games and activities. While items such as the school newsletters were frequently updated, other areas of the site such as a school calendar were not maintained and others contained links that were no longer active.

A Learning Management System (LMS) had been introduced at the school about two years before the study took place and both of the teachers in the study at School B integrated it into their lessons regularly. The system was much like School A's e-portfolio system in that each student created a profile and could upload and store electronic versions of their work that were not available for public viewing. At the time of the study parents were not able to directly access the LMS, but there were plans to allow them to do so in the future. Students were also given a school email account which they could access at home and at school. While the teachers in the study utilised many other digital applications over the course of the year, these were the only ones that were introduced school-wide.

Technical support at School B was provided by knowledgeable teachers or outside contractors. While Jack was a fulltime classroom teacher at the school, 0.2 of his time involved an IT Coordination role. Although the IT role involved assisting other teachers with any technical issues that arose within their classrooms, the 0.2 was not a designated day, and therefore he was often asked to provide this support when he might otherwise have been teaching. In addition, the school hired a private company that provided phone support weekdays from 9.00am to 5.00pm as well as onsite support one day per week.

School leadership

The school was led by an established and well-known principal. In addition, one of the two DPs at the school was the designated leader on the IT Committee, although the participants reported that he was supportive but not extremely knowledgeable regarding digital technology. However, the all three members of the management team encouraged the integration of digital tools and both Jack and Zoe discussed the importance of this support. Jack stated, "the biggest enabler [for using digital technology] is having management with a similar viewpoint so we're all on the same

page" (Jack, Interview 5). In addition, Zoe talked about the flexibility she felt that she had in the classroom to incorporate digital tools because "[principal name] doesn't really mind what we do so much, as long as there's a purpose for it and it's authentic" (Zoe, Interview 3).

One way that the principal communicated with the staff and parents was through school newsletters that were written and posted to the school website every two weeks. In the first newsletter of the year, parents were informed that they could sign up to receive the newsletters via email, although instructions on how to sign up for this were not given. School website information was listed at the top of the newsletter and many of the community notices at the back included contact information in the form of email and web addresses. However, most information about communication with teachers and other school members referred to contact via telephone rather than through digital means such as email.

Policy

The school's curriculum was a one-page document that was made available on the school website. The five overarching ideas: make decisions, solve problems, work collaboratively, innovate, and develop independence, directly related to the key competencies as listed in the New Zealand Curriculum (Ministry of Education, 2007). Specific skills that the school had deemed necessary to reaching these ideas had been listed under section headings (e.g., exploring included compare and contrast ideas; create innovative ideas; justify opinions and arguments; etc.). There was no direct reference to digital technology in this curriculum document.

Information posted on the school website offered additional insight into important aspects of school policy regarding valued methods of teaching. Pages listing the school's aims and philosophy as well as values conveyed that "teaching must be student-centred" and "we develop a learning culture which is totally focused on meeting the developmental needs of the emerging adolescent" reflect a student-centred standpoint. In addition, both teachers talked about the school adopting an inquiry-based approach, although this was not specifically found in curriculum documents. In relation to digital technology, another page describing the facilities

available at the school provided a list of the “high-quality up-to-date equipment” available at the school which included many of the resources previously described.

As was discussed in Chapter 4, National Standards had been introduced as a new assessment and reporting system in reading, writing, and mathematics for all students in Years 1 through 8. At the time of the study, School B was participating in the introduction of National Standards. Both teachers involved in the study reported that the new standards had not influenced the way that they taught or used digital technology, although they both hoped that work done in the LMS could eventually become a significant part of the report that was provided to parents regarding student progress. Jack spoke about how technology had been used in relation to standards throughout the year:

> Technology is being used for our own standards to a degree. We’re starting to get everything into KnowledgeNet. We’re starting to develop assessments for our school’s framework, so moving away from the subject-specific things into more of a school-specific framework and our reports will get more and more based on skills rather than subject. So we don’t report on science, we report on how people are inquiring. (Jack, Interview 5)

The school leaders elected to have students complete the standardised PAT and e-asTTle tests early in the year in order to gain information about their current abilities and skills.

Jack and Zoe reported that guidelines were in place regarding the use of digital technology by teachers, but Jack explained that “they're more guidelines than requirements” (Jack, Interview 4). Zoe reported that forms used by the Learning Leaders during classroom observations included a section for technology use during the lesson:

> As learning leaders in management we have to do four-minute walk-throughs and on our four-minute walk-through sheet there's a part that says what technology is being used. So the whole school knows it's an expectation. Whether or not they're meeting that expectation is a different story, but it is an expectation that it's used in every session. (Zoe, Interview 3)

However, both Jack and Zoe conveyed that these policies were not strictly enforced and that while they used technology extensively themselves, they were disappointed that others did not.

Professional development

School B had participated in the Information and Communication Professional Development (ICT PD) cluster programme several years before the study took place and neither Jack nor Zoe had been at the school to take part in the professional development, although both reported that they had attended conferences around the use of digital tools. Since both of these teacher participants were considered to have expertise in digital technologies, they were given time away from students to provide professional development to other teachers in their use of digital tools. Within these roles, Jack focused on technical issues while Zoe was one of two designated contact people for help with the LMS. Additionally, both teachers spent time sharing ideas and providing examples of ways that digital technology could be integrated into the school curriculum.

Case Study C: Jack

The classroom

Jack had been teaching for nine years when he agreed to participate in the study. He was starting his fourth year at School B when the study began and as previously mentioned, spent the equivalent of one day per week fulfilling his role of IT Coordinator.

Jack possessed a high level of interest and expertise in the use of digital technology and used it extensively in his personal and professional environments. He was proficient at using school devices and software and had purchased several of his own including recently released devices such as an iPad® and an iPhone®. He encouraged his students to bring their own devices and during one observation he and a student were comparing apps that they had downloaded for their iPhones which allowed them to take and share 360 degree photographs. Jack disclosed that his personal interest led him to learn more new technology and that he had received very little formal instruction in the use of technology:

> Everything I've got [about technology] is because I've been interested, I've read things myself, I observe things, I ask questions of technicians. Just inquisitive by nature about computers.... although I have gone to the ULearn conference for the last two years. (Interview 4)

Because of his in-depth expertise, Jack was able to resolve technical issues as they occurred. As mentioned before, part of his role as IT Coordinator meant that he was also obliged to help others at the school when problems occurred with digital devices; these queries often came at inconvenient times as he was teaching students. He had been in the role for three years and reported that his response to these requests had changed over time:

> Two years ago...I'd stop teaching and do it. Last year I had a really cool class and I tried really hard not to let that part of the job get in the way. But there were still times, you know, kids would come in and they would be standing there waiting, hey, can I do it. And this year I tell them to go away. To leave the computer there, go away. If I can fix it I'll bring it back, if I can't I won't. But you know, I'll usually tell them the technician's on Wednesday and don't expect it back before Wednesday.... Yeah, it really is a disruption to the class to have people coming in all the time with problems. (Interview 4)

While the IT Coordinator position was important for Jack, his main focus was with his students in his classroom. The students in Jack's class were comprised of 17 males and 13 females including equal numbers of Year 7 and Year 8 students. Jack commented informally that his students had scored very high on the literacy section of the PATs at the beginning of the year. Although the school had an inclusion policy, there were no students with recognised disabilities in Jack's class.

The physical setting in Jack's classroom influenced how he used digital devices in his classroom. An Interactive White Board (IWB) was installed during the first term so he could trial it and report on his experiences before they were bought for the entire school. The three desktop computers were located on one side of the classroom where the power outlets were located while the three laptops for student use were stored and brought out whenever they were being used. He also had his TELA laptop which he sometimes gave to students to use and often borrowed laptops from other teachers in his team when he felt that more were needed for the activity he had planned. Jack utilised the ICT suite frequently, especially when he wanted to "introduce a new idea or to reinforce something that we're all doing at the same level at the same time" (Interview 4). He was passionate about integrating technology seamlessly into classroom instruction and had many ideas of how he would set up his classroom in an 'ideal world' scenario:

> In the ideal world they [the students] would have access, their iPod, iTouch [iPod Touch®], or similar type device as their dictionary, their thesaurus, their calculator, their graphics calculator, their scientific calculator. It's where they go to look at the periodic table, it's where they go to look at what the weather's doing, it's where they go to do geocaching or whatever. So they'd have devices that can do that. They'd be economical enough that they'd be able to afford them. There's the iPads and things that they can run their fingers on and all that digital manipulation for those who use iPads. I've come to realise that even though I don't like netbooks, other people do, and so it's about having diverse IT in your room that they can just pick up as far as hardware. (Interview 4)

In some cases, Jack altered aspects of his teaching practice because of the number of digital devices that were available. He spoke directly about this in relation to his use of the computers during mathematics and literacy rotations:

> Instead of sending 15 kids to do something independently on the computer by themselves while I have a small group with me...I have to send them in twos and there's 10 that work on the computers. And it's affected my classroom practice because my grouping's now based around it as well. So I deliberately make...three groups and each group's got 10 kids because 10 is a good number for the computers...so I've manipulated my groups...to fit the teaching I want to do. (Interview 4)

Jack was an experienced classroom teacher and had a high level of interest and expertise in the use of digital technologies. As a result of this, he had taken on the role of IT Coordinator which required him to spend the equivalent of one day per week out of his classroom taking care of technology-related issues around the school. Within his class of 30 students he had access to a total of seven computers on a regular basis and was learning how to use the IWB that he had received at the beginning of the school year. At times he altered his class instruction to make the most out of the computers that were available.

Integration of digital technologies

Jack integrated digital technologies into his classroom practices to support his pedagogical beliefs in a number of ways. His personal interest and expertise in technology meant that he was familiar with a variety of tools so he was able to choose those that he believed would best support the learning intentions he had for students. Figure 6.1 outlines the key components of learning activities that were observed in Jack's classroom while Appendix M provides details of each observed lesson.

Figure 6.1. Key components across observations in Jack's classroom

Jack believed that integrating digital tools into his classroom practice would benefit his students; therefore he used a variety of technologies with students from the very start of the year. He believed that it was important that he learnt about students' prior knowledge of and experiences with digital technology early in the year:

> The reality is to actually try and sit down with each one of them, you just can't do it with 30 kids, so I have to do my formative assessment by just quickly seeing what they can and can't do in terms of their knowledge. But in saying that some kids are turned on by KnowledgeNet because they use computers and other kids are turned off by it because they have to use the computer. Some don't want to use the computer at school, they only want to use it to play games only, and so it's sorting all that out as well. (Interview 1)

Therefore, within the first term he took time to informally assess their technical skills by giving them introductory tasks in the ICT suite. During an observation during Term 1 (see Appendix M), Jack took students to the ICT suite to give them time to create or modify their profile in the LMS. Since Jack presumed that Year 8 students had learnt to do this the previous year, he teamed Year 7 students with more knowledgeable Year 8 students. While students were working he circulated through the room to assist them as well as to determine how proficient they were at using the programme. He reported that he would later examine their profiles to see how much progress they had made.

Jack introduced several technology-based projects early on in the year to familiarise students with the digital tools that they would be using for learning activities throughout the year. However, these learning activities were usually designed with a deeper purpose in mind. When he discussed his motivation for asking students to create their profiles in the LMS, he talked about the need for students to become comfortable using the tool so that it could be utilised later as a space to post their work:

> This is going to be the portal for their parents to see their work. So there'll be times I say, "Alright, that's cool, go put it on KnowledgeNet." And their parents can login from home and they can see what the work is. (Interview 1)

In another observed lesson later on in the term, Jack gave students the task of video recording a short message to the victims of the Christchurch earthquake, editing their video, then converting the video to the proper file type and uploading it to the LMS. While the message itself was important, Jack reported that he was most concerned

that students learnt how to use the video cameras and the technical computer-based skills rather than producing a fantastic video:

> It's a skill that they can then take into many other contexts and concepts. So I'm using the concept, the context of the Christchurch earthquake and the concept I suppose is of sharing feelings. But it will lead on to being able to do podcasts, to be able to do video CVs, video conferencing, and being more natural with it. And hopefully also...they'll be just a bit more used to sitting in front of the camera. (Interview 2)

Jack often gave minimal directions and allowed students to explore new digital tools independently or within small groups. This occurred during the filming of the Christchurch video; as the students had not previously used the video cameras, Jack gave them very brief instructions on how to use the device and told them when they were to return, and then allowed them to take the cameras to any location around the school to film their messages. He believed that allowing students to have choice and agency when using digital technologies enabled them to learn from each other and encouraged creativity:

> Even the videos today, I could've sat them all down, I could've gotten one person, I could've gotten them to video me, I could've modelled the perfect session and said, "Right, now go and do that." And they could've all done it, and they would've all come back with exactly the same thing. The perfect session. Which could've been fine, but I'm actually quite keen to see what they could've come up with. Some of them went into a room and sat in a room and just did it in the corner. Some of the boys I think went outside and tried to do it outside somewhere. Some of them tried to do a bit of song and dance while they were doing it I would imagine...so it will just be interesting to see what they come back with. (Interview 2)

As students arrived back to the ICT suite after recording their messages, Jack helped each group copy their videos from the camera to the proper folder in the computer. He allowed students to manipulate the computer while he stood behind them giving instructions; by the end of the session all students had recorded and saved their video clips. Two days later in another observation, students had progressed in their work on the videos. A group of three students reported that they had re-recorded their message as the sound had been too quiet. Other students had finished editing their movies in Windows Movie Maker and had converted their files to the proper format so they could upload them to the LMS. When asked what they had

learnt from the project, one student reported that they had learnt to edit the movie and convert the file. Students later reported that they had utilised these technical skills for at least one other project during the year. At the end of the year, one student talked about a video project they had completed in which they acted out and video recorded a scenario about puberty from both a girl's and boy's perspective.

Students were often asked to collaborate when working with digital tools in Jack's classroom. As previously mentioned, older students were often paired with their younger classmates as they were often more experienced and knowledgeable technology users. At other times, the limited number of computers altered Jack's activities. In some situations when he would prefer to have each student using their own computer, limited resources forced him to group students when they worked with the technology. In addition, a school initiative encouraged Jack to allow students to work together to encourage engagement:

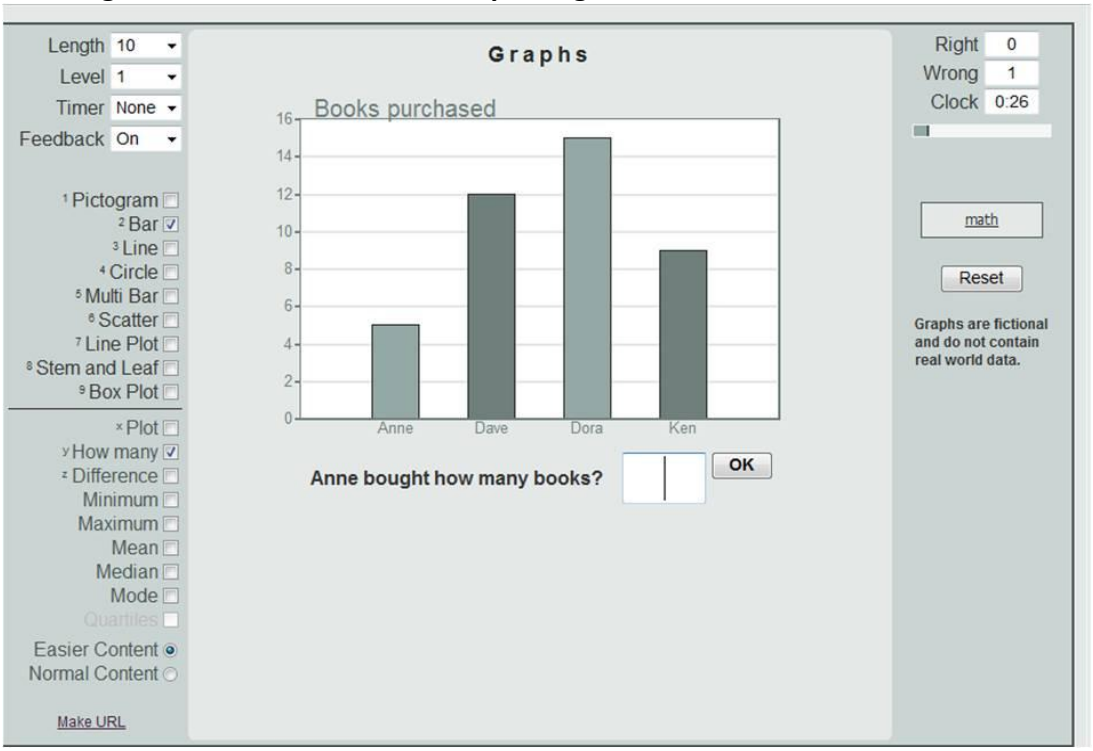
> What I'm trying to do is there's been a lot of research that our school's trying to follow which is all about how kids can be more engaged if they can talk to a peer about what they're doing. And it's just one way of getting that engagement. So by setting up this activity, they have to reflect on each other's writing goals, but for me the important thing is actually that they start talking together. And it could actually be that some of the talk could be off-task. The research has shown, and I'm hoping to see if it works, that off-task talk for two minutes encourages better work for five minutes time frame. (Interview 3)

Jack integrated web-based resources into his mathematics and literacy lessons to give students practice with content-based skills that he had previously taught. For example, during an observed mathematics lesson, students were split into their ability groups and while Jack worked with one group on the IWB, another group completed book work and a third group worked in pairs on Thatquiz.org, an interactive website that Jack asked students to use regularly. During this lesson, students on the computers practised reading different types of graphs. The website allowed students some options such as their choice of level from 1 to 5, the type of graphs that would be included, and concepts that would be tested (see Figure 6.2). The right side of the screen provided students feedback regarding their progress. At the end of the quiz, students were given their overall percentage of correct questions and answers to the questions they missed, although there was no explanation of how to accurately solve the problem. According to Jack, these types of activities in both literacy and

mathematics were part of a regular routine. He believed that allowing students time to practise on the computers increased their engagement in the activity:

> And what I'm doing, because the kids are so engaged when working with the computer, if I give them something, just a paper worksheet, it won't excite them as much as if they did that identical worksheet on a computer. And so I try and balance that practise or that, you know, once you teach a skill you try and get it grounded into them with repeated practise. So I try and vary that so that they will have worksheets, paper worksheets, but they also know there's going to be computer time as well. And so between the two methods we make sure we've got them engaged. (Interview 4)

Figure 6.2. Screen shot of Thatquiz.org interactive website



Jack believed that in general students were capable users of digital technology and that they were sometimes more knowledgeable than he was. He was comfortable creating opportunities in which students could use their expertise even when he was not personally experienced with a particular tool. Jack believed he was better able to integrate digital technology in a way that was meaningful for students by providing them opportunities to have control and agency over the way they used the resources:

> I think one of my strengths with IT is that I am more than prepared to let the kids fly with it. I suppose there are many instances of where the teacher's only comfortable letting the kids do as much as the teacher knows how to do themselves whereas my thoughts are quite the opposite in that I'm keen for the

> kids to learn as much as they can amongst themselves because I suppose I learn from it too in the end. I learn more from what they can tell me that they've found out than from what I can find out myself. So I'm keen for them to have a lot more control and to give them a lot more flexibility so that they can choose. (Interview 2)

Jack also made use of the many informational resources that were available on the Internet. During inquiry projects, Jack often presented students with a concept (i.e., diversity) and then allowed students to ask questions about the topic and research those questions on the Internet. He spoke about one project in which he had presented the topic of diversity and students had become interested in how different public buildings were designed in ways that promoted diversity:

> They'll be using computers to research what is diversity. We've done a lot of work on that already. Ah, and the other things is what are other people trying to create areas of diversity within a mall...Perhaps an area where there's a Marae entranceway, so people of Maori cultural background could feel just a little bit more a sense of, "Oh, this is a cool mall." So it's those sorts of ideas, even things down to the car park and why do we have disability parks, why do we have parks for mums with prams? We use computers just to access all that. (Interview 4)

Once students had researched diversity, Jack reported that they would use SweetHome 3D, a free software programme that allowed students to design their own floor plans, to create new designs for public buildings in the area based on the information they found. He had used the programme before and explained how it would be suited to the project:

> The next step is if they choose, they can actually design on the computer and use the 3D design programme such as Sweet Home 3D and see what it looks like. If it's what they have thought it would be, and also then understand the complexities of design, that you can't just do everything that you want. Things might not quite work out. So it's all of that and that's what the inquiry is. (Interview 4)

Activities such as these allowed students to learn content, but also apply their new knowledge creatively.

The LMS was used in Jack's class on a regular basis as a place where students could post their work and reflect on their progress. Jack explained how he used the tool within his classroom:

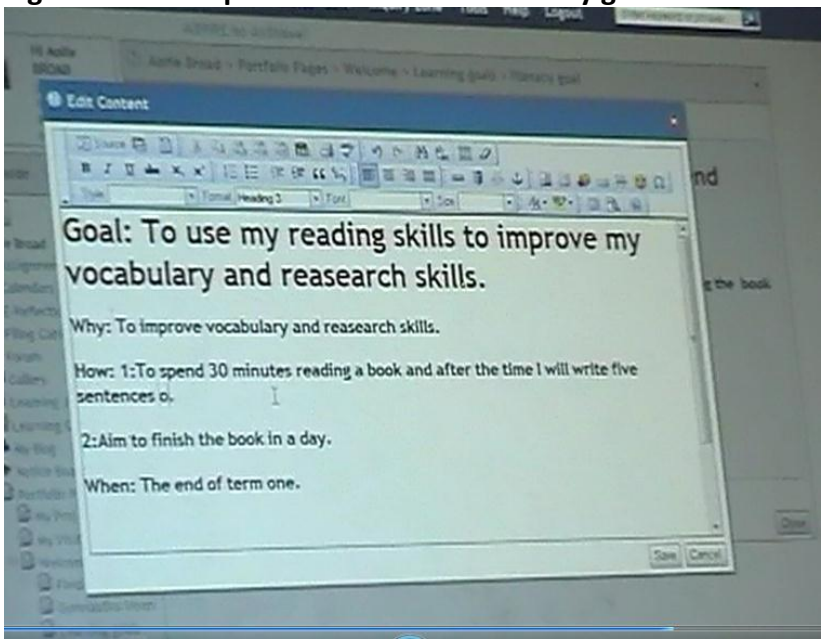
> KnowledgeNet [LMS] is for students to put up any work. It's to show progression...part of it is an e-portfolio, but it's more than just, like e-portfolios

> or portfolios in the past tended to always be published work. And this is supposed to be work in progress from beginning to end. So yeah, that's the big difference, and that's why we don't want it to go public. Because you want every kid to be able to put their work in regardless of how good it is. (Interview 5)

During one observation, students created learning goals in the different subject areas (e.g., reading, writing, mathematics) within the LMS. Students reported that within the classroom, Jack had discussed appropriate goals and had given them results from their standardised tests so they could find out the skills that they needed to work on and write their goals based on this information. During the observation in the ICT suite just afterwards, students were asked to work in pairs to critically critique each other's goals and to revise the goals and enter them into the LMS. Each goal was specifically designed to target a skill that could be worked on at home and this would be students' homework until they felt that they had achieved the goal (see example in Figure 6.3). Jack explained his focus for the lesson and why he believed that creating their goals in the LMS was more effective than writing them on paper:

> The main focus was getting quality goals prepared in a format that other people can see them and see what they're doing with it. It just happens to be that the computers were the best way to do that. And having done...goal-setting on paper the last three years, this year's group are far more focused on what their goals are because they've done it on the computer, they know it's there, they know mum and dad can see it, they know I can see it and so it just seems to be a lot more focussed. (Interview 3)

Figure 6.3. Example of one student's literacy goal written in the LMS



Jack believed that LMS was an important tool that could be utilised to involve parents in what happened during the school day. He encouraged parents to look at the LMS with their children as they did not yet have their own passwords. Jack discussed many forms of work that he asked students to include in their accounts such as their goals which had been directly entered into the system, uploaded videos and photos that the student had made, and photographs or scans of students' work that had been completed by hand. He also included assessments that he had given the students:

> As I do an assessment, I can put the assessment onto KnowledgeNet, put why I marked it that way and the parent can see it. As they do a goal they put their goal on KnowledgeNet while they're doing it and their parents will see it. So that's what it's all about. (Interview 1)

Jack used the LMS as a way of reporting student progress to parents when they came in for parent meetings and hoped that eventually enough work would be added that the LMS itself would serve as a written report to parents.

There was a strong focus on building students' technical skills in Jack's classroom. He believed that students needed to become proficient technology users to be able to successfully function in the world:

> The second side is they have to have digital skills because that's the way the world is getting more and more. If they don't have them, they will be left behind and it's quite evident out there now….You know, you go online to do everything. If you don't know how to save your work you're never going to succeed at it. If you don't know how to be innovative in your presentations, if you're just always going to rely on Microsoft Word documents and not explore video or photo or sound, any of those other ideas, you're just going to get behind. (Interview 4)

Therefore, sometimes Jack created lessons primarily to teach students how to use a tool or to give them practise using a tool that they would use in the future. For example, during an observation in the second term, Jack took students to the ICT suite to type up a report in Microsoft Word about a field trip they had taken the previous day. Jack stated that while the students could have written the reports down by hand, he wanted to give them practice using Word as he believed they would need to be familiar using it in their future schooling and jobs.

Besides teaching students the technical aspects of particular tools, Jack also believed that it was important to explicitly teach students how to use them most effectively. For example, he discussed the need to actively teach students how to navigate through the vast amounts of information available on the Internet:

> I've got a differentiated programme going, sort of, about what to look for in websites to see which is a good one, and which isn't. You know, things like looking for dates of when it's updated, looking for details about the author...So it's just teaching them a bit more about that, evaluating just their sources of information to make sure it's relevant. And also, I suppose, recognising that probably 95% of their research now will be web-based which is why it's so important that they start learning the web is not all nice, not all correct...So it's the checking to make sure where we're getting our information from is correct. (Interview 4)

Outside of his own classroom, Jack's interest in and knowledge of digital tools motivated him to teach other students at the school how to use digital tools that were not frequently used in the classroom. For example, when each teacher was able to plan an enrichment activity that any student in the school could sign up for, Jack and another teacher taught a group of about 40 students how to use an Internet-based tool where they could create their own animations. In his regular teaching style when using digital technology, Jack first showed students the basics of the tool, then gave them several minutes to explore the tool without a specific task in mind. Before they departed that day, students were instructed to create a story board describing a story that they would be developing in the animation programme the following week. During the next session, students created animated versions of their stories in the programme. In addition, Jack taught a weekly after-school programme over eight weeks that accepted up to 25 students who could pay the enrolment fee. Each week, Jack taught students how to use a different software tool that allowed students to create a product such as a floor plan or an animation.

By the end of the year, Jack had made some changes in the way that he integrated digital technology in his classroom. He reported that he had begun allowing students to utilise their own devices more regularly in ways that were currently outside the limitations of what the school could provide:

> Now my kids are encouraged to have their phones with them when we're doing things. They're encouraged to take photos and send them up to the sky and then get them down onto the PC. We've [got] limited storage now, so they're only

> allowed 1 gig of storage on our network, which means we have to use the sky for a lot of the things they want to do. A couple of my girls have got some outstanding video or photography work and it's way more than a gig. So they've had to learn to adapt and use things and work to limits, which is a real-world situation. (Interview 5)

Furthermore, Jack had working on developing a class blog where the students could publicly share their work and have a forum through which they could communicate with other classrooms throughout the world:

> That's what the blog's all about, yeah. It's authentic, it's supposed to be best work. We check it, it gets moderated. So we're doing all of that. The kids are encouraged to use pen names, not their real names, so that we've got a bit of safety going on. (Interview 5)

Several students had already done some work for the blog that showcased their work. Figure 6.4 shows a mash-up that one student had created and posted in one of the first few blog entries. The student had taken several photos of herself and her classmates and had created a mash up of the pictures; this is a good demonstration of students' creative use of technical tools by the end of the year.

Figure 6.4. Screen shot of photo editing done by a student and posted on the class blog

Jack used digital technologies to support his existing pedagogical beliefs and practices. At the beginning of the year, he took time to informally assess students' technical skills to ensure that he provided adequate training later on. When teaching students to use a new software or hardware tool, he often took students to the ICT suite where they could each work on a computer independently. When introducing the tool he generally gave students a quick demonstration of the new tool, and then gave students time to explore while he roamed and offered assistance as needed. Students were also asked to collaborate often when they used digital tools, especially when working in the classroom with a limited number of computers, and the more experienced Year 8 students were often paired with Year 7 students so that less experienced students would be supported.

Digital tools were utilised in a variety of ways to enhance learning activities. Online games and activities that allowed students to practice mathematics or literacy skills that they had learned previously were used often in Jack's classroom. Both Jack and his students searched for information on the Internet and students were often asked to take this content knowledge and create a new product with the information.

Students were often provided control and choice when they used digital technologies and therefore developed a sense of agency in the classroom. The LMS was used regularly for students to post work and their learning goals and Jack looked forward to a time when parents could also monitor their child's progress through the system. Jack believed that students needed to learn technical skills and media literacy skills to be able to function successfully in the world, so sometimes his lessons were designed to provide practice with commonly used tools. By the end of the year, Jack had begun to let students use their own devices more frequently and had created a class blog so that students would have an authentic audience with which to share their work.

Student experiences

Four students in Jack's class who participated in the focus group and those who the researcher questioned during observations reported a range of experiences with digital technology in the classroom and at home. Four participants in a student focus group reported that they had used a range of tools in the school setting including Internet-based activities to practise both mathematics and literacy skills, design tools such as Google Sketchup and SweetHome 3D, and Wikipedia for researching information. These four students also had a range of experiences outside of school. One student reported that she enjoyed reading e-books on the computer while another participant who wanted to be a veterinarian played simulation games in which she was a zookeeper. Other students reported that they used Facebook and played non-educational games. Two students reported that they had created their own videos at home and uploaded them to YouTube; one of these students had purchased a simple video camera with his friends that they used to record physical stunts which they then posted online. One student shared that she had posted "Something about dogs, the cutest dogs in the world, and something about Disney" (Focus group C).

Despite Jack's effort to informally assess students' technical abilities, students in the focus group believed that teachers in general sometimes underestimated their skills. One student mentioned that "it takes them half a year to understand where you're really at" and another noted that "they start you off at the bottom" (Focus group C). Evidence from observations supported the idea that many of Jack's students were technically competent. Early in the year, one student quickly modified his profile

in the LMS and was able to add a new picture and edit the content without instruction. All students who were observed during classroom visits were able to log into the network without problems although there was sometimes a long wait time logging into the laptops through the wireless network. At the end of the year, one student who was creating the mash up picture above demonstrated how she created her pictures in Microsoft PowerPoint® using a variety of techniques that she said she had "figured out herself" (Observation 9).

Students were often observed asking other students in class, often the person sitting beside them, how to do something when they needed assistance. This was almost always acceptable in Jack's room, although on one occasion students were told to work independently. Generally, the classroom culture reflected a collaborative community where assistance was requested and received without disruption to the class. However, during activities when students were asked to work together, some students took turns rather than working together. For example, when two students were observed accessing Thatquiz.org during a mathematics lesson, each student answered 10 questions independently before giving access to the other student (Observation 8). During another activity when students were asked to critique each other's learning goals, observed students worked primarily independently rather than providing each other with feedback although they had created appropriate learning goals by the end of the session (Observation 5).

When given new digital tools to use, a group of three students reported later that they had successfully learned how to use them either through exploration or explicit instruction. After being given video cameras that they had never used before, three students were able to discover how to record and playback videos on their own (Observation 3). While in the ICT suite, students in the enrichment programme as well as the after school programme were attentive during Jack's brief instructions and then effectively manipulated the new programmes to create animations or the floor plan for a building (Observation 2). After several minutes of exploration, students shared new discoveries of the capabilities of the tools with one another which Jack encouraged. When students were asked during the focus group if they thought they learned more exploring on their own or by reading directions available on games, one student responded:

> They're both good things to do because if you figure it out yourself, like you get a little smarter at playing stuff and figuring things out. But if you read it, you get your share of reading. So they're both pretty much good. (Year 7 student, Focus group)

Sometimes attributes of digital tools influenced students' ability to complete tasks efficiently. When students were writing reports in Word, four students spent a considerable amount of time formatting their document and modifying fonts and colours rather than writing down their ideas (Observation 9). Additionally, five students who were creating a story in an animation programme during the enrichment activity revealed that they had created a story based around the pictures that were available in the programme rather on their own unique ideas (Observation 7). Two students completing the activity focused on small details such as showing large explosions rather than creating an in-depth and thoughtful story.

Students in the focus group were very insightful about the limitations of digital technologies. One student talked about her experiences with Wikipedia and how she was aware that some of the information on the site could be inaccurate. Another student who was using Thatquiz.org during an observation explained that the website only supported practising skills that he was already familiar with rather than learning new skills because "it's kind of hard to learn if it's [the explanation] not there. Like on here it won't tell you which one so if you get it wrong, you don't know what it means anyway, so I can't get better at it" (Observation 8). A student in the focus group explained why she thought that using computers was more engaging than learning from a book:

> I think it helps because it makes the learning more fun with all the active, like hands-on sort of learning. Like if you're just doing bookwork it's not as intriguing for students, I guess. And so on the computer, and especially like our age, we've got so much technology around us, and we're not as into book work as we are into the computers. So I think it makes it more fun. (Focus group C)

Another student added:

> I guess because computers are more interactive instead of just reading a book. On computers you can you see that something is underlined whenever you're reading the text and you can click on it and it tells you what it means. (Year 7 student, Focus group)

Students' own attributes influenced how they used digital tools within the classroom setting. When using Thatquiz.org, a pair of students who worked together increased the level of difficulty twice after their scores had been 90 to 100%. Another pair of students who provided informed consent, Hamish and Chris (pseudonyms), who also shared a computer to access Thatquiz.org, chose activities on the same website with different intentions. When asked why he was choosing to include only graphs on his quiz and did not select other options such as mean, median, and mode, Hamish disclosed, "I like graphs because I'm good at it and I don't really do stuff that I'm not really good at" (Observation 8). However, during his next turn on the task after making this comment, he selected some different options during his next game including related vocabulary words (e.g., mean, median, mode) and scored only 40%. On his next try, he changed the options back and scored 90% once again. Later, as Jack instructed another group on the same ideas across the room, Hamish took out his mathematics notebook and wrote down a definition for 'mode', one of the vocabulary words that had caused him trouble on the quiz. Chris gave the following answer when asked if he only chose activities that he was confident completing:

> Not that I'm fully confident with, but things that I know how to do that I just need practise with because I still make mistakes on it. I chose the stem and leaf because I don't really know it and I need to get better at that. (Chris, Observation 8)

When asked if they enjoyed using the website to practise skills Hamish reported:

> It's hard because you can't write it down and figure it out on a piece of paper. You have to type it. I like using the computer, but not particularly this website. I like other websites better...that just do normal basic facts and stuff. (Hamish, Observation 8)

One of the students in the focus group had a different opinion:

> And for mathematics we use the Thatquiz.org which is really good because it's like a timed quiz and they're like all the different categories for mathematics which is good because you can choose and then for whatever subject we just learned about on the mat we can go and practise it. Which is fun rather than doing worksheets. It's a bit more interactive which is good. (Focus group C)

Student participants reported that they used digital technologies for a range of educational and non-educational uses and those in the focus group reported that they thought that teachers sometimes underestimated their technical skills. Students

generally asked for and offered assistance to their peers, but when working collaboratively, some students were observed taking turns rather than working together on a task. Attributes of the digital tools being used as well as student attributes affected the way students interacted and learned with these tools. Overall, students in the focus group reported that they believed that the interactive and hands-on nature of digital tools such as computers facilitated learning.

Case Study D: Zoe

The classroom

Zoe had been teaching for nine years when she agreed to participate in the study. She was entering her fourth year at School B when the study began and was the learning leader of her team of five teachers, resulting in additional responsibilities and one block per week (about 1.5 hours) release time. As previously mentioned, Zoe was also a member of the IT Committee and was one of two teachers who were given an extra block of release time per week to help teachers with issues relating to the school's LMS (KnowledgeNet) because of her expertise with the programme. During Term 2 she talked about the workload that was associated with these further responsibilities:

> I get two blocks of release a week, one block that is supposed to be for KnowledgeNet related things, and one block is supposed to be for my learning leader release time. Generally both of them get taken up by KnowledgeNet stuff. It's a big job. I didn't quite realise how big when I took it on. It's changing the teacher's pedagogy as well as up-skilling parents and all the technical issues...I'm hoping as the teachers get better at it, I won't have to do so much. But at the moment it's a big job. (Interview 3)

While Zoe was able to model and discuss appropriate use of the LMS and take care of technical issues related to the programme, she expressed frustration that she was sometimes unable to have an impact on teachers' classroom practices and shared that "the environment here is quite a hard one to shift. And so while I'm very willing to use new things and to do different things with them...it's hard to shift some of...the people who don't use technology" (Interview 3).

Zoe was comfortable using digital tools in her professional and personal settings. She maintained a personal Facebook account and owned a smartphone which she

reported using to access information on the Internet when she was away from her computer. Zoe spoke of her reliance on digital technologies and how she believed that many tools had permeated into the facets of everyday life:

> I don't think I see it [technology] as a separate part of life; it's part of who we are. It's a part of what we do. It's a part of everything we do, and every job, every situation. I don't think computers are separate to anything anymore. I think that, like not just computers, but technology. I mean, if I'm out somewhere and I don't know where something is I just Google it. I don't think about the fact that I'm Googling on my phone or the fact that I'm finding a map on my phone. It's what you do nowadays. (Interview 3)

While she was a proficient user of many different digital tools, Zoe had limited expertise when technical issues arose with the tools in her classroom and was often frustrated by problems she was unable to solve. On several occasions during observations, unexpected complications occurred that resulted in lost learning time (i.e., video not loading, speakers not playing sound from a laptop). She often relied on Jack or the IT contractors who came in once a week to assist her when devices were not working properly. However, she reported that over her nine years teaching she had become more capable at troubleshooting problems with devices in her classroom:

> I've taught myself a lot...I'm not really a...techie kind of person so while I...love the fact that the kids are so engaged with it, and...I love using it in my classroom, I'm not the type of person who can just fix computers so I have to learn how to change things. (Interview 3)

Zoe actively investigated resources that would inform her use of digital technologies. She reported that books about effective practice and colleagues that she had worked with had influenced the ways in which she incorporated technology in her classroom. She also mentioned that in her past experiences "there was a lot of 21st century learning stuff that I read through and that formed a lot of my ideas about the 21st century learner and why we should be using technology and that kind of thing" (Interview 3). In addition, she had attended a number of conferences and explained the benefits of these:

> I've been now to two KnowledgeNet conferences which I think have probably been the most valuable things of all. I've been to a couple of ULearn conferences as well, which ULearn conferences are more big picture kind of, overarching, this is the way it could be done. But no specifics of how to get that into your classroom. Whereas with the KnowledgeNet conference, it's people kind of

> saying, this is how I use it, this is what I use it for, you can use it for this, this is the capabilities of it. (Interview 3)

There were 14 males and 16 females in Zoe's class which included equal numbers of Year 7 and Year 8 students. Although the school had an inclusion policy, there were no students with identified special learning needs in Zoe's classroom.

The use of digital devices was influenced by the number and types of devices available to Zoe and her students as well the configuration of the classroom. Computers in the room included the school standard of three desktop computers, three Windows laptops, and the teacher laptop along with five Macintosh notebook computers that the school had purchased several years before. Zoe had acquired these additional portable computers with the understanding that although they could access the Internet through the school wireless access, they could not be connected to the school network and were not supported by the school's IT consultants. As a result, her student to computer ratio was 2.5 to 1, but only when all machines were functional. When there were issues with the unsupported machines, Zoe was forced to spend valuable time finding a solution on her own. Additionally, Zoe reported that there were "only two plugs in this classroom...either right by the teacher cupboards, or right by the front of the room are the only two places I can have them...It's just a logistical nightmare" (Interview 3). This limited the classroom layout as well as students' mobility if they were using the desktop computers or needed to plug in their portable devices.

An IWB was installed at the front of Zoe's room early in the school year; previously she had been connecting her laptop to a mounted television when she wanted to share her computer screen with her students. However, it was a new tool that she was relatively inexperienced with and she made the comment soon after it was installed that "my projector that's not actually that good, it looks like 5-year-old writing even if you're writing really neatly" (Interview 3) which affected the degree to which she used the board with her students.

To summarise, Zoe was an experienced teacher who had also taken on additional roles at School B such as learning leader of her team and IT Committee member who assisted other teachers with the LMS. While she was proficient with a variety of digital tools, she did not consider herself to be technician and was often unable to solve

technical issues when they occurred. Zoe relied on a number of sources such as books, colleagues, and conferences to inform her pedagogical practices and methods of successfully integrating digital technologies. Finally, a number of tools were available in her classroom including 12 computers and an IWB, although limited power outlets limited student mobility when they used portable devices.

Integration of digital technologies

Zoe integrated digital technologies into nearly every facet of her teaching. She strongly believed that because digital technologies were a fundamental part of the students' world outside the classroom, they should be used in the classroom just as extensively:

> It's part of their world. I guess that we weren't brought up with computers and those kind of things, but they don't know any different. They know computers, they know texting, they know cell phones and all that kind of thing and then when it comes to school some teachers, say, "Put all that away. You're back to pen and paper for the whole day." It's just the way the world's going. I think it's important that we use it to become part of everyday teaching, not a special kind of thing. (Interview 3)

As a result, Zoe reported that she aimed to "make sure something's [technology] being used every session. Otherwise it's just sitting in the cupboard and a waste of time and money" (Interview 3).

Zoe's integration of technology supported her pedagogical beliefs and practices. She reported that she viewed her role as a facilitator and she strived to create a student-centred environment where students were given control over their learning:

> I facilitate learning. I would like the kids in my class to take more responsibility for their learning and to know where they are in their mathematics and know what their next steps. And they're starting to do that. I think it takes a big change from me and sometimes I slip back into my old comfort zone of just being the teacher in front of the classroom. So my role is definitely more facilitating learning than just standing at the front. (Interview 3)

As a result, Zoe believed that she was responsible for initiating an exchange of power between herself and her students. She spoke of her experiences learning to shift the control in her classroom and why she thought other teachers struggled with this transfer in power:

> I know that a lot of teachers are scared of letting go of the power and go with things. I guess I've realised that I'm not the be all, end all and I don't know

> everything and I don't have time to find out everything. So I don't know how I came to that point, but I think someone must have let me at some stage do something like that where I could really see the benefit of it. And the kids teach me so much...I think I'm just comfortable with who I am and how I am as a teacher enough to let them, and I know that it's not losing control, and I think that's what some people fear is that if you let them have the power to investigate things that you've lost control of them. But you haven't. (Interview 4)

Zoe considered her students to be knowledgeable technology users and utilised their expertise in helping her to develop their sense of agency. Consequently, she often integrated digital technologies into her practice in a way that allowed them to have more control over their learning; this was observed on several occasions. Figure 6.5 outlines the key components observed during activities in Zoe's classroom while Appendix N provides details of each observation. During two observations early in the year, Zoe created pages on the LMS that included instructions for activities that she wanted students to complete. She believed that providing information that they could access themselves allowed learners to work at their own pace rather than relying on the teacher to give them the next steps. Additionally, at the end of the year, Zoe asked

Figure 6.5. Key components across observations in Zoe's classroom

students to explore a variety of web-based recording tools so they could make an informed choice about which one they would use to record a radio show that they had been writing. While Zoe introduced students to an informational website that gave a brief description and link to several different tools, she had not personally utilised the recording devices herself. Instead, she felt confident that students would be able to work out how to use the tools without her assistance and allowed them to choose which one they felt would be best suited to their needs.

When introducing a new digital tool, Zoe provided experiences for students so that they could learn technical skills in a familiar context that they could then transfer to new situations. On one occasion she explained the benefits of giving students the time to create a music video so that they could learn how to record, upload, and edit video before they made their own advert:

> If you teach it in a context that they understand and they find easy first, then that skill can transfer to any context. If you try and teach it in a context that they find hard...I probably would have lost half of them...So I just got them to make a music video of, you know, 30 seconds or so. They all know how to download, they know how to edit. So when it comes to making these advertisements, I don't have to teach that as well. (Interview 3)

However, as previously mentioned, Zoe had confidence her that students were knowledgeable technology users; therefore she used little direct instruction when she introduced a new technical tool. Instead, she gave students time to explore the tool, usually with their peers. She believed that making use of students' expertise was a way to promote a sense of agency and control over their learning:

> I'm absolutely prepared to help them if they need it, but I think that you've got to give them that freedom of letting them have the go. And I think if we don't then we're kind of doing a disservice to their knowledge. They're amazing with technology. So much more amazing than I am probably ever going to be and I'm completely willing to just give them a go. (Interview 1)

Zoe believed that digital tools should be integrated with a genuine purpose in mind. Therefore, she planned activities for her students that included applications and resources that they used outside school. She felt that this made learning more meaningful for students:

> It's when you put some of those things that they're using in their personal lives into a context where they can use it in school, they see the reality of it, [such as]

> things on YouTube like Newton's law. If I'd just done it on paper and they'd all done their different experiments, they wouldn't have got the impact of seeing someone else's. So...it's using those things that they're using all the time, but trying to put them into a context in the classroom where it's real and not just because they like it. But it's bringing what they do every day into the classroom. I think that's made the biggest difference. (Interview 4)

The school's LMS provided Zoe with a resource where she could place information in a secure environment that her students could access in the classroom as well as at home. She had been using the system for several years and utilised it extensively in her classroom. For example, during one lesson which she reported was designed to teach students to ask high-level questions of text they had read, Zoe created a page in the LMS which provided a link to an online news article as well as instructions that guided students' thinking. While Zoe worked with a small group across the room, students were able to access and read the article and follow directions to complete the activity independently. During another observation early in the year, students worked in groups of four or five to write the script for an advert they would later be video recording. Rather than writing the script on paper, Zoe reported later that she preferred to have students type the script into the LMS to give them practise using the system as they would be asked to access it often over the course of the year. However, the main goals for the lesson that she shared with students were skills that had been identified in the school curriculum: creating a plan to meet a purpose and creating innovative ideas. Finally, in another activity students were asked to create a page in the LMS where they were to write a review for a group video project that could be easily accessed by the other members of the class. In this situation the LMS was used as a venue in which students were writing for an authentic audience, their peers.

Another aspect of the LMS that Zoe appreciated was the fact that data that the students put into the system could later be used as evidence of student learning. She felt that this would eventually become a valuable communication tool where parents could become more informed of their children's progress. While initially parents were not able to directly access the LMS, Zoe looked forward to Term 3 when they would be given their own passwords so they could view their children's work:

> I could have last week given them out a photocopy of the learning intention activity and they could've written it in their books, but if I did it on the computer, then their parents, next term, will be able to have feedback on it on their comments as well. So it's really opening up those lines. It will all be on there for the parents to see, so the classroom becomes more open and more transparent. So parents actually know what's going on inside the classroom. So it's a lot more open for everyone to see what we're doing, what's going on, what the kids are actually learning, the purpose of school, which I think's great. (Interview 3)

Zoe believed that her students were more interested and engaged in activities when they were able to use digital tools:

> I do think it engages the kids. I mean, sometimes you can say, go and look up this website and you could print out the exact same piece of paper. But the amount of times those kids refresh to try and get it on the laptops, they could have read it three times over. But because it's on the laptop, they want to do it on there. (Interview 3)

Therefore, there were instances when Zoe integrated digital tools primarily to engage students. For example, during one observation she had been reading a book to the students in which characters in the story had been captured by a witch who locked them in a tower. As part of the follow-up activity, students were asked to design an escape plan for the characters which they created in a simple drawing programme on the computers. Later Zoe reported that she "thought it would be quite a fun activity to use Paint; something different rather than just a bit of paper" (Interview 3).

Activities that Zoe planned were often collaborative in nature as she believed that "a lot of school is the social interaction and at this age group; learning how to be social with people and interacting is just important as the learning of mathematics and literacy" (Interview 3). This directly corresponded to the New Zealand Curriculum's key competency of 'relating to others' and the school curriculum which includes 'work collaboratively' as a key tenet. This was evident in her teaching practice as students worked in groups during every observed lesson and she reported that she generally allowed students to choose their own groups rather than being assigned to a group. Frequently the number of working computers played a large part in Zoe's decisions regarding how many students worked together in each group.

Zoe reported that she often asked students to search for information on the Internet which fit into her teaching philosophy:

> I think when I was at school you never questioned your teacher. You went along with every single thing they said. Teachers were supposed to be infallible, teachers were supposed to be some kind of book on how to do everything. But I'm trying to teach the kids that no one's that way. That I make mistakes all the time and I have to look things up and I don't know all the answers. But I can find them out for myself. And I think that's a big thing for them as well, to see that if I don't know something, I don't just give up, I go and find it out and research it, and that's what I'm expecting them to do. (Interview 3)

On several occasions, students were observed searching for information online. As part of a larger activity in which students were creating their own cereal box, students were asked to find contact information for different community members relating to food production and distribution (e.g., supermarket managers, marketing agents). Students utilised the Internet to find email addresses for these individuals so that they could later ask them questions about cereal such as packaging restrictions and placement on shelving. During another activity, students were asked to have a debate with one of their peers regarding the proposed 'Wellywood' sign near the Wellington airport[1]. Students were assigned a position of supporting or opposing the sign and were asked to find factual information to support their position on the Internet.

Zoe believed that because her students were constantly engaging with the media through digital devices, it was partially her responsibility to teach them how to use the tools safely and effectively:

> We've had lots of conversations around the safety issues and what do you put online...conversations that never used to have to happen at school and probably at homes as well. With the technology these kids just open their whole lives up...it's a really different world than we ever grew up in and I just think we need to make sure the kids are really aware of it. (Interview 3)

In one observed lesson, Zoe had set up several pages in the LMS where students could explore different advertisements and the social messages they conveyed. Zoe had embedded links of some advertisements in one page so students could view the videos and discuss them in their group of four or five students. They created their own page where they could type in the answers to questions about the advertisements. Later

[1] At the time of the study, the construction of a Hollywood-type sign (reading 'Wellywood') had been proposed in Wellington which could be viewed from incoming aircraft to draw attention to the locally based Weta digital effects company. However, there was contention around the sign and varying opinions about it had been shared on the national news from citizens around the country.

they were asked to search for advertisements with additional social messages. Zoe discussed her rationale behind the activity:

> We've had quite a few conversations around what advertisers and things are trying to tell us and why. It's a result of all the technology and things they've got. I mean, we've talked about the fact that on websites there's advertising now. You get bombarded with advertisements everywhere you go. (Interview 3)

Zoe believed it was essential that students used digital technologies widely and often to prepare them for their future employment. She spoke about her belief that technology was embedded into jobs that may have traditionally been more hands-on:

> I don't think you could name a job for me now that they're not using technology. My dad's a truck driver and he's got a GPS that he has to programme in, he spreads fertiliser and seed and stuff and he has to programme the whole of this so it's spread at the right speed and the right amount. He's driving a truck, but he's using technology. There's not many jobs now that we want people to do that don't use technology. (Interview 3)

At times technical issues hindered Zoe's integration of digital technologies. As previously mentioned, the school's Internet connection was unreliable throughout the year; therefore it was common during observations for there to be delays when Zoe and her students worked. She spoke of one occasion when this was particularly frustrating:

> One day I had the whole day planned on the Internet, the kids were using the Internet 99% of the day and the network crashed. I think that's the downside is that it's so based on the technology working. It was an election thing and they were doing, they were comparing YouTube clips and doing all this stuff, and it crashed and I freaked out. (Interview 4)

Zoe encouraged students to use their own personal devices, such as cell phones, for classroom activities. She explained a scavenger hunt she had set up for students in which they were given written or picture clues around the local mall and used their cell phones to photograph each location. Students worked in groups in which at least one student had their own device they could use for the activity. At the end of the year Zoe explained that many of her students owned their own devices and that she planned on integrating these into classroom activities more frequently the following year:

> I'd like to get them using their own technology more. That's probably my biggest goal for next year. Whether it's laptops or not, whether it's just their own

> handheld devices and things...I think I need to start exploiting that a bit more. (Interview 4)

Finally, Zoe collaborated with other teachers in her team to plan some learning activities that included digital technologies. As previously mentioned, she spent 1.5 hours per week helping her colleagues use the LMS and part of her role as a member of the IT Committee was to use digital technologies herself to set an example for others; therefore, she spent time during team meetings sharing appropriate methods of integrating technology:

> In my team meetings I've started having a KnowledgeNet part to each team meeting. Because it is the way we're going. There's going to be no excuses about not using it, so I kind of feel that if I'm talking the talk, I have to kind of walk the walk and teach them and do a bit more of that kind of thing in my team meetings. So when we are working together in a team I'm showing them some things and hopefully they'll have some ideas of what they can use it for, not just always me. (Interview 3)

To review, Zoe integrated digital technologies into nearly all learning activities to support her pedagogical beliefs and practices. Zoe viewed herself as a facilitator and preferred to give students control over their own learning whenever possible which required a shift in power that she believed was difficult for some teachers. She considered her students to be proficient technology users and aimed to make use of this expertise to develop their sense of agency. New technologies were first introduced within familiar contexts so that these skills could be transferred to new situations, and often Zoe did not teach students how to use the tools explicitly, but instead gave them time to experiment with the tool.

The LMS was used frequently in Zoe's classroom as a venue where students could complete and display work from inside the classroom or at home. Zoe believed that this made learning transparent for parents who could see examples of student work and track their progress from their home computer. Zoe believed that students were motivated and engaged by technology; therefore she sometimes included digital tools specifically for that purpose. When students worked with the computers and other technologies, Zoe often asked them to work collaboratively as this was an important goal linked to the key competencies.

The Internet was accessed regularly by students and Zoe herself to search for information, and Zoe also believed that she had a responsibility to teach students how to use the Internet and other digital tools safely and effectively. In addition, she believed that she needed to teach students technical skills as their future jobs would require the use of digital technologies. Technical issues could be an issue when they occurred as Zoe's lessons often included many digital tools. When possible, she allowed students to use their own devices during classroom activities.

Zoe collaborated with the members of her team regarding methods of integrated digital technologies. She also modelled uses of technology to the staff as part of her role as member of the IT Committee, but was frustrated that more teachers did not integrate digital tools despite her efforts.

Student experiences with digital technologies

Four of Zoe's students spoke of using technology extensively in the classroom as well as at home. Three students from Zoe's class that participated in a focus group reported a variety of experiences with digital technology inside the classroom including making movies, using the school LMS, and researching on the Internet; these were consistent with classroom observations and interviews. These students also explained that they often accessed and completed their homework through the LMS on their home computers and sometimes commented on other students' work. When asked how they thought digital technologies impacted their learning, one participant said, "it can help us research and stuff so we can actually learn how to use the computer so when we go up to college and stuff and when we actually have to use computers, we'll know how to do it" (Focus group D). Another student who had talked about creating a video added, "Well, you can learn lots of things. You can learn how to actually act, and like drama and dance. And also [develop] confidence" (Focus group D).

All three students in the focus group reported that their home use of digital technology included playing games and using email, and one student had her own Facebook account. During an observation at the end of the year, another student talked about how he played the guitar and had learned how to record and edit his music using GarageBand on a Macintosh laptop that his mother had given him.

From the beginning of the year, students who were observed displayed actions which indicated that they were skilled at using the school LMS, which Zoe utilised often. During the first month of school, four students easily created a sub-page and began writing the storyline for their advertisement in the LMS (Observation 1). In another lesson, five participants who were looking at advertisements through the LMS were able to navigate to the page that Zoe had posted and created a new page in which to save their own work (Observation 2). However, the same group of students spent several minutes trying to log into the system and when they still could not access the page, they reported the problem to Zoe who provided them with her teacher laptop. On another occasion during a literacy lesson, two participants also had trouble accessing the LMS; several minutes expired as they logged out of the computer and then back into it to try to solve the problem (Observation 4). As Zoe reported, these occurrences were not uncommon and were also frustrating for students.

When they worked collaboratively, most students who were observed appeared to work well with the other members of their group. When a group of three students used the IWB to create their escape plan, they took turns using the pen so that they all had a chance to try out the board. Sometimes all the students in the group actively participated in the activity, such as when four participants worked together to write their camp advert. At other times some learners who did not have full access to the computer appeared to be disengaged from the ongoing activity. This occurred during the observation when five students looked at the advertisements that Zoe had posted on the LMS (Observation 2). While all of the students watched when the videos played, the two that sat furthest away from the laptop were easily distracted by other activity around the room. A similar scenario occurred when a group of three students were researching the 'Wellywood' sign; one participant completed most of the searching while the two boys in her group watched passively for most of the time spent searching (Observation 7). At the end of the year, Zoe discussed that she was aware that she did not always have an understanding of individual students' contributions to group work and that this had affected her ability to write reports:

> What I've noticed with all the group teaching we do is when I came to writing reports, because I've gone even more into group teaching and the kids investigating things, and I can only work with so many people at a time, I don't know who the leaders in my class are in groups. I don't know who is giving all the

> really awesome suggestions. There's some things that I now don't know because I'm not seeing the whole class work together. (Interview 4)

During observations, some students appeared to be unsure of the actions they needed to take when they were given verbal instructions by Zoe before they worked with digital technologies. The four students observed writing the advert in the LMS first opened the iMovie programme before an announcement by Zoe that they were only to be typing their stories that day (Observation 1). On another day, the group of five students who were examining television advertisements began searching for their own adverts on YouTube until Zoe interrupted the class to announce that students needed to answer questions about the advertisements that she had posted first before they found others (Observation 2). In another situation, two of four students who had been assigned to find contact information for a manager at a local grocery store reported that they were initially unsure what they were looking for (Observation 6). After some discussion, they did find a contact email address and had written several questions to send the manager, but the other two students who had been given the same task had only managed to write down the names of the local grocery stores and reported that they just searched for 'supermarkets' in Google to see what they could find. During the final observation, all students appeared to be on task when asked to search for a tool that could be used to record their radio show (Observation 8). However, at the end of the session when students were asked to report back about the tools they had investigated, two groups had looked only at a programme that was installed on the machines rather than an online tool as Zoe had expected them to do. In these situations, students appeared to be unsure of the task goals rather than intentionally engaging in off-task behaviour.

As mentioned, Zoe monitored students as they worked and made frequent announcements to the class to steer students in the right direction if she realised that they had gone off-track. The announcements that occurred during observations appeared to be beneficial to students as those who were being observed often altered their activity to be more responsive to Zoe's instructions.

The physical setting sometimes affected students' progress on their activities. Four times during observations, laptop batteries were running low and students were

forced to change their location in the classroom or switch computers to avoid losing their work. When students worked on the escape plan in the drawing programme on the computers, two of the groups lost their drawings when their computers' batteries ran out before they could plug them in (Observation 3).

Zoe sometimes used the computers primarily to engage students. During observations, most students appeared to be on-task when they worked with digital technologies. However, the learning products did not necessarily reflect deep thinking. An example of this occurred during an activity when students were asked to create an escape plan. In this instance, Zoe later reflected that:

> I was gutted that day because some of the stuff they've come up with on Paint is amazing, but that day it did not work very successfully. And I guess that's the same as probably, if I'd done on paper maybe the next day it might not have worked on paper. (Interview 3)

Students in the focus group spoke enthusiastically about the technology-based activities they had worked on in Zoe's classroom. When they reported that they completed their homework on the LMS, they were asked whether they would prefer working online or with traditional materials. One student reported that she would rather write on paper while the two other students said that they had no preference of one over the other. One student commented, "I prefer both, too, because like sometimes KnowledgeNet can fail, and if it's on like paper it can be just, it's always there unless you lose it or your dog eats it" (Focus group D).

The students in Zoe's classroom reported that they used digital technologies in a number of ways and that they thought that this would be helpful in their future studies. During activities, evidence indicated that students were skilled with the tools they were asked to use such as the LMS, but were frustrated when technical issues resulted in less time engaging in meaningful learning activities. The observations of students working together showed that they worked collaboratively, although students who were not actively manipulating the machine were disengaged from the activity. In addition, clarity around the purpose of the task impacted on students' ability to engage in learning activities while technical issues were frustrating for students and sometimes resulted in lost work.

Chapter 7. CHAT Analysis of School B

This chapter will include an analysis of each classroom case study within School B through the CHAT framework to address the research question: *What underlying processes within a system influence teacher's choice and use of digital technologies in their classroom?* A description of the school context will be explored through a CHAT framework. An analysis of each classroom case will follow which will include a description of tensions within each classroom and an analysis of each of the factors that motivated teachers to integrate digital technologies into classroom activities. Within each case analysis, factors which influenced each participant's activity will be organised and presented in a table. This analysis enables an in-depth critique of the contextual variables that influenced and impacted on teacher practices. This allows an understanding of how contextual, personal, and student factors underpinned teachers' decisions to incorporate digital technology within their learning environments as well as the processes that occurred as they did so.

School B

Within School B, all activity was directed toward the ultimate objective of student learning, and both Jack and Zoe incorporated digital technologies often when working toward this goal. Evidence indicated that the school leadership encouraged teachers to use digital technologies to support the student-centred practices that were expected at the school. However, they allowed teachers to make independent decisions of how best to meet student needs within the guidelines of the school curriculum. Therefore, support was demonstrated through investment in hardware and software and the creation of leadership roles fulfilled by digitally proficient teachers who were asked to lead and assist their colleagues in the use of these new technologies. This section will explain the historical evolution of this sociocultural context and will describe each of these factors in detail as they all contribute to the participants' rationales for and methods of including digital technologies in their classroom practices.

The main focus at School B as communicated through the school curriculum as well as the school website was that classroom instruction was expected to be

underpinned by the key competencies and student-centred in nature. In addition, the school placed an emphasis on literacy and mathematics competency, consistent with the national standards' focus. Beyond this, the principal relied on each individual teacher to decide how to best meet these objectives based on their own pedagogical skills and competencies. School funds were invested in purchasing particular digital technologies that could support this type of teaching, and guidelines were in place to encourage teachers to use these. However, teachers were given flexibility to make their own decisions about how often they made use of these tools, and some were able to accomplish the objectives without using digital tools. Therefore, teachers within the school made use of technology primarily in ways that they believed aligned with the cultural expectations of acceptable teaching methods and enhanced the teaching of skills that were emphasised at the school.

Historically, the leaders at School B had actively supported the integration of digital technologies in a number of ways. Several years prior to the study, School B had participated in an ICT PD cluster, although neither Jack nor Zoe had been at the school when the professional learning took place. More recently, a significant amount of money was invested in hardware and software both for the ICT suite and classrooms, and early in the year of the study a new server was purchased for the school. In addition, Jack and Zoe's comments suggest that school administration allowed them to use digital technologies without restraint and supported the use of technology to meet curricular goals. For the most part, these school leaders took a passive role in supporting teachers in the integration process. Expectations were not clearly communicated to stakeholders such as parents regarding how digital technologies could or should be used at the school, although the school website did contain a list of the digital technologies that were available. The IT Coordinator role and the IT Committee were created to provide leadership in the use of these tools at the school.

Both Jack and Zoe were members of the IT Committee and Jack also served as the IT Coordinator. The IT Committee had been formed in part to make decisions on the spending of money that had been allocated for digital technologies. The committee included both teachers and one of the Deputy Principals (DPs), demonstrating that both the priorities of the school leadership as well as teachers were considered within this context. In addition, the committee members were asked

to model appropriate use of digital technologies and support other teachers who were not as proficient or did not use digital technologies often in their classrooms. Zoe and one other member had also been given one block per week release time specifically to assist other teachers in the use of the LMS (KnowledgeNet). Jack and Zoe were both conscious of their responsibilities in this area and evidence indicated that they made effort to work with their teams and other teachers to share ideas and offer assistance often.

As the IT Coordinator, Jack had slightly more responsibilities than the other members of the IT Committee. He was given a relief teacher (a teacher to provide teaching release) for the equivalent of one day per week and in turn was asked to offer technical support to other staff members when issues occurred. Not surprisingly, problems did not always arise when he was free; therefore, he was often approached for help while he worked with his students. Within the roles of committee member and IT Coordinator, both Jack and Zoe essentially acted as quasi-administrators with the responsibilities of actively communicating the importance and methods of teaching with digital technologies without authority to enforce this use. As a result, both teachers experienced frustration that despite their efforts, many teachers were still reluctant to include digital technologies in their classroom practices. This resulted in tensions that will be discussed within each teacher's analysis.

At School B, emphasis was put on curricular goals and methods of teaching in order to attain the ultimate goal of student learning. The school administration recognised that digital technologies could support the student-centred learning that was encouraged; therefore funding was provided and roles and responsibilities were allocated to confident technology users in an attempt to promote the use of digital tools. However, the teachers within these roles lacked the capacity to require its use. Consequently, some teachers made use of digital technologies quite often in their classroom activities while others did not.

Case Study C: Jack

Jack's decisions to integrate digital technologies into his pedagogical practices were in response to both environmental and personal factors which are outlined in Table 7.1. The primary driving factors in Jack's activity system were his personal

expertise and interest as well as the expectations for his roles of IT Coordinator and a member of the IT Committee. Additionally, students' experience and knowledge, the needs of other community members such as parents, and the mediating tools that were available to Jack and his students were significant aspects of the system that mediated Jack's activity.

Table 7.1. Significant components of the system within which Jack operated

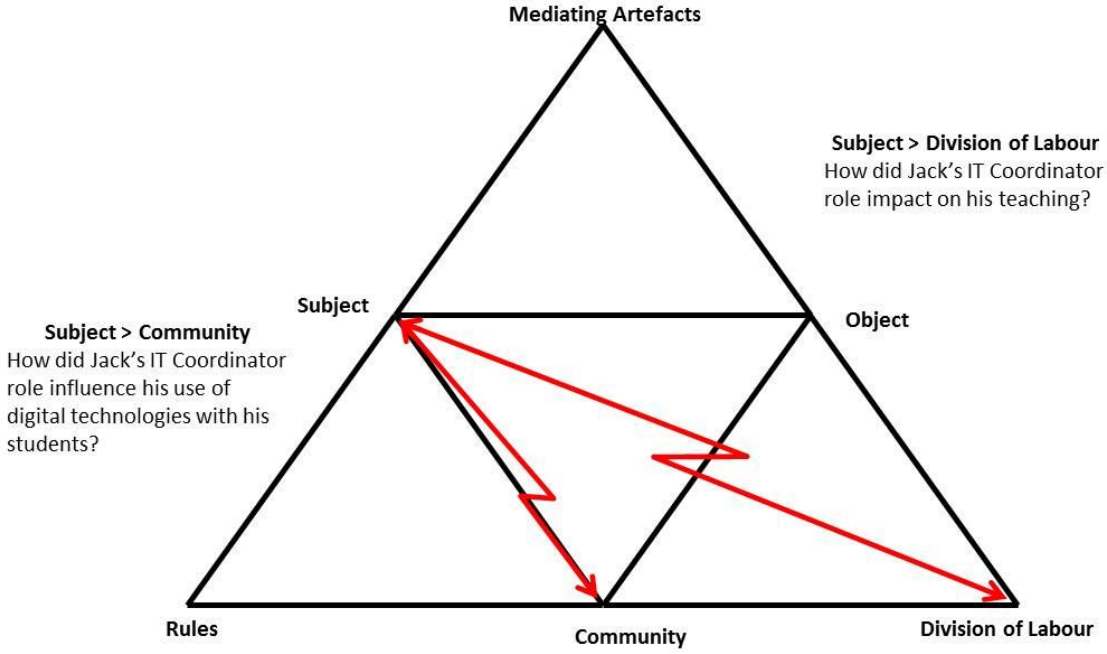
Activity Theory	Factors that influence Jack's activity toward the object
Subject	Jack, an intermediate teacher • Expert technology user and familiar with wide variety of tools • Strong personal interest in digital technology • Believes that students engage more with digital tools than traditional materials • Believes that students are proficient users of digital technology • Serves as the school's IT Coordinator • Member of the IT Committee
Object **Outcome**	Student learning Prepare students for future jobs and life in a digital world
Mediating artefacts	• 7 desktop, laptop, and netbook computers in the classroom • ICT suite which includes 25 student computers and a large television connected to a computer for demonstrations • An IWB within the classroom • A classroom digital camera and a classroom video camera • 25 digital cameras and 5 video cameras available for check-out • Programmes provided by the school (i.e., LMS) • Wireless access to the Internet that was sometimes unreliable • IT help one day per week
Community	• Students • Parents of students • Administration • Other teachers at the school
Division of Labour	• Jack's students assisted each other while using digital technologies • Jack spent the equivalent of one day per week assisting other teachers with technical issues
Rules	• National and school-specific curriculum • As IT Coordinator and part of the IT Committee, there were expectations that Jack would facilitate technology use at the school and model appropriate technology integration for the benefit of other teachers • Guidelines for technology use that are not strictly enforced

Tensions that created learning opportunities for Jack

The in-depth analysis of the activity system uncovered two primary tensions which affected Jack's progress towards supporting student learning, the object of activity (see Figure 7.1). Several underlying factors contributed to tensions within the

system. The first tension became evident between the subject and the division of labour as a result of Jack's role as the IT Coordinator impacting on his activity with his students. In addition, a second tension occurred between the subject and the community due to Jack's commitment to making the best use of the tools available sometimes without fully considering the needs of students. The following sections will describe these tensions in detail.

Figure 7.1. Tensions between components of the system within which Jack operated



Tension between the subject and the division of labour

Jack's primary focus within his classroom was student learning and his activity reflected this. However, within the school he assumed the additional role of IT Coordinator which entailed many additional responsibilities at the school level that sometimes did not coincide with his classroom goals. Jack had been the IT Coordinator for two years before the study began due to his high level of expertise with digital technologies. The role required him to offer technical assistance to other teachers when they experienced problems, contribute to decisions regarding the spending on school funds for new hardware and software, and model appropriate use of technology for his peers. While Jack was allocated a relief teacher so that he had more time to fulfil these responsibilities, he was not always able to predict when he would be needed. As a result, there were instances when time that he had previously

dedicated to teaching or planning classroom activities was instead spent performing other obligations. For example, Jack reported that students brought broken devices to him from other classes throughout the school day and during one observation, another teacher came into the ICT suite when Jack was working with students and briefly took his attention away from students. This activity contributed to the division of labour of the other teachers at the school and therefore influenced the overall school's object of student learning. However, this sometimes detracted from the learning of his own students as he was able to spend less time actively engaging with them as a result.

Jack reported that over time he had negotiated how he responded to the responsibilities of the role while still fulfilling his classroom duties. While he had initially prioritised the needs of teachers with technical issues when broken devices were brought to his classroom, more recently his attention had shifted back to his students as his main concern. However, as demonstrated previously, over the course of the study the IT Coordinator role occasionally hampered his activity toward his own students as his primary concern.

Another aspect of this tension occurred within the IT Coordinator role as Jack worked hard to promote the use of technology throughout the school, but did not have the authority to require teachers to follow through with this use. His experiences in the job over the previous two years had demonstrated that although he could offer technical assistance and training to teachers to encourage them to use digital tools, not everyone would change their practices. This frustrated Jack as he was unsure how to adequately fulfil the IT Coordinator role when he could provide ample support, but the decision to change remained entirely with the teachers.

Tension between the subject and the community

As previously described, the administrators at School B had invested in a variety of hardware and software that were readily available to Jack and the other teachers at the school including the ICT suite, laptop and desktop computers in each classroom, and digital video cameras. As part of his responsibilities as IT Coordinator and member of the IT Committee, Jack had assisted in selecting these digital tools; therefore, he wanted to ensure that the purchased tools were being used. This along with his personal interest in digital technologies and his responsibility of modelling the use of

tools to other teachers sometimes motivated Jack to plan activities around specific hardware or software rather than considering what activity would best facilitate student learning. For example, Jack divided his students into three groups of ten so they could work in pairs on the five available computers during mathematics rotations. While he still grouped students who had similar ability levels, his primary concern was ensuring that there were equal groups so that every student got an equivalent amount of access to the technology. In other situations student need was a primary concern, but Jack chose to integrate digital tools into the lesson because in his view, the interactive nature of the tool would motivate and engage students, which in reality was not always the case.

A slightly different aspect of this tension resulted when attributes of the digital technologies dictated the way that students were able to complete activities. For example, when using Fluxtime.com to create animations, the pictures and scenes that were available within the programme set limitations on the stories that could be portrayed. Additionally, interactive websites such as Thatquiz.org allowed students to choose the skills and levels to engage with, but did not provide adequate feedback to enable new learning to occur when a student did not fully understand a concept.

Despite these tensions that occasionally occurred in Jack's classroom, it is important to note that for the most part, Jack was able to appropriately match the affordances of the tools that were available with activities that led to student learning. This is described in more detail in the following section.

Activity in Jack's classroom

Jack considered his primary responsibility as that of classroom teacher; therefore the majority of his activity within his classroom was directed toward his students as his primary focus. In addition, he had a strong personal interest in digital technologies and spent a considerable amount of his personal time learning about the newest gadgets and programmes. As a result, Jack had a strong knowledge of the affordances of the tools that were available at the school and therefore was able to integrate these into his classroom practices in a variety of ways. In addition, Jack was aware of his responsibilities as IT Coordinator and considered the needs of his students as well as

stakeholders such as students' parents when considering how to make the best use of the digital tools that were available.

As demonstrated by the research, Jack's use of the digital tools available within his classroom and the school environment was mediated by his personal beliefs about his teaching practice as well as ideas about students' characteristics. Jack was motivated to provide all of his students adequate and individual instruction that they needed to succeed in the classroom and in their future lives. He believed that students needed to be proficient technology users in order to function in the world, so he spent considerable effort developing their technical knowledge. Jack was aware that learners had varying interest and ability with digital tools, therefore he spent time informally assessing their needs and capabilities early in the school year. New digital tools were introduced within familiar content areas by providing a few simple instructions and then allowing students time to explore the tool. This built student knowledge and proficiency with the tool so that later in the year they would be able to create similar projects while they focused on the content rather than the technology. These activities were facilitated by the ICT suite which allowed all students to access a computer simultaneously. In addition, this type of instruction was supported by the school culture because: 1) Jack was actively modelling methods of integrating digital tools to his colleagues; and 2) he was equipping students with skills that would enable them to have agency in future activities, therefore enhancing student-centred pedagogical practices supported by the school.

A number of digital technologies were integrated with the intention of meeting student needs while also satisfying curricular goals. For example, in line with the curriculum goal of 'developing independence', Jack wanted students to learn to develop personal goals based on their own skills and be able to monitor and modify these easily. Therefore, he asked them to complete this task within the web-based Learning Management System (LMS) so that they could be easily accessed within both the school and home environment and eventually shared with parents who were important community members. Additionally, ensuring that students were proficient in mathematics, reading, and writing was a priority for the school, hence Jack made use of data from testing to individualise instruction and incorporated web-based programmes into classroom rotations to provide practice that he believed was more

engaging for students. In addition, Jack was keen to use the LMS more often during activities because he was aware that he needed to report on students' progress against the National Standards. In his view, the ability of the programme to store data throughout the students' two years at the school would allow teachers to complete this requirement with little effort.

School initiatives regarding appropriate pedagogical practices prompted Jack to make use of digital technologies in specific ways. For example, during one observation Jack spoke of research presented during a staff meeting which suggested that student collaboration enhanced learning. Therefore, activities were deliberately planned in which students were given time to work cooperatively on computer-based tasks and students were place in a role in which more experienced students assisted those who were less knowledgeable. In addition, inquiry-based learning was implemented at the school and Jack considered both the Internet and computer-based creation tools to support students as they developed and attempted to answer questions about broad topics such as diversity and demonstrated their new knowledge through computer-based projects.

Jack considered parents to be important to the overall education of their child, and he therefore deliberately chose to include them in the learning process, thus creating their relevant role within the activity system. This was one of the primary rationales for using the LMS as a repository for both work and assessments as Jack believed that the accessibility of the system enabled parents to be well-informed of students' progress over the course of the year. In addition, the possibility of using information stored in the LMS in place of written reports motivated Jack to ensure that the system was used regularly and that parents were familiar with the process of accessing information in this way.

By the end of the year, Jack had developed his pedagogical practice in order to accommodate the changing needs and restrictions of both the school and the students. First, students had occasionally been permitted to use their own devices such as cell phones during specific activities earlier in the year, but Jack reported that he had begun to allow them to use these tools more often and planned to do so even more in the following school year. This was due in part to the limitations of the school system as students were beginning to create projects which required more space than was

available and also due to the expense of purchasing devices. Jack realised that as more of his students had their own cell phones and other portable devices that they could use in class that the school could invest in other resources to support this such as Ultra Fast Broadband. In addition, as a method of motivating students, Jack introduced the idea of a class blog where exemplary work could be displayed to an authentic audience from around the world via the Internet.

Case Study D: Zoe

Zoe's activity within her classroom environment was mediated by personal, student, and contextual factors. Table 7.2 lists these aspects in alignment with the CHAT framework. Zoe's own beliefs and skills as well as her perceptions of the learners within her classroom were key factors in the system. Zoe considered a number of mediating artefacts available within the classroom when determining implementation procedures. In addition, parents were important community members that were taken into account when designing learning activities. Finally, a number of cultural expectations within the system such as Zoe's role as Learning Leader and member of the IT Committee contributed to the use of digital technologies within her classroom.

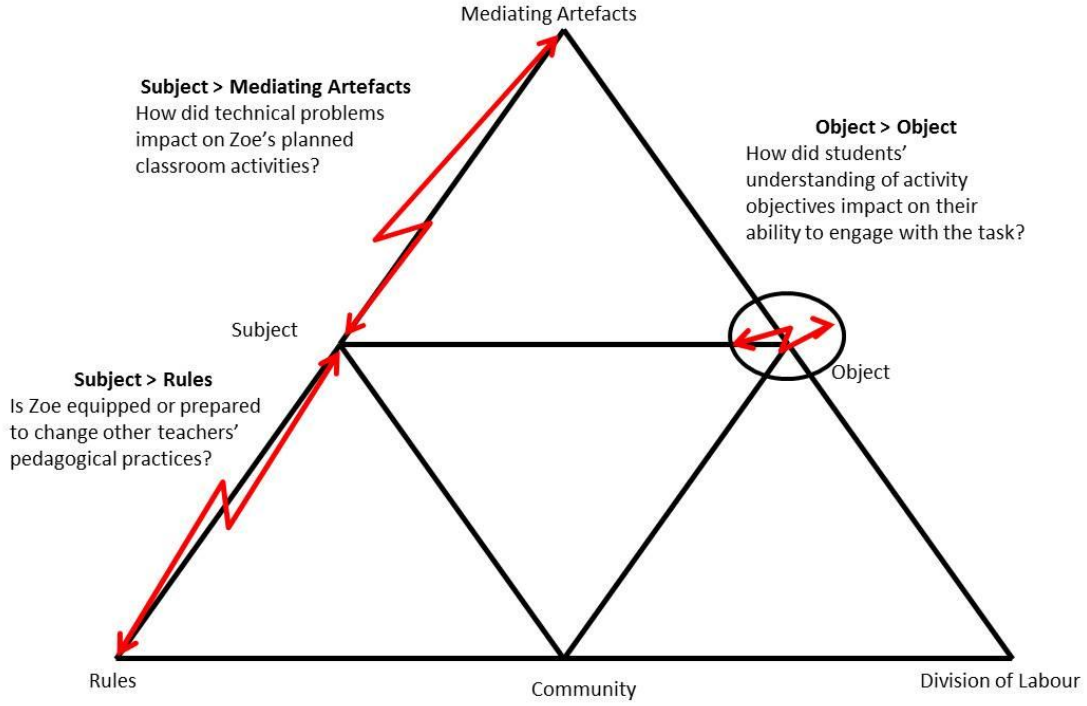
Tensions within the activity system

The in-depth analysis of the activity system within which Zoe operated revealed three primary tensions within the system (see Figure 7.2). The first of these tensions occurred between the subject and the division of labour as a result Zoe being uncertain how to fulfil her additional roles. The second tension occurred between the subject and the mediating artefacts as technical issues sometimes prevented Zoe from fully attaining her goals. Finally, a third tension became apparent within the object of activity when the purpose or procedures of classroom activities were unclear to students. These contradictions will be described in detail in the following sections.

Table 7.2. Significant components of the system within which Zoe operated

Activity Theory	Factors that influence Zoe's activity toward the object
Subject	Zoe, an intermediate teacher • Proficient technology user and familiar with a range of digital tools • Believes that students engage more with digital tools than traditional materials • Believes that students are proficient users of digital technology • Member of the IT Committee • Learning leader of her team of 5 teachers
Object **Outcome**	Student learning Prepare students for future jobs and life in a digital world
Mediating artefacts	• 12 desktop, laptop, and netbook computers in the classroom • ICT suite which includes 25 student computers and a large television connected to a computer for demonstrations • An IWB within the classroom • A classroom digital camera and a classroom video camera • 25 digital cameras and 5 video cameras available for check-out • Programmes provided by the school (i.e., LMS) • Wireless access to the Internet that was sometimes unreliable • Limited power outlets • IT help one day per week
Community	• Students • Parents of students • Administration • Other teachers at the school
Division of Labour	• Zoe shared ideas about how to use technology with members of her team • Zoe's students assisted each other while using digital technologies • Zoe spent two blocks per week (a total of 3 hours) assisting other teachers with the LMS
Rules	• National and school-specific curriculum • As a member of the IT Committee, there are expectations that Zoe would model appropriate technology integration for the benefit of other teachers • Guidelines for technology use that are not strictly enforced

Figure 7.2. Tensions between components of the system within which Zoe operated



Tension between the rules and the subject

Zoe's roles as member of the IT Committee and KnowledgeNet specialist required her to spend a significant amount of her preparation time assisting other staff members with the LMS, and she reported at the beginning of the year that she spent all of her allotted time away from students supporting her peers who were having issues with aspects of the LMS. While she reported that much of her time was spent coping with low-level technical assistance such as changing passwords which she was fully capable of doing, she also realised that part of her responsibility was changing teachers' pedagogical practices in encouraging them to use digital tools, and she was unprepared and unequipped to fulfil this requirement. Zoe had attended KnowledgeNet conferences and used the tool often in her own classroom, so she had many ideas about how it could be integrated successfully into teaching practices. However, she was aware that simply showing her peers how to use new tools would not necessarily modify their practices and this created a tension for her as she was uncertain how to fulfil this role successfully.

Another aspect of this tension resulted because Zoe spent time allocated to her Learning Leader role helping her colleagues with KnowledgeNet instead. This gave an

indication of her dedication to the role and her belief that expectations of the role sometimes required more time than she was allocated to accomplish these duties. However, this took time away from performing both her Learning Leader and classroom teacher responsibilities, which contributed to this tension.

Tension between the mediating artefacts and the subject

Activities in Zoe's classroom quite often included and were based around specific digital technologies. Therefore, when technical errors occurred that were unable to be repaired in a timely manner, lessons sometimes were not able to be executed as planned. For example, Zoe depended on the wireless Internet access in the room as nine of the 12 classroom computers were laptop computers, but throughout the study there were several times when the wireless access was not working on some or all computers and students could not engage in the planned activity. While Zoe reported that this did not deter her from planning to use the Internet or other digital tools, she often had a backup plan in which she printed off information that students had been asked to access in the event of a connection failure. As a result, Zoe constantly had to be aware of the status of the Internet access and the devices in her classroom, so she could make other resources available if necessary. At times, Zoe reported that she had been forced to completely terminate activities such as the example in which she spoke of a day when she had planned to have students access the Internet, but they were unable to connect. These issues forced Zoe to swiftly come up with alternative activities when they occurred.

Tension within the object of activity

As outlined in Chapter 6, evidence indicated that Zoe perceived learners to be proficient technology users and wanted to provide them with control over classroom activities which aligned with her student-centred beliefs. Therefore, she often assigned students tasks in which she gave limited instructions when introducing lessons that included digital technologies with the aim of building students' cooperative skills and problem-solving capabilities. However, observations of student actions suggested that at times this created a situation in which the purpose and the procedures of the activity were not clearly defined for students, leading to a lack of clarity around the object. The unintended outcome of this lack of clarity around the object resulted in

students being motivated to complete, rather than understand, the activity. As a result, the students sometimes did not understand how to engage with the task in the way that Zoe had intended. When Zoe realised that this was happening, she redirected students through specific verbal instructions as they worked on the task. However, at other times she did not recognise that students were off course and they did not complete the activity in the way that Zoe had anticipated, creating a situation in which some students did not attain the goal of the activity.

While all three of the tensions described influenced Zoe's progress toward the object of activity, many factors of the system served to reinforce her activity as well. In the following section, aspects of the sociocultural context which impacted on Zoe's decisions to include digital technologies within her classroom will be discussed in detail.

Activity in Zoe's classroom

All activity within Zoe's classroom was directed toward her students, the object of activity. Zoe was aware of the student-centred teaching practices that were communicated through the school curriculum and website, and these matched her own beliefs about effective teaching practices that had developed over time. A variety of different hardware and software tools were incorporated into Zoe's classroom to facilitate her preferred practices as well as to meet the needs of students. Her view was that digital technologies were utilised regularly by both adults and her students outside the classroom, so they should also be used within the school setting. In addition, she believed that nearly all jobs would require employees to use computers and other digital devices in the future; therefore she considered one of her responsibilities to be providing students experiences with and instruction in using digital technologies effectively. The devices that were available within the school, particular community members, and her additional roles of Learning Leader and member of the IT Committee all served as motivations for Zoe as she planned and executed classroom instruction.

Zoe identified with cultural expectations that one of the purposes of schooling was to prepare students for future jobs and their participation in the modern world. Therefore she was highly motivated to include digital technologies in her classroom activities as her experiences had led her to believe that technological skills were

essential for the careers that students would be pursuing. This was reinforced by specific information that Zoe had read relating to the needs and attributes of 21st century learners that she disclosed had shaped many of her ideas about her students. Zoe realised that a variety of digital devices were becoming more accessible to her and her students and she wanted to ensure both that there was not a disparity between these two environments and that students' personal devices were utilised within the classroom. Therefore, student-owned and/or school-owned digital devices were included in nearly every activity in Zoe's classroom.

Student-centred practices were encouraged by the school leadership team and these aligned with Zoe's own beliefs about effective pedagogy. She reported that over the course of her nine years teaching she had engaged in dialogue with colleagues and read books and other research on pedagogical practices that were appropriate for learners at the intermediate-school level. These materials shaped her view of teaching and motivated her to plan activities in specific ways which aligned with the student-centred practices that were emphasised at the school. In addition, the KnowledgeNet conference that Zoe had attended provided her with new ideas of incorporating the LMS into her teaching to support her pedagogical practices.

The school curriculum and expectations communicated through the school website reinforced Zoe's beliefs that students would benefit from an approach which would require students to be active, responsible participants in their own learning. Therefore, she planned activities in which students were given agency through digital tools such as the Internet which transferred power from Zoe to her students as they could locate information independently. Zoe was aware how the affordances of the tools could support the type of instruction that was expected at the school and that she believed would be most conducive to student learning. An example of this was Zoe's use of the LMS, which she used regularly as an easily accessible location where both she and her students could post instructions, learning resources, and new knowledge. In this way the LMS had become essential to Zoe's teaching practice as attributes of the tool itself enabled her to teach in the ways that she perceived to be culturally acceptable as well as most effective for her students.

The number and quality of the digital devices that were available within the school and the classroom mediated Zoe's activity directed toward student learning.

Besides having access to the seven laptop and desktop computers allocated to her classroom, Zoe had acquired five dated iMacs that became available through the school. While these additional computers were able to access the Internet through wireless, they were not able to connect to the school network. Furthermore, none of the technical specialists knew much about the Apple platform, so when these machines were not working properly Zoe was forced to fix them herself, taking time away from her other responsibilities. However, she persevered with the machines because students could use them to access both information and the web-based LMS and therefore the student to computer ratio was significantly lower when they were in play. Therefore, many of the activities in her classroom were based around the number of machines that could be used for that particular lesson. For example, when she wanted all students to be working with the technology simultaneously, the number of computers dictated the size of the groups. Finally, Zoe was given an interactive white board at the start of the year, but she was not satisfied by the quality of the writing that appeared when using the electronic pen. Therefore, she used the device more as a regular data projector connected to her laptop computer.

Students' own devices also affected Zoe's activity as she was aware that over time more of her students possessed personal cell phones and smartphones with a variety of features such as audio and video recorders, Internet access, and cameras that could be used during classroom activities. The portable nature of these devices and the students' familiarity with their own personal technologies motivated Zoe to ask students to use these for activities such as the scavenger hunt in which learners used their cell phones to take pictures of places outside the school grounds which matched written or picture clues. Zoe also realised that if students were able to provide their own devices that be connected to the school network, then school funds allocated for digital technologies could be spent on Ultra Fast Broadband or other school-wide technology initiatives. Furthermore, allowing students to use their own devices transferred more control to the learners, once again facilitating the student-centred environment that Zoe strived to nurture.

Zoe's additional roles of IT Committee member, Learning Leader, and KnowledgeNet specialist all acted on her progress toward her goals. Because of the additional duties associated with these positions, a relief teacher came into the

classroom two blocks per week which meant that she had to plan activities that the relief teacher would be able to undertake. She revealed that at times, the relief teacher was not familiar with or comfortable allowing students to use the digital tools that Zoe and her students relied on during learning activities, and this sometimes caused difficulty when learning tasks were not carried out as Zoe had intended. Additionally, Zoe was aware that part of her responsibility as member of the IT Committee was to model appropriate teaching with digital tools and this was reinforced by the leadership position she held in her team. Therefore, she spent time during team meetings sharing ideas related to the integration of the LMS and other digital tools to encourage others to make use of them as well.

Zoe believed that parental involvement was essential to the overall education of their child, and therefore she intentionally included them in the learning process. Digital tools such as the LMS provided a venue where parents could see evidence of their children's progress and Zoe looked forward to an upcoming stage when parents would have their own passwords for the system and could become actively engaged in school-based lessons.

Finally, student needs were a primary concern for Zoe and as described, she endeavoured to meet these based on her views of 21st century learners that had developed through her own investigation and cultural expectations at the school. One of her beliefs related to this was that students would be more engaged in activities that included digital technologies. Therefore she often integrated digital tools with the primary intention of making activities more engaging and motivating for students, such as when she asked them to create an escape plan in the Paint programme.

A number of factors within Zoe's environment impacted on her decisions to integrate digital tools into her classroom activities. The majority of the time, her personal beliefs aligned with school curriculum and cultural expectations around appropriate methods of teaching and the incorporation of digital technologies to support these practices. However, other aspects of the sociocultural context also influenced her decisions to use digital tools such as the availability and attributes of technology, additional roles that she was expected to fulfil, and the needs of parents.

Chapter 8. Cross-Case Analysis

The four cases provide insight into the participating teachers' rationales for and methods of integrating digital technologies into their classroom practice. At times this meant integration of technology into their pedagogical practice, and at other times it focused on means to manage information between the school, child, and parents. The specific analysis of the individual school and classroom environments in which these teachers were situated highlight the diverse factors within each sociocultural context. Combined, these influenced the participating teachers' decisions to include digital technologies. The subsequent findings and analysis of each classroom case involved examining each case study independently within the school context within which it was situated. A further analysis entailed the examination of data and findings across the case studies; these are discussed within the current chapter.

The chapter is divided into three sections. First, it begins by addressing the first two research questions of *why* and *how* teachers chose to incorporate digital tools; not surprisingly, these findings tended to be intertwined. Second, the chapter presents an examination of students' experiences of working with digital technologies as they participated in teacher-planned lessons. This provides insight into factors that influenced their participation in these activities. Finally, a Cultural-Historical Activity Theory (CHAT) analysis of each of the cases addressed the final research question by uncovering relationships between sociocultural and personal factors within each case which served to influence and motivate teachers to make these decisions.

Rationales for and methods of integrating digital technologies

All teacher participants within the study were proficient users of variety of digital technologies in their personal and professional lives and were able to use the tools provided at the school for their own personal purposes. Furthermore, the research findings show that these teachers were motivated to include digital technologies into their classroom practices for a number of reasons and were able to accomplish this in a range of ways. Table 8.1 below displays rationales for integrating digital tools that were identified by three or more teachers (these are listed along the left side of the

table). Within each teacher column, data are listed which provide examples from interviews and observations. Combined, these illustrate why and how digital tools

Table 8.1. Teachers' rationales and methods of integrating digital technologies

		Helen	Fiona	Jack	Zoe
Support pedagogical practices	**Collaboration**	Students were placed in groups of 3-4 while playing estimation games (O5)	Students worked in pairs when working on mathematics learning object (O3)	Students worked in groups of 3-4 to film a video for victims of the Christchurch earthquake (O3)	Students were placed in groups during every observation when working with digital technology (O1-O8)
	Student motivation and engagement	Computers were used for one rotation during mathematics in order to make practice more engaging (O2)	Students typed their descriptive verbs into a Google Doc that was projected at the front of the room for motivational purposes (O4)	Computers were used for one rotation during mathematics in order to make practice more engaging (O8)	Students used the Paint program rather than traditional materials when creating their escape plan for "Badjelly the Witch" (O3)
	Student agency and autonomy	Students were given opportunities to discover and explore new digital tools rather than being given instructions on their use (I5)	Students were given opportunities to be more responsible for their own learning through the use of digital tools (I3)	Power was transferred to the students so that they could manage their own learning within the school LMS (I4)	Students were asked to explore different Internet-based audio recording options so that they could eventually choose one to record their radio show (O8)
	Practise content-based skills	Students practised estimation skills by interacting with online mathematics games (O5)	The CSI software was used when teaching a literacy lesson on how to visualise when reading (O7)	Students accessed Thatquiz.org to practice reading and interpreting graphs (O8)	Students accessed a news article online and then answered questions about it in the LMS (O4)
	Access to information	Students accessed travel websites to find flight information online during the "Amazing Race" activity (O7)	Students were able to access up-to-date information online (I3)	Students were able to use the computers to research (I4)	Students researched the proposed Wellywood sign online to prepare for a debate on whether or not the sign should be constructed (O7)
	Individualise instruction	Students were provided with specific individualised activities to personalise their learning (I5)	Fiona demonstrated how she assigned students particular lessons in the interactive Mathletics website based on their standardised test results (I3)	Students wrote their own goals based on standardised tests taken at the beginning of the year (O5)	

		Helen	Fiona	Jack	Zoe
	Repository for work available outside classroom	Helen constructed her lesson plans on the school's LMS where they were available to students and parents to view at home (I5)	Fiona embedded her planning in the school's LMS where they were available to students and parents to view at home (I3)	Students completed their learning goals in the LMS so they could access these at home to guide homework activity (O5)	Students completed work within the LMS so they could continue working at home (I3)
Communicate with parents		Email was utilised to keep in regular contact with parents (I5)	Email was utilised to keep in regular contact with parents and student work was projected to the front of the room during learning conferences (I3)	Parents were going to be able to access their children's work from home through the LMS (I1)	Parents were going to be able to access their children's work from home through the LMS , creating a line of communication between home and school (I2)
Comply with school policy/expectations		All classroom teachers were expected to create and update a class blog regularly (I5)	Fiona spent planning time working to link her students' learning with the school's e-portfolio system (I5)	Jack believed that an important aspect of his role of IT Coordinator was to be seen using IT and to help other people use IT in their classroom (I4)	Zoe shares ideas of how to use the LMS during team meetings and models its use to fulfil her role as IT Committee member (I3)
Prepare students for a digital world		Helen believed that her students needed be able to use a computer to function successfully in the world (I5)	Fiona believed that technology was a significant part of her students' lives outside of school and that it was part of her responsibility to teach them how to use it effectively (I3)	Students were asked to use video cameras and video editing software to film a message for the Christchurch earthquake victims in part to give them experience with technical aspects that they would likely need in their future jobs (O3, O4)	Zoe believed that part of her responsibility as a teacher was preparing her students for their future jobs that did not currently exist (I3)

Rationales are listed along the left column while the methods populate the centre of the table. Key: O=Observation I=Interview

were included within each corresponding teacher's classroom. The next sections will discuss the purposes for including digital tools identified by all four of the teacher participants. These included: support pedagogical practices; communicate with parents; comply with school policy and expectations; and prepare students for a digital world.

Support pedagogical practices

All four teachers in the study had distinct beliefs and knowledge about methods of teaching that would most benefit their Year 7 and Year 8 students and predominantly chose to incorporate digital tools in ways that aligned with and supported these existing beliefs and practices. Despite their varying philosophies, several common purposes for incorporating digital tools emerged from the data. All four teachers perceived that digital tools could be utilised to facilitate collaboration between students, motivate and engage students, promote student agency, practise content-based skills, and provide access to information. In addition, three teachers described ways in which technology was used in their classroom to individualise instruction and three of the four teachers believed that digital tools could be used as a repository for student work that could be accessed outside the classroom. As a result, teachers integrated digital tools into their teaching practices with these objectives in mind. The following sections will outline each of these rationales with supporting evidence from each of the case studies.

Collaboration

All four teachers reported that they made use of digital technologies to facilitate cooperative learning and activities were observed in each classroom in which at least two learners worked together with one device to complete a specific task. Evidence revealed that in some cases, the number of available computers or other devices influenced or dictated such decisions. For example, during mathematics and literacy rotations, Jack purposely grouped students so that one group of 10 students could work in pairs on the computers available in the classroom. In addition, Fiona commented that, "Sometimes I plan a lesson using group work as I know I can't have every child on a computer, so this influences the number of times we do cooperative learning" (Fiona, Interview 3). However, teachers also believed that group work and

collaboration was an effective pedagogical method for intermediate school students as well as a skill which they should develop. For example, Jack explained “these kids learn best in small groups…I think it's probably more the age and as they get older that will continue to be the way it is” (Jack, Interview 2). In addition, Zoe remarked:

> I don't think I would have a laptop per kid all the time. I think I'd have access to it, but the whole proven research around group work versus individual work, it's so strong on the group work side, that if you had a laptop per kid, you are taking away that amazing cooperative group work side of school. (Zoe, Interview 3)

All teachers had both Year 7 and Year 8 students in their classrooms and spoke of instances when they asked the older and more experienced students to assist the younger students. For example:

> [Student name] has done quite a bit on the blog last year. He's very cooperative, he's a leader in the class, so now I tend to say, "One of the Year 7s, can you go and post? [Student name], can you go show them how to get started?" (Helen, Interview 5)

> I do [depend on the Year 8 students to teach the Year 7 students]. Usually when I'm busy, and only when I know that the Year 8s should have been taught the skill before. (Jack, Interview 1)

When students were asked to assist each other in this way, they were placed in a role of technical assistant or instructor, thereby contributing to the overall objective of student learning within the classroom.

Motivation and engagement

Digital technologies were utilised in every classroom to motivate students or engage them more fully in the activity. This was most likely to happen during mathematics or literacy lessons in which students were taught a skill and then given time to practise that skill. Each of the teachers remarked that when digital technologies were used in place of traditional books, paper, and pencil, students were more interested in the activity and produced more in-depth and interesting learning products as a result:

> They are so engaged by, "Oh my gosh, I get a laptop, I get to do my work on the laptop." You get better work out of them just because they're on a laptop, which, you know, I've kind of always doubted when you've been to all these

> conferences about the use of technology and things and they always say, "Ah, kids will love it." You kind of think, "Really?" But yeah, they do. (Zoe, Interview 3)

> It's [computers] one of the rotations [for literacy] and they just are automatically more engaged if it's on the computer rather than a piece of paper even if it's the same kind of thing. Automatically more engaged. (Helen, Interview 5)

While engaging students was often one of several rationales for using digital technologies during many classroom activities, in some situations teachers incorporated these tools mainly for this reason. This occurred in Zoe's classroom when students were asked to draw a picture in the Paint programme on the computer rather than drawing the escape plan using traditional materials (Zoe, Observation 3). At other times, digital tools were used to provide a different way of presenting or practising material in a format that the teachers felt the students would enjoy. This occurred during observations in Helen, Fiona, and Jack's classrooms when teachers asked students to access interactive websites during literacy or mathematics rotations so learners could practise specific mathematics and literacy skills.

Student agency and autonomy

Common across all four teachers participating in this study was their belief that students in their classroom were competent technology users, sometimes viewed more knowledgeable than the teachers themselves. Each of the four teachers regarded this situation as an empowering opportunity to shift control and power to students during activities in which digital tools were utilised; effectively providing students with agency and autonomy within the learning environment. This was consistent with the pedagogical belief that facilitating a student-centred environment would promote student learning. Statements from each of the participants demonstrated this awareness and shift in power that resulted:

> They are so much better at everything than I. I mean, I don't teach myself stuff now, I just get them to. If I want to learn how to put a movie onto YouTube or even make a movie, I just say, "Someone's going to have to teach me how to do this." (Zoe, Interview 3)

> I tend to kind of let them go and then see if they need support. And if they're stuck then I'll go and help them, but it's much better if they can figure it out themselves. (Helen, Interview 5)

Teachers made use of digital tools to provide students with a sense of autonomy when they offered students choice during learning activities. This was observed in Zoe's classroom when she gave her learners time to explore the features of a number of web-based recording tools and allowed them to use the one that best suited their needs to record a radio show they had written (Zoe, Observation 8). Students also developed a sense of agency when they were given the opportunity to have an impact on what happened within their classroom environment. This occurred in Helen's classroom when students were asked to provide feedback on their classroom experiences in an online survey created in Google Docs. Helen later used this data to inform her classroom practices (Helen, Observation 3 and Interview 2).

Within these four classrooms, digital technologies played a central role in enabling teachers to establish learner-focused environments. Students were considered to be experienced technology users who were often proficient with a range of digital tools and could be relied on to explore and work out how to use these with little teacher assistance. As a result, teachers perceived digital tools to directly facilitate a transfer of control to the students and therefore provided these students with a personal sense of agency and autonomy within the classroom.

Practise content-based skills

Interactive Internet-based activities and software purchased by the school were used in each classroom to provide students a means of practising specific content-based skills in a range of content areas. This was primarily observed during mathematics and literacy instruction in which students rotated through learning stations throughout the lesson and one rotation was spent working with computers on sites pre-chosen by the teacher. During these activities, teachers generally asked students to work in pairs and the purpose was generally to supplement traditional paper-based practice with a more engaging and interactive approach:

> I've got three reading groups all doing three different learning intentions. One of them was differentiating between fact and opinion, so when it came to their time on the computers they worked on Skillswise [website] on an area that was all about fact and opinion in text. So it's trying to reinforce what I'm doing as opposed to just giving them busy work just so they can go on the computers. It's still got to be relevant. (Jack, Interview 4)

> We have six computers in the class. I use them as another part of my maths rotations. So they might have teaching group with me, a worksheet, an activity, and then a computer activity. (Helen, Interview 5)

Access to information

The research findings indicated that both teachers and students accessed a range of resources and information from the Internet during classroom activities. At times, this was teacher-led such as Helen's reported use of retrieving YouTube videos to clarify abstract concepts which were difficult for students to understand (Helen, Interview 5). A similar method was used by Zoe during an observation to illustrate the destruction that had been created by the Christchurch earthquake:

> When I came in at 10.55am the students were sitting on the floor and Zoe was sitting at the front of the room with her laptop showing students some of the before and after pictures of the Christchurch earthquake on the Stuff.co.nz website through the TV connection. She demonstrated to students how to use a slider that could be dragged across each picture which displays the building both before the earthquake and after (most of which were completely destroyed). (Zoe, Field notes, Observation 2)

During other observations, students accessed the Internet individually or in groups to locate information as part of projects or activities. For example, students in Helen's classroom were directed to travel websites during the "Amazing Race" activity to plan a mock journey around the silk route that they could fit into a specific budget (Helen, Observation 7). In addition, students in Fiona's classroom accessed information about the Kupe oil field off the western coast of New Zealand through a virtual field trip website which included short instructional video clips (Fiona, Observation 6).

Individualise instruction

Digital technologies were utilised in three of the four classrooms in order to individualise instruction for students. Within each of the four classrooms in the study, students were tested on their prior knowledge in reading, writing, and mathematics early in the school year using Assessment Tools for Teaching and Learning (e-asTTle) and the Progressive Achievement Tests (PAT) and teachers were given an electronically generated printout of every student's achievement on each of the items on the test. Fiona displayed these to the researcher during an interview and pointed out "online assessments such as e-asTTLe and PATs give you detailed information…and it's handy

because it helps you as a teacher give them their next steps" (Fiona, Interview 3). Jack gave test results to students so they could create their own goals in the LMS which would guide them in their homework activities until the goals were re-assessed (Jack, Observation 5).

Helen made use of the many resources available through the Internet to access specific interactive games and activities for students in order to differentiate instruction. During one observation Helen found different web-based activities for each of the mathematics ability groups to access during rotations where they could practise a specific mathematics skill she had taught within the previous few days (Helen, Observation 2).

Repository for work available outside classroom

Finally, three of the four teachers in the study used web-based repositories such as the LMS, e-portfolio system, or Google Docs as a location where information could be posted by teachers and students and accessed from any computer with Internet capabilities. Zoe often posted instructions for students and asked them to record information within the LMS system utilised at School B; this was observed when students completed a literacy activity in which they accessed an online news article and answered questions about the article that had been placed on the LMS (Zoe, Observation 4). Students who had not finished during class time could then access and finish the assignment at home through the Internet. Additionally, the students in Jack's class entered their learning goals into the LMS specifically so that they could be accessed at home to guide homework activities (Jack, Observation 5). Fiona reported that she and her students used Google Docs to store and share work that had been done in the classroom and at home:

> Google Docs has been easy for us because we just save…anything that they do…onto their Gmail. That's been good. (Fiona, Interview 3)

To conclude, each teacher within this study recognised how digital technologies could be included in their classroom activities to support and enhance the pedagogical practices that they believed would most successfully facilitate student learning. The previous sections described specific purposes for using digital tools that were evident across the cases. Furthermore, a range of digital technologies were used to fulfil

additional and broader educational obligations which are outlined in the following sections.

Communicate with parents

Communication tools available at each of the school including email, LMS, and class blogs were valued by all of the teacher participants as they provided a means of keeping parents informed of classroom activities. Both Helen and Fiona reported that they posted their lesson plans online, ensured that posts were made to the class blog on a regular basis, and emailed parents a weekly newsletter:

> If we open up the blog now, you can see that's what [student name] put on yesterday because she did some gorgeous coconut fudge slice for us all which was really nice. (Fiona, Interview 3)

At School B, Jack and Zoe both were able to email parents and also considered the LMS to be a means of keeping parents informed of students' learning and achievement. Both teachers spoke of the possibilities in the future of using the LMS to monitor progress in order to supplement the traditional formal written reports.

> KnowledgeNet is for students to put up any work. It's to show progression… part of it is an e-portfolio, but it's more than just that because e-portfolios or portfolios in the past tended to always be published work. And this is supposed to be work in progress from beginning to end. (Jack, Interview 5)

> KnowledgeNet is proof of learning, so when they put that onto their page then when their parents go onto KnowledgeNet they can see it. So it's more of a communication between home and school….KnowledgeNet will be opened up next term to this class' parents, and so it's going to be way more communication between home and school than just the two reports we do a year. (Zoe, Interview 2)

Comply with school policy and expectations

Policies and guidelines for the use of digital technologies were in place at both schools and each of the teachers in the study reported that at times they integrated digital tools primarily to comply with these directives. At School A, policies were in place which required the use of specific tools within particular time frames. As a result, both teachers within this school, Fiona and Helen, created tasks around these digital tools (i.e., the e-portfolio system) to ensure that they had complied with these

objectives. These sometimes took precedence over other work that Helen wanted students to complete with the technology:

> It's a literacy session, but we have to get students set up on MyPortfolio, and we have to have a blog up and running, so I wouldn't really class what the kids on the computers were doing as literacy. They have literacy activities to do on the computers, but they didn't get to them. (Helen, Interview 2)

At School B, guidelines regarding the use of specific tools were more flexible, but Jack and Zoe's additional leadership and support roles required that they modelled the use of technology for other teachers at the school. Both teachers were aware of this expectation and strived to satisfy these obligations in a number of ways. Zoe reported that she shared methods of utilising the LMS during team meetings while Jack planned activities in which students could take and use devices around the school grounds such as when they were sent out to record a video with a message for the victims of the Christchurch earthquake (Jack, Observation 3).

Prepare students for a digital world

Finally, digital technologies were included in classroom instruction to enable students to develop technical skills that teachers perceived would be necessary to their future success and participation in a digital world. As Helen stated, "they're [digital technologies] part of their future. It's something that they need to be able to do" (Helen, Interview 5). Zoe, Jack, and Helen each indicated their belief that technological skills would be necessary for students' future employment.

Additionally, Jack, Zoe, and Fiona believed that they had a responsibility to help guide students in their use of digital tools that were becoming more available and accessible to their intermediate students. This included teaching students how to effectively search for and critically evaluate information on the Internet as well as to raise awareness of the messages that were being presented through the media:

> We talked about the Britney Spears ad and because people have got TiVo and all those kind of things now they're not watching the ads anymore. So programmes and stars and things are having to do product placement so then advertisers are still getting their products out there. (Zoe, Interview 3)

Student perceptions of activities which included digital technologies

The third research question explored students' perceptions of their use of digital technologies within the classroom setting and how they engaged with digital tools during teacher-planned activities. When examining student observations and 'think alouds' as well as focus groups across cases, three themes emerged from the data. First, evidence indicated that a number of attributes inherent to the learners affected student participation in activities that included digital technologies. Second, aspects of the pedagogical methods utilised by the teachers when they integrated digital technologies influenced the ways in which students interacted with these lessons. Finally, aspects of the classroom context including the number of digital devices that were available played an important role in the levels of student engagement. All of these themes will be discussed in detail in the following sections.

Student factors

The students in each classroom demonstrated a varying range of knowledge and abilities during classroom observations which influenced the ways in which they engaged with activities that included digital technologies. Evidence indicated that students' content knowledge, technical expertise, and collaborative skills in particular contributed to their ability to engage in the lesson as the teacher had intended.

The students in this study began each observed activity with prior knowledge and understanding of the concept or skill that was to be targeted during the lesson. Classroom observations revealed several instances in which this knowledge affected the way in which students interacted with the lesson. For example, three of the four teachers were observed making use of Internet-based interactive games or activities during mathematics and literacy rotations where students could practise particular skills. Jack, Helen, and Fiona all reported that they requested students to access sites targeting skills that had previously been taught. However, observations revealed that students did not necessarily hold these pre-requisite skills, and had a range of competencies that influenced their participation when digital technologies were utilised. For example, in Fiona's room, two students who worked together on a digital learning object were able to successfully answer the questions throughout the activity which demonstrated their ability to read and interpret graphs (Fiona, Observation 3).

However, when three students in Helen's room were solving puzzles that related to estimation, one student did not contribute and revealed at the conclusion of the activity that she did not understand how the other two group members were able to solve the puzzles (Helen, Observation 5). Additionally, one of Jack's students was observed manipulating the settings on Thatquiz.org based on his prior knowledge of graphing concepts (Jack, Observation 8).

Students' technical proficiency with the digital tools found in the classroom also served to mediate the activity when digital technologies were utilised. When students were familiar with the hardware and software they were being asked to use, they interacted more fully with the content of the activity. This was observed in Jack's classroom when students wrote their goals in the LMS (Jack, Observation 5) and in Fiona's room as students contributed to a shared Google Doc on descriptive verbs (Fiona, Observation 4). In both of these situations the observed students used the digital tools capably and spent the duration of the lesson engaging with the skills and concepts being taught. In other situations, particularly when a new tool was introduced, students spent time interpreting how to manipulate the technology before engaging with other subject areas. For example, three students in Zoe's classroom were observed spending time setting up the IWB screen and learning to manipulate the interactive pen before beginning to draw their escape plan (Zoe, Observation 3). Additionally, three of Jack's students had to re-record their video message to the victims of the Christchurch earthquake because they realised afterwards that their voices had not recorded clearly, resulting in additional time being spent on recording rather than editing the video that day as Jack had intended (Jack, Observation 4).

Finally, teachers often asked their learners to work together when using digital technologies because of their limited resources; therefore, students' collaborative skills influenced activities that included these tools. One student in Helen's focus group aptly pointed out that group interaction depended partially on the relationships between students working together and that an unpleasant rapport could result in disagreements between members of the group (Focus group A). This was evident when students worked in groups of three to four to solve questions that Helen briefly displayed through the data projector and one group was observed taking turns answering the questions while another discussed the response before writing it down

(Helen, Observation 5). During one lesson in which Zoe allowed students to self-select their group, the four learners observed during the activity collectively discussed and typed out a plot line (Zoe, Observation 1). On other occasions students were observed taking turns rather than working together. For example, while working on Thatquiz.org in Jack's room, two pairs of students were observed taking turns on the program rather than working collaboratively (Jack, Observation 5). The same scenario was observed in Fiona's room when two students worked with the graphing learning object during mathematics rotations (Fiona, Observation 3). These examples illustrate that students' own skills, abilities, and preferences contributed to their participation in lessons in which digital technologies were integrated.

Teaching factors

A second aspect that influenced student participation in activities within the four case studies was the pedagogical methods that teachers utilised when they incorporated digital technologies into their classroom practices. Specifically, both clarity around the purpose and objective of the activity as well as support provided to students, especially when a new tool was introduced, impacted on the activity that transpired.

Evidence from the observations indicated that when students clearly understood the goal of the activity and how they were expected to accomplish this, they spent more time engaging with the lesson as the teacher intended. For example, during a lesson in which Fiona asked students to log on to Google Docs to contribute unique descriptive sentences, her directions were clear and students efficiently wrote sentences together in their notebooks, logged onto Google Docs, and added their sentences to the growing list (Fiona, Observation 4). Similarly, in one lesson Jack clearly explained to students that they were to create an animation in Fluxtime that told a story which must include a problem and a solution during an enrichment session and students subsequently completely this activity successfully (Jack, Observation 7). In other situations, when students lack clarity or purpose about the nature of the assigned task, they often became involved in off-task activities. An example of this occurred in Zoe's classroom when students were asked to search online for contact information for a worker at a nearby supermarket and generate questions that they

could ask this contact about the cereal that was sold at the store (Zoe, Observation 6). However, two groups of two students who were asked to work on this task reported at the beginning of the activity that they were unsure of what to do. One pair was able to write down the email address of one person by the end of the session while the other pair struggled to start, but eventually found contact information and proceeded to write several questions to send.

The type and amount of assistance that teachers provided to students, particularly when a new digital tool was introduced, also affected students' interaction with the activity. Jack offered his students a brief demonstration of the basic features of a new technology the first time he introduced it, which was observed when he used the large television in the ICT suite to demonstrate how to manipulate both Fluxtime and SweetHome 3D to his students (Jack, Observations 2 and 6). Afterwards he gave students a few minutes to explore and learn to use these programmes freely. After this introductory phase, he assigned students specific tasks using the programme and all students in the class were able to come up with their own creations within the specifications. Fiona frequently provided students with templates or demonstrated new technologies to the students through the data projector. For example, to support their creation of a PowerPoint presentation giving the French translations for their own family members, she provided students with a template that she had created. The result was that several students completed the optional homework task (Fiona, Interview 3). Conversely, Helen considered students to be competent technology users and during one observation, she asked one student to access a web-based game in which he was to practise subtraction skills without providing guidance of how to manipulate the game (Helen, Observation 2). As a result, the student was unable to practise his subtraction skills until about 15 minutes into the activity when he and another student discovered what they needed to do.

Contextual factors

Features of the environment played an additional role in the ways that students were able to engage with tasks that included digital technologies. The number of computers available within each learning environment impacted on student engagement in each activity. In addition, the digital tools themselves had specific

features that enabled or restricted student actions, thereby affecting student participation in the lesson.

The limited number of computers in each classroom influenced the teachers' approach to learning. For example, they often asked students to work collaboratively or booked additional computers (i.e., the ICT suite or laptops from team members) when they wanted each student to work directly with the technology. Students were observed working in a one-on-one computer environment during at least one lesson in Helen, Fiona, and Jack's classroom. In Helen's room, students worked with their own computer when participating in a small-group lesson in which Helen provided clearly articulated and step by step instructions on how to upload documents to the e-portfolio system which students followed on their own machines (Helen, Observation 4). During this lesson, all of the seven students who worked with the e-portfolio system remained on task over the duration of the lesson and completed the task in the time allotted. At School B, the ICT provided 25 desktop computers and Jack booked this space for eight of the nine observed activities. During enrichment sessions in which students used Fluxtime.com to create their own animated stories, all of the 30 students in Jack's session created an animation and spent the duration of the hour-long session working diligently on their creations (Jack, Observations 6 and 7).

Small group work was another feature of the teachers' approach to learning. Students were observed working in small groups in all four classrooms. During a literacy lesson in Zoe's classroom, groups of two students worked together to retrieve an online news article and answer questions about the article in the LMS. Two students who were being closely observed by the researcher during the learning activity made progress completing questions although they did not finish these. As noted in the field notes, "the students initially worked together, but later began to take turns answering the question and [student name] was disengaged from the activity for several minutes as he watched other groups and the teacher across the room" (Zoe, Field notes, Observation 4). A similar phenomenon was observed in Jack's classroom. On this occasion, two students apparently 'working together' on Thatquiz.org during mathematics rotations were instead observed taking turns answering a round of 10 questions (Jack, Observation 8). In contrast, when a group of four students in Zoe's class worked together to write a story for the camp advert, all

contributed to and participated in the story creation (Zoe, Observation 1). On a separate occasion, when a group of three students also in Zoe's classroom used one computer to research the proposed 'Wellywood' sign, one student actively searched the Internet while the other two students "passively looked on…one of the boys cannot see the screen from where he's sitting" (Zoe, Field notes, Observation 7). Similarly, a group of five students also in Zoe's room who worked together examining advertisements on YouTube were fully engaged primarily when the videos played, but otherwise the attention of the students who were seated away from the computer strayed from the activity (Zoe, Observation 2). Finally, when students in Helen's room played games designed to improve students' estimation skills in groups of three to four, one student passively watched two other group members as they worked together to solve the problems (Helen, Observation 5).

The findings from these observations indicate that the ratio of student to computer impacted on student engagement within these four classrooms. Overall, evidence showed that students were far more likely to be actively engaged in activities when they had direct control over the device, in other words, when they had access to their own computer. However, this was also influenced by the actual assigned task or activity. Students who were actively *creating or constructing new knowledge* demonstrated higher levels of sustained engagement while those who *practised skills* or searched for specific information were more likely to take turns and to be fully engaged in the activity when they were in control of the computer.

Finally, student participation was influenced by the attributes of the particular digital tools that were used in each classroom. For example, as students worked with web-based interactive activities during mathematics rotations, feedback provided by each site dictated how students were able to engage with the activity. One student in Jack's class reported that he was only able to practise skills that he already knew when using Thatquiz.org because the programme did not provide adequate feedback when he missed a question; therefore, he could not learn a new concept through the technology (Jack, Observation 8). A similar situation occurred in Helen's room when two students attempted to solve greatest common factor problems but were unable to detect that their reasoning was incorrect as the programme did not provide an explanation when a question was answered incorrectly (Helen, Observation 2). Fiona's

students were unable to access the sound on the videos located on the virtual field trip web site as only two of the eight computers located in the library had an audio output (Fiona, Observation 6). This resulted in only one of the four observed students being able to listen to the video as Fiona had intended. In Zoe's room, the Macbooks that students often used did not connect to the school network, which on one occasion resulted in lost work when they were unable to save to the file server and the computers ran out of power before students could present their escape plans (Zoe, Observation 3). Furthermore, the limited power outlets in each of the four classrooms mandated where students could physically work within the classroom when power was needed for laptops and other devices.

Sociocultural factors which motivated teachers to integrate digital technologies

Analysis of each of the classroom cases through a CHAT theoretical framework revealed sociocultural factors that underpinned teachers' decisions to incorporate digital technologies into their classroom practices. While some of these influences were unique to individual teachers, a comparison across cases revealed that there were three factors within the environment which impacted on the activity of each teacher as they worked toward their objective of student learning. First, school leaders were important members within each activity system and communicated expectations for the use of digital tools to each of the subjects who altered their activity accordingly. Second, teachers' perceptions of the affordances of the technology available in their classrooms as well as the limitations of these tools affected the ways in which they were able to integrate these tools into their classroom practices. Finally, the four teachers strived to maintain a relationship with students' parents as they believed that parents held an important role in the learning process; therefore, their activity was carried out in part to connect with these community members.

School leadership and policy

The senior management team at each of the participating schools were important community members that carried out distinct activities, but their functions were similar in that each principal requested that digital technologies were used within each classroom to enhance student learning. At School A, the leadership team

consisting of the principal and two Deputy Principals (DPs) had specific ideas about how technology should be integrated throughout the school. This had distinct effects on teachers given that expectations were explicitly stated that teachers were to make use of specific digital technologies in their classroom environment. However, teachers felt the support of the leadership team through their willingness to provide technical and pedagogical assistance as they carried out daily classroom activities. In a different approach, School B's leadership team distributed the authority over the digital integration process technically able staff members such as Jack and Zoe. These teachers were assigned the roles of promoting and supporting other teachers in their use of technology throughout the school. This indicated that the leadership team at School B were aware that Jack and Zoe were committed to encouraging the incorporation of digital tools at the school, and had the skills to provide collegial support.

Due in part to the participation in the ICT PD cluster at School A that was initiated by the school principal, school policies had been created around digital tools by the leadership team with input from some of the teachers including Helen. Both participating teachers at the school were committed to fulfilling these expectations. For example, Helen's ownership over these decisions led her to accept the additional role of assisting her colleagues to ensure that they were also able to comply with the policies that she had helped to create. Each of the members of the school leadership team had specific responsibilities of assisting teachers in meeting the demands placed upon them. Additionally, explicit expectations for technology use were communicated through parent newsletters and the school action plan. While teachers may not have known how to facilitate learning with tools such as the e-portfolio, policies ensured that the tools were used and support was offered throughout the year to help teachers recognise how they could alter their practice to successfully include these technologies. Evidence indicated that this was the case in Helen's classroom. While she initially struggled to integrate the e-portfolio system, by the end of the year Helen was using it to facilitate the 'Amazing Race' learning activity (Observation 7). The principal's active involvement with Fiona's team as outlined in Chapter 6 also demonstrated a commitment to determining how the e-portfolio could best be used in alignment with curricular goals.

The principal at School B was equally influential in the success of technology integration within Jack and Zoe's classrooms, but took a much different approach. Rather than placing pressure on teachers through explicit school policies, the principal aimed to provide those teachers who were reluctant technology users with both exemplars and the necessary support to encourage them to begin to use digital tools on their own. In addition, the leadership team provided the financial backing for the hardware, software, and infrastructure that was requested by the IT Committee to maintain and improve the technological capabilities of the school. As a result, teachers who demonstrated technology use that supported the student-centred practices that were expected at the school were allocated leadership roles. These teachers, which included Jack and Zoe, took on additional duties to assist their colleagues with technical and pedagogical issues related to the software and hardware and made an effort to demonstrate uses of technology that aligned with curricular goals. However, because they were quasi-administrator roles that lacked authority, Jack and Zoe found that at times there was little they could do to encourage their colleagues who were reluctant technology users.

School leadership at each of the two schools supported the integration of digital technologies in diverse ways. While the principal and DPs at School A were actively involved in technology integration and created policies around their use, the leadership team at School B financially supported technology initiatives and transferred leadership roles to teachers to support the incorporation of digital tools throughout the school. These differing approaches caused tensions for each of the teachers in the study as explained in Chapters 5 and 7 but overall resulted in increased technology use in each of the classroom cases.

Digital technologies as mediating tools

A number of digital technologies were available within each classroom environment and the teachers in this study altered their behaviour based on their knowledge of the tools that were available and their perceptions of how these could be used within their classroom practices. As teachers' technical abilities increased, so did their efficacy for including digital tools in ways that supported their pedagogical

beliefs and practices. However, technical issues often prevented teachers from integrating digital technologies in the ways that they envisioned.

The number of digital devices within each classroom was similar as the four teachers each had access to several laptop and desktop computers within their classroom as well as a projection device. Nevertheless, teachers chose to use these tools in varying ways because of their understanding of the affordances of the hardware and software that was available. For example, the e-portfolio system at School A and the LMS at School B were similar in that they were accessible via the Internet and both teachers and students could create a profile and post information on pages that they created. However, at the beginning of the year these systems were used differently at each school. Helen and Fiona had used the e-portfolio system themselves and understood the tool only as a repository for completed student work; therefore they found implementation as a redundant activity when completed student work could be easily retrieved in other ways (i.e., on paper or in Google Docs). Conversely, Jack and Zoe perceived the LMS at School B to be an online working space where students could access instructions, collaborate with others, and keep a record of their everyday schoolwork to monitor progress. By the end of the study, Helen had begun to use the e-portfolio system in a similar way after learning more about the tool and working to find ways in which it could be incorporated into her everyday activities rather than using it in addition to regular classroom activities. Another example was demonstrated in the use of PowerPoint as a learning tool. While Fiona's students used the tool in a traditional manner to create a presentation to share information with others, both Zoe and Helen's students created animations with the tool. Helen reported that she had learned about this use of PowerPoint at professional development and that students who were often disengaged had been engaged in the learning activity and took on new leadership roles in the classroom environment when the software was used in this way.

Technical issues arose in the use of technology (e.g., Internet outages) and were common in each classroom. Subsequently, each of the teachers altered the learning activity based on the knowledge that these problems would occur or were forced to redesign lessons instantly when glitches transpired. They also learned to think and plan ahead should such an issue arise. For example, knowing that the wireless Internet

access at School B was unreliable at times, Zoe made printed copies of a newspaper article that she asked students to read in the event that they were unable to access the article online (Zoe, Observation 4). Zoe also reported that lost Internet connectivity on the day she planned to have students access web-based resources meant she was forced to abandon the activity (Zoe, Interview 4). Partially because her class had experienced problems navigating the e-portfolio system in Helen's room early on (Helen, Observation 1), in Term 2 she explicitly taught a small group of students new features of the programme through the data projector (Helen, Observation 4). Additionally, on one occasion when Fiona's students were unable to access a learning object on the small screens of the netbook computers, she was forced to handle the situation rather than teach the small group that she had intended to work with. Not surprisingly, Jack did not have the same degree of time or activities affected by technical errors as he was knowledgeable enough to solve technical issues as they occurred without disrupting the activity.

The four teachers in this study adjusted their teaching and associated planning practices as a consequence of their knowledge of the tools that were available and their awareness of how these could be used within their classroom practices. As teachers' learned about new affordances of the tools, they were able to use these in new ways to support their students' learning. However, technical difficulties often prevented the four participants from integrating digital technologies in the ways that they had intended, and they were left to 'problem solve' alternative ways to support their learners.

Parents as stakeholders within the community

Within the community, parents of students were considered to be important stakeholders and each teacher was motivated to ensure that they were involved in their child's learning process. The school leadership at each school encouraged teachers to maintain this relationship through regular email contact and use of the LMS at each school, but ultimately each teacher was encouraged to facilitate communication with parents due to their own belief that this would facilitate student learning.

Weekly newsletters sent via email, updates to the class blog, and lesson plans displayed on the LMS by Helen and Fiona kept parents informed of the school activities and showcased student work. Positive comments from parents regarding these communication tools encouraged these teachers to continue with these practices to ensure that parents were involved in their child's learning. At School B, both Jack and Zoe shared that the LMS enabled parents to view student work in progress as students could log in at home to exhibit work to their families. Zoe's interest in giving parents their own passwords and ability to comment on student work indicated that she was keen for them to be actively involved in the technology and learning process from outside the classroom.

Within the sociocultural communities of School A and B, each of the teachers in the study was motivated to integrate digital technologies into their classroom practices to meet the expectations of the school leadership team and parents as both of these groups held significant roles within the community. Besides these factors, teachers' perceptions of the affordances of the digital tools available in their classroom environment as well as the technical difficulties that they encountered modified their use of the digital technologies that were available within each of their learning environments.

Chapter 9. Discussion

The imperative to discover teachers' motivations and methods of integrating digital tools as well as what students experience as a result was important because a better understanding of these elements can assist teachers in fully employing the potential of digital tools within their classroom environments to facilitate learning. This research was undertaken to examine within authentic classroom contexts the reasons why experienced intermediate classroom teachers (i.e., teachers of students in years 7 and 8) chose to integrate digital technologies within the classroom setting. The research explored the manner in which these teachers incorporated digital tools into their daily lessons and the associated outcomes. It also sought to explore how students perceived and interacted with these tools during classroom activities. From the four case studies, the data revealed a snapshot of the everyday experiences of these four teachers in two schools and their respective 120 students over the course of a school year as digital technologies were incorporated into classroom activities. These data provided insight into the details of the participants' personal experiences as well as the contextual environments in which they acted, allowing for an in-depth examination of the system as a whole and how each part within that system impacted on activity, and ultimately the teachers' and students' learning. The current chapter draws together findings and analyses from four case studies within the context of existing knowledge about teaching and learning with digital technologies. Additionally, the use of Cultural-Historical Activity Theory (CHAT) provides a lens to explore the complex activity systems within which each of the participating teachers operated.

The chapter begins with a discussion of how the roles of both teachers' personal pedagogical and technological beliefs and knowledge, as well as elements of the sociocultural setting, influenced and motivated teachers to incorporate digital technologies in their classroom practices. Prior research has demonstrated that a variety of factors influence this process (e.g. Becker, 1998; Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006), and a CHAT analysis extended current understanding by providing insight into the interactions between these factors that, in some cases, drove change within the system. Next, the participants' methods of teaching with technology will be explored in relation to Vygotsky's (1978) theory of the

Zone of Proximal Development (ZPD) with a focus on the concept of scaffolding in order to explain student experiences when teachers employed various pedagogical methods while utilising digital tools. Within this section, the results challenge the concept of students as digital natives and the claim that they have an inherent ability to manipulate digital tools. Additionally, the effectiveness of using digital technologies as motivational tools will be discussed. The chapter will conclude with holistic implications as well as avenues for future research in light of the aforementioned topics.

How and *why* teachers chose to integrate digital tools

This research illustrated that many personal and contextual factors influence teachers' decisions to integrate digital technologies within their teaching practices. Similar to previous research, teachers' motivation for using digital technologies is influenced by their own personal beliefs and knowledge, as well as by features of the environment in which they function such as the culture of the school environment, the levels of access to technology, and student prior knowledge of digital technologies (e.g. Becker, 1998; Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006). In the current research, a CHAT analysis facilitated a critical analysis of the interactions and tensions between these elements, in order to explore *how* and *why* technology integration occurred. Most notably, teachers' pedagogical and technological beliefs and knowledge underpinned their decisions to use digital technologies, but their activity transformed to various degrees over the course of the year in response to contextual factors within the environment.

The roles of personal and contextual factors will be explored in relation to previous research in the field in the following sections. Additionally, new knowledge that emerged within this context will be examined.

Knowledge as a key variable

Personal knowledge played an essential part in dictating how each of the participants was able to make use of digital tools within their classroom settings. Each of the teachers had a working knowledge of a variety of technologies that could be used in the classroom setting as well as content knowledge about the subjects they taught and pedagogical knowledge of how best to teach their students. The current

research supports Mishra and Koehler's (2008) proposition that technological awareness and understanding is an additional and separate knowledge base in addition to pedagogical knowledge and content knowledge that teachers must draw from when engaging in lesson planning.

In the current study, the participants possessed a range of technological knowledge and their understanding of particular digital tools and the affordances of those tools influenced the way they could be integrated within the learning environment. When the technology was familiar and one of its uses could be matched with the pedagogical and content objectives for the activity, integration could be easily planned and carried out. However, when the capabilities of the tool were not fully understood, much more effort was spent determining how the tool could be incorporated into the lesson to reach the intended objective. Use of the school Learning Management Systems (LMS) illustrated these differences; at School B the teachers had a high level of expertise with the tool and were able to incorporate it seamlessly into their classroom activities, whereas the teachers at School A were in the process of learning the capabilities of the system and devoted significant time and energy to planning how to use the tool with their students. Just as Mishra and Koehler (2006) suggested, when these teachers were inexperienced with particular tools they were forced to consciously consider content, pedagogical, and technical knowledge separately.

At times, teacher knowledge of the affordances of a particular programme superseded the importance of having a working knowledge of the technical tool. As teachers became competent with a variety of technical tools and had a broader understanding of how these technologies could be incorporated into their teaching practices, they were sometimes able to identify the affordances of new digital tools before they learned how to use them. This coupled with the belief that their students were experienced and knowledgeable technology users allowed these teachers to transfer the responsibility of some of the technical knowledge to their students. This transition freed the teachers from spending the necessary time learning how to use each programme. More critically, it also had the potential to empower students through this additional expectation. However, this transfer of control did not come without complications; these are discussed in a subsequent section.

Evidence indicated that the participating teachers' technical knowledge, and in some cases their pedagogical knowledge, increased over the duration of the study. While this knowledge iteself is considered to be an internal, or personal factor for the teachers, the *growth* in knowledge occurred due to contextual, or environmental factors such as professional development and the expertise of their students; this will be discussed further in the following sections.

Personal beliefs as a key variable

The teachers in this study expressed strong personal beliefs about the role of digital technologies in their classroom practices and within the modern world which drove much of their classroom activity. Digital tools were included in classroom practices when teachers perceived that they added value to their pedagogy and led to increased learning outcomes, similar to previous research (Gibson, 2001; Kiridis et al., 2006; Mueller et al., 2008). More specifically, they made use of technology in ways that matched their own personal instructional philosophies as found in previous studies (Ertmer et al., 2012; Kim et al., 2013; Niederhauser & Stoddart, 2001; Ottenbreit-Leftwich et al., 2010). The participants utilised digital tools to support the teaching practices that they believed would be of the most benefit to their students (i.e., promote collaboration, increase engagement, encourage student agency) and would support the learning they wanted to occur.

The participating teachers believed that digital tools, such as tablet computers and smartphones, were becoming more accessible to their students and integrated into modern society, therefore they felt that it was part of their responsibility to expose students to these modern tools as well as give instructions in their use. Additionally, these teachers believed that technology use was essential in preparing students for their future lives and careers, similar to recent findings by Ottenbreit-Leftwich et al. (2010). A CHAT analysis revealed that this belief influenced teachers' practice in that providing students with opportunities to practise operating a variety of tools became an objective in itself. Given this, there were instances during the study when digital tools were included within classroom activities primarily to give students experience using the hardware and software that was available.

Another driver for technology integration was the teachers' belief that digital tools could be included in classroom lessons to motivate students and engage them more fully in learning activities; in some cases, this was the primary reason for including digital devices. These results are not unique to this study as previous research has indicated that technology is often included to stimulate engagement and to motivate students (Ertmer et al., 1999; Oblinger, 2004). Despite a long-held view that the use of technology primarily for motivational purposes is less likely to help students meet intended learning goals (Zhao et al., 2002), these beliefs continued to be a strong motivation for these teachers. However, as discussed in a subsequent section, including digital devices for this purpose did not always have the intended results.

The significance of personal beliefs on teachers' integration of technology has been acknowledged and explored in depth in recent years (e.g., Angers & Machtmes, 2005; Ertmer et al., 2012; Miranda & Russell, 2011). Research has indicated that personal beliefs underpin how and why digital tools are integrated (Ertmer et al., 2012; Ottenbreit-Leftwich et al., 2010), but the short duration of these studies limited the ability to assess whether teachers' espoused and enacted pedagogical beliefs were static or shifted over time. Conversely, this research demonstated that over a period of one school year, two of the four teachers were reassessing their pedagogical beliefs. Although research has demonstrated that underpinning beliefs are not quickly or easily changed (Nisbett & Ross, 1980; Rokeach, 1968), the transformation of these teachers' practices over the course of the year as well as their explanations regarding how digital technologies best fit within their pedagogical practices indicate that their beliefs were in a state of flux rather than static in nature. While this is a 'moment in time' for these four particular classrooms within one specific year, the following sections provide a deeper nuanced understanding of the relationships between personal and environmental factors.

External factors impacted on the integration of digital technology

Regardless of the teacher participants' personal intentions, knowledge, and beliefs, their classroom and school-based context impacted on the way they planned and carried out activities that included digital technologies in their classrooms. Levels

of access to digital hardware and software, the professional development the teachers engaged in, and school and cultural expectations around both pedagogical practices and technology that created new roles and responsibilities for the participants all influenced their behaviours. From a CHAT perspective this arguably changes the dynamics of their interactions within the activity system, and their relationship with the mediating artefact.

Access to digital technologies and technical support persists as an issue

Levels of access to technology and associated devices as well as technical support mediated the participants' decisions regarding their use, similar to the findings in previous studies (Becker, 2000; Palak & Walls, 2009; Smarkola, 2008). The number of devices available contributed to pedagogical choices the teachers made when they integrated them in their classrooms, such as how many students were in each collaborative group. At times the student-to-computer ratio matched the teachers' preferences, but at others the teachers would have preferred to have additional machines to lower the proportion. Furthermore, technical issues that occurred during classroom activities often disrupted learning time when unexpected issues arose.

The quantity of digital tools available served as motivation for teachers to use the devices more frequently. Each of the four teachers expressed an appreciation for the number of technological tools that were available within the school community and attempted to make use of them as often as possible. There was a sense that because the school leadership had so generously provided additional devices, they should be utilized often.

The location of the digital devices available also contributed to how the teachers made use of these devices. Petko (2012) found that teachers were more likely to use computers when they were easily accessible such as located in their classrooms rather than a central computer lab; however, findings from this study demonstrate that this ultimately depended on the teachers' personal preferences of teaching with technology as three of the four teachers made use of extra computers provided in common areas. This use corresponded to the participants' pedagogical practices and objectives for each lesson. When collaboration was intended as an outcome of the lesson, teachers preferred shared classroom computers, and other times when

independence was sought, teachers used a computer lab to provide a one to one environment in which students could work independently on a dedicated computer.

Finally, technical issues hindered these four teachers' ability to incorporate digital tools in the ways that they envisioned, consistent with findings by Bauer and Kenton (2005). At times, a number of problems occurred (i.e., lost Internet access, sound output issues, lengthy login times) which impacted on learning time. While each teacher was persistent in their use of the tools that were available within their teaching environment despite the difficulties they faced, congruent with previous studies (Angers & Machtmes, 2005; Ertmer et al., 2000), technical issues persist as an issue that impacts on student learning time.

Undoubtedly, even in schools in which financial commitments have been made to support the acquisition of digital equipment for teacher and student use, access to hardware, software, and the Internet continues to be a variable and has an impact on teaching and learning within these two New Zealand intermediate schools. Sufficient access to the desired digital tools can empower teachers. However, at other times insufficient quantities of the preferred devices can constrain pedagogical decisions. Furthermore, there was a sense that the speed at which new technologies were being introduced created a situation in which the schools could not adequately continue to provide cutting edge technology that both teachers and students were using at home. Therefore, discussions were taking place at the participating schools regarding whether a Bring Your Own Device (BYOD) policy would be feasible in which students were permitted to bring their own technological devices from home to use during classroom activities. Clearly, access to appropriate technological devices continues to be an important factor in determining how integration occurs within individual classrooms and school communities are considering alternative options to supplying all devices that are used by students.

The impact of structured and internally driven learning opportunities

Facilitated learning opportunities in the use and integration of digital technologies were quite different at each of the participating schools. At School A, formal professional development programmes attended by both Helen and Fiona significantly impacted on their integration of digital tools. Conversely, the participants

at School B reported little or no school-based organised training in the use of digital technology and instead cited a personal interest that motivated them to educate themselves and investigate new ways of utilising technology within their classrooms. Teachers at both schools actively sought new understandings about how to integrate digital technologies, such as attending national technology conferences to further this knowledge. Both structured and internally driven learning experiences played a key role in the ways in which the participants integrated digital tools.

Participation in formal professional development opportunities had a significant impact on the activity of the teachers at School A. The three year duration of the ICTPD cluster and the collaborative nature of the programme align with attributes of successful professional development (Lawless & Pellegrino, 2007). Through the training, the teachers had both learned to use a number of digital tools personally and had also begun to perceive how they could incorporate particular programmes into their usual teaching practices and administrative tasks. Similarly, Helen's involvement in additional professional development over the duration of the study as well as attending a national technology-based conference equipped her with new ways of using familiar tools to best meet the needs of her students. Therefore, both of these professional development programmes increased Helen and Fiona's technical skills and pedagogical understanding of how digital tools could be utilised in alignment with their pedagogical beliefs, which was similar to previous outcomes (Jacobsen et al., 2002; Zhao et al., 2002). Additionally, evidence demonstrated that the participants' classroom practices and in some cases their beliefs expanded through this growth and reveals how a contextual factor within the activity system had the potential to influence the teachers' viewpoints.

Data revealed that these organised professional development opportunities impacted on Helen and Fiona's pedagogical beliefs and practices. Fiona discussed the impact of the experience on her conception of her role as a teacher and was observed trialling new ways of including technology that aligned with her emerging student-centred pedagogical beliefs. Likewise, Helen was exposed to new affordances of familiar tools that allowed her to plan activities for her students that promoted knowledge creation, aligning with her espoused belief that control of activities should be transferred to the students. This is consistent with previous research which has

demonstrated that teachers often initially make use of digital tools in ways that enhance their own productivity and pedagogical practices (Kirschner & Erkens, 2006; Lai & Pratt, 2008), and as they become more familiar with digital tools, they are able to utilise these tools within the classroom in more student-centred ways (Moss et al., 2007; Sandholtz et al., 1997).

The extended duration of the study revealed that this shift in beliefs and practices was a process for the participants and that over time they were learning to explore and adapt their methods of teaching to match their espoused beliefs about how their students learnt best. This meant that there were sometimes complications during lessons that included digital tools, but interviews with the teachers afterwards indicated that these situations became their own learning opportunities. In this way, they reported gaining knowledge about the possibilities and limitations of the accessible tools, building their technological pedagogical content knowledge (TPACK); a finding consistent with Mishra and Koehler (2008). Long-term studies such as the Apple Classrooms of Tomorrow (ACOT) research (Sandholtz et al., 1997) conducted two decades ago have also revealed a progression of the adoption of digital tools, and findings from the current research suggest that this concept should be re-explored within the digital age to discover if the same types of transitions are occurring and the impact this has on student learning.

Informal and self-guided exploration of new and familiar digital tools was key to the professional growth of the teachers at School B. Structured learning opportunities were not provided for the teacher participants at School B; however, a belief that digital tools could be used to support their pedagogical practices prompted both Jack and Zoe to seek out approaches to digital learning that were feasible given the access to the technology that was available. This is consistent with previous research which found that teachers who are highly motivated to teach with technology are able to find ways to obtain the resources they require to pursue this goal (Angers & Machtmes, 2005; Ertmer et al., 2000). Both of these teachers had a strong understanding of the capability of digital technology and were able to focus their efforts on searching for tools with affordances that supported activities that aligned with their pedagogical beliefs.

While searching for and discovering new digital tools for her students to utilise, Zoe focussed her attention on matching the affordances of the tool to the task she wanted her students to complete rather than learning how to use the tools herself. In this way, Zoe's actions was in line with previous research that suggests that teachers must provide learning environments in which the tools align with the goals of the lesson (Wijekumar et al., 2006), but relied on students to bring their technical expertise to the lesson rather than providing instruction using the tool herself. Her belief that her students were knowledgeable technology users often meant that she directed them toward a variety of appropriate resources for the task and then allowed them to explore and learn how to use them without her help; consequently, part of the technological learning was passed on to her students. Clearly, Zoe's internal motivation to locate digital tools that facilitated the learning she desired was equally significant as the formal training received by the teachers at School A, extending previous findings that have identified the importance of formal professional development opportunities on technology integration (Ertmer, 2005; Scrimshaw, 2004; Smarkola, 2008).

Teacher interest in technology has been identified as a factor which motivates teachers to integrate digital tools into classroom practices (Angers & Machtmes, 2005; Ertmer et al., 1999), and this study extended these findings by demonstrating that teacher interest and expertise was a factor in determining *when* and *how* technology would be used in the classroom. For example, Jack's personal interest and high level of expertise in technology influenced him to continuously learn about new programmes and devices that he could use with his students. The tools that Jack found often supported student-centred practices, and Jack gave students opportunities to work collaboratively and create new knowledge with the digital tools that he favoured.

Although data from each of the participants varies regarding the formal and informal learning experiences that took place over the duration of the study, the knowledge that they gained from these events clearly influenced their integration of digital technologies throughout the course of this study. Further research is needed to determine the role of both school-driven and self-guided learning opportunities on successful technology integration and student outcomes and experiences when engaging in these activities.

The role of school culture and leadership

This research highlighted the critical role of the policy, environment, and conditions within the schools, in terms of how technology was introduced and used within each school. Several aspects of the sociocultural environments of School A and School B supported the integration of digital technologies within the study. First, members of the leadership teams at each school valued and encouraged technology integration, although they varied in their methods of supporting teachers as they did so; this had an impact on teachers' activity. Within these distinct environments, both the teacher and student participants accepted new roles and responsibilities within their community due to their growing expertise with digital technologies. Additionally, parents were perceived by the teachers as important stakeholders within the community and teachers recognised the affordances of digital tools that allowed them to effectively communicate with these community members as well as encourage greater parental involvement in the learning process.

School leadership and new roles for teachers

All four of the teachers identified the support of the school leadership as vital to their integration efforts. Consistent with findings from other studies (e.g. Dawson & Rakes, 2003; Smarkola, 2008), the leadership team's support for the use of digital technologies is pivotal to the successful integration of digital technologies in schools.

In this research, examples where the leadership team empowered the teachers to explore the use of digital technologies within their classrooms were consistently found across the two schools. For example, the principals of both schools offered the allocation of funds to purchase the hardware, software, and infrastructure that were necessary for the types of technology integration the teachers valued. Encouragement and moral support was provided by the school leaders in various ways. From these diverse situations, new roles and responsibilities emerged for the teachers, influencing their actions at the school and classroom level.

At School A, the school leadership team took a hands-on approach to technology integration efforts. The principal and Deputy Principals (DPs) took an active role in the activity at the classroom level by offering technical and pedagogical assistance when needed; this was paired with specific policies requiring the use of particular digital

technologies which had been purchased and configured for teacher and student use. Similar to findings in other studies (e.g. Harris & Hofer, 2011; Hennessy et al., 2005; Wikan & Molster, 2011), these policies influenced classroom practice in part by putting pressure on Helen and Fiona to use particular tools within their classrooms. While the use of some tools such as email and Google Docs were valued by the teachers because they matched their pedagogical beliefs and were encouraged by the administration, there were times when the teachers made use of required technologies such as the e-portfolio system even when there were no or few perceived benefits for student learning. As Campbell (2003) points out, conflict between school policies and teachers' personal beliefs can create ethical dilemmas for teachers as they must decide "whether to obey administrative directives and accept without complaint all policies and procedures they find morally objectionable" (p. 68). Over the course of the school year, this tension was eased as direct assistance from the school leaders demonstrated a commitment to supporting teacher and student use of particular digital tools in ways that would benefit students. As a result, Helen and Fiona expanded their uses of digital technologies in part to comply with school policies with help from the leadership team at their school, and in the process discovered techniques for integrating these tools in ways that supported their educational objectives for their students. This extends findings by Baylor and Ritchie (2002) who identified links between principals who actively model technology use and technology use by teachers and Anderson and Dexter's (2005) work which found that when school administrators were actively involved with technology (i.e., creating policies, using email), technology use at the school increased.

However, as this research also demonstrated, there is no 'one' leadership model to pursue. The role of leadership at School B provided an alternate model. There, the school leaders offered verbal reinforcement encouraging the use of technology, but maintained a hands-off approach to activity at the classroom level. Specific policies regarding the use of digital tools such as the LMS were "more guidelines than requirements", according to Jack (Interview 4). Instead, a technology committee was formed and these responsibilities were allocated to teachers with expertise in technology use such as Jack and Zoe. This created a situation in which responsibility to train and encourage other teachers to use digital technologies was transferred from

school leaders to some teachers. While Jack and Zoe embraced these leadership roles, they lacked the authority to compel reluctant teachers to use the technological tools available at the school which was frustrating for them at times. Shared leadership is common in technology integration (Flanagan & Jacobsen, 2003). However, two main functions of school leaders have been identified as providing direction and exercising influence to achieve shared goals (Leithwood & Riehl, 2003), and in this study both Jack and Zoe lacked the influence to ensure that all teachers attained the shared technology goals of the school. Similar to Forkhosh-Baruch et al.'s (2005) 'islands of innovation', progress toward technology integration in these schools was generated and implemented by a specific group of highly motivated students and leaders such as teachers or the computer coordinator. While both teachers spoke positively about these roles, at times the additional responsibilities interfered with their classroom obligations. Technical issues that occurred in other classrooms pulled Jack away from his students during learning time, although he reported that he had learned to manage this more effectively over time so that it had a minimal impact on classroom activities. Similarly, Zoe found herself using more of her release time on LMS maintenance and training than she had anticipated, taking time away from her learning leader duties. Due to limited funding, scenarios in which teachers are responsible for providing training and technical assistance at the site is not uncommon; therefore these results indicate a need for further research into the impact these additional roles have on classroom practices and student learning that occur in similar environments.

The dynamics and aspects of the involvement of the school leadership at the two schools varied; however, tensions were evident for each of the teacher participants within his or her context as they endeavoured to meet the expectations of their leaders while simultaneously meeting the needs of their students. At School A, these tensions led to eventual evolution of the teachers' progress toward their objectives as their use of digital technology developed over the course of the year and fell more in line with the school objectives for technology use that were posted in the teacher's lounge. This scenario was similar to Forkhosh-Baruch et al.'s. (2005) notion of 'school-wide implementation' in which "the principal's vision and motivation is of central importance in the innovation, and formal school policy is the rationale for the large-scale implementation" (p. 213). As previous research has demonstrated, top-down

pressure to integrate technology into classroom activities can lead to "a perception of eroded autonomy and a feeling of disempowerment in teachers" (Hennessy et al., 2005, p. 170). However, the current study demonstrates that while the success of school-wide implementation may take significant time and effort on the part of the entire community, the combination of both exerting pressure on teachers to employ digital tools within their classrooms and providing appropriate support and access as they attempt to meet these expectations can lead to advancement in technology use.

Being included in the decision-making process regarding policies around digital technologies was an empowering process for the participating teachers, congruent with prior findings that a shared vision is essential for successful technology integration (Hew & Brush, 2007; Sandholtz et al., 1997). This involvement increased teacher commitment to the policies and gave them ownership over the decisions rather than being viewed as a top-down mandate. Helen and Fiona, for example, made a great effort to utilise their newfound knowledge of digital tools in their classrooms both to enhance their lessons and to fulfil school policies around technology, as did the other members of the community. Helen's success in doing so was recognised by her colleagues and she was approached by both Fiona and another colleague to assist in the use of particular tools in an effort to comply with school-wide policies that had been put in place. Helen's beliefs about her role in the community led her to offer these teachers direct support, earning her respect and, to some extent, a leadership role within her community. Additionally, on these occasions her students were given the responsibility of assisting the pupils in other classrooms, placing them in new roles.

Technology as a catalyst for altering the depth of parent involvement

Parent involvement in their child's education through receiving teacher communication was increased as the use of technology increased. Each of the participating teachers discussed their enthusiasm for utilising communication devices such as email and the LMS to correspond more effectively and efficiently with parents.

While email provided a convenient way for each of the teacher participants to connect with parents quickly, it served to supplement and in some cases replace other traditional forms of communication such as face-to-face and phone conversations. Conversely, the teachers at School B had begun to conceptualise how parent

involvement could be drastically altered through the use of online tools such as the LMS. Jack spoke of the potential of the LMS to provide an online repository where student work could be completed and referred back to throughout the year by both students and parents, and Zoe further articulated this vision as a means of making learning transparent for learners and parents. While they also made use of email as a direct communication tool between themselves and parents, the teachers at School B had begun to think differently about how digital tools could alter parent participation in the learning that occurred in their classrooms. As Hill and Tyson (2009) earlier argued, 'academic socialisation' includes the notion of "parental involvement that creates an understanding about the purposes, goals, and meaning of academic performance; communicates expectations about involvement; and provides strategies that students can effectively use" (p. 758). For Hill and Tyson (2009), this type of parental involvement has the strongest positive relationship with achievement. While this transition was emerging as a vision for the participating teachers, and the outcome had yet to come to fruition, it demonstrated the teachers' shift in beliefs as to the type of parental involvement that was desired as opposed to a means of streamlining or automating an existing practice. Here, the teachers were adjusting the role of community members and were doing so through the way they enacted with the mediating artefacts.

Contextual factors created opportunities for shifts in beliefs

Teacher motivations for making use of digital technologies within their classroom practices are multifaceted, and while their beliefs and knowledge underpin these decisions, many aspects of the cultural context also influence their actions. Data collected from the four teacher participants over the course of the school year illuminated changes in their beliefs and practices that occurred throughout the duration of the study. Contextual factors such as access, leadership, teacher roles, professional development, student characteristics, and school policies around digital technologies influenced the teachers' immediate actions as discussed in preceding sections and as a result their technical and pedagogical knowledge increased. Teachers' developing knowledge of the affordances of digital tools and experiences of

using these in their classrooms had the potential to affect their pedagogical practices and beliefs.

The participating teachers made use of digital technologies in different ways to support both teacher-directed and student-centred learning activities relative to their beliefs about how to teach their students most effectively during each individual activity. Within the literature, 'best practice' of using digital technologies is thought to be constructivist in nature, focussing on student-centred instruction (Becker & Riel, 1999). While the beliefs and actions of the teacher participants were within the continuum of teacher-centred to student-centred rather than in one category or the other, similar to previous research (Ertmer et al., 2000; Gibson, 2001), there was evidence that their pedagogical beliefs evolved to some degree over the duration of the study. For example, the teachers at School A were initially compelled by school policy to make use of the electronic portfolio and believed it to be primarily a repository for student work, but their growing familiarity with the tool and support from the school leadership team resulted in a developed understanding of the affordances of the tool. By the end of the year, the e-portfolio was being utilised as a shared virtual workspace where students could work collaboratively and evaluate the level of their thinking. Interviews with Helen and Fiona at the end of the year revealed that they had shifted their attention away from the *product* of the learning (i.e., the Prezi or PowerPoint presentation that was posted to the e-portfolio site) to the *process* of learning (i.e., evaluating the depth of their thinking, working collaboratively to learn and practice a variety of skills in an authentic context), and that they could perceive the value of these student-centred practices.

Learner attributes also had an impact on teachers' actions and beliefs. Despite their varied pedagogical beliefs and practices, each of the teacher participants believed that student agency and autonomy could be facilitated through the use of digital technologies. Because they viewed their students as proficient technology users, the teachers perceived opportunities for transferring varying levels of control to their students when digital tools were included in classroom activities. Teachers valued the expertise of their students and recognised the opportunity to provide choice in their activities by including digital tools. Additionally, they welcomed the opportunity to reverse or reconceptualise a traditional teacher-learner relationship and to learn from

their students about the affordances of new or familiar tools. Through this activity teachers encouraged ownership and voice, fundamental to creating a constructivist learning environment (Cunningham, Duffy, & Knuth, 1993), and shaped students' perceptions about their role in the learning environment. Additionally, the teachers were able to build their knowledge of the technical tools available through these interactions, which allowed them to rethink their pedagogical decisions. Similarly, Rambe (2012) recently found that lecturer-student power-sharing was enabled at the university level when students were given opportunities to demonstrate technical problem solving to their peers, shifting their role from passive recipient of information to resources of information themselves. The current study suggests that teachers at the intermediate level are also making use of technological tools to support this type of reconceptualization of their role in the classroom, and in the process their pedagogical beliefs are shifting toward the student-centred ideals perceived as effective practice.

The results from this study suggest that while teachers' underlying beliefs are the primary motivation behind integrating digital tools into their classroom practices, access to technology as well as the teachers' local school environment prompts technology use. In some cases these have the power to alter teachers' pedagogical beliefs and ultimately their practice.

Considering student experiences

The examination of student experiences throughout the study provided insight into students' thinking, learning, and actions as they worked with digital technologies within the classroom setting. The student experiences in this study were varied and data revealed that a number of factors impacted on the ways that students engaged with activities and the learning that took place as they worked with digital technologies. Interviews and observations indicated that teachers' methods of organising and presenting activities when integrating digital tools varied and led to mixed outcomes for students. Additionally, students brought their own unique knowledge and experiences to these activities, influencing their experiences when utilising digital tools in the classroom. In the following section, these aspects of the

teaching environment will be discussed. Then, these factors will be discussed in relation to Vygotsky's (1978) theory of the Zone of Proximal Development (ZPD).

Furthermore, digital tools were utilised by the four participating teachers in part to motivate and engage students in learning activities. However, results from this study indicate that student engagement and motivation varied and was influenced by student attributes, characteristics of the learning task, and physical features of the learning environment. This phenomenon and the impact on student learning will be discussed.

Outcomes depended on students' technical skills

This research demonstrated that much of the participating teachers' activity in the classroom was influenced by their belief that students were capable and proficient technology users. These viewpoints are similar to the ongoing supposition that the current generation of students have grown up with and are proficient and familiar with a variety of digital tools (Oblinger, 2004; Prensky, 2001, 2005, 2012). However, while Jack reported that he informally assessed his current students at the beginning of the year to determine their prior knowledge of digital tools, the three other teacher participants reported that their previous teaching experiences and knowledge of the students they had taught the previous years had primarily contributed to this belief (both Fiona and Helen's Year 8 students had been in their classes the previous year). None of the teachers had formally assessed the technical skills and knowledge of their students. Consequently, teacher perceptions of students' technological proficiency were sometimes inaccurate and this impacted on the outcome of classroom activities.

This research demonstrated that methods of introducing new hardware and software influenced students' ability to complete tasks and acquire the skills or knowledge expected from the activity. Although many students reported during observations and focus groups that they were proficient with a range of digital tools that they used outside of school (i.e., posting videos to YouTube, accessing and posting pictures to Facebook), observations indicated that this expertise did not necessarily transfer to new tools introduced in the classroom. When students were explicitly shown how to operate unfamiliar programmes by the teacher or another student before its initial use, they were observed engaging with the programme as intended

(i.e., learning to estimate using a web-based math game or using descriptive verbs in their writing). Conversely, students who were simply given a link or sent to a new tool without specific instructions in the appropriate use of a new tool generally experienced one of the following outcomes. Either the student quickly succeeded in using the hardware or software when they had sufficient prior knowledge of similar tools and could quickly work out the new tool, or the student spent a considerable amount of the allotted time for the activity learning how to use the new tool and in some cases, never learnt how to use the tool properly. While problem solving skills were valued by the teachers and at times they believed that they were facilitating student autonomy by allowing students to independently explore new tools, there were instances when the students did not engage with the curricular material as the teacher had intended because of their unfamiliarity with the digital tool.

This research indicates that the participating teachers perceived value in both increasing their students' technical skills and building students' content knowledge in particular curricular subjects (i.e., mathematics, literacy), but that they did not always differentiate between the two when considering the objectives of each lesson. Previous research has indicated that teachers may experience conflict in determining whether their responsibility is to utilise digital tools to teach technical skills or to facilitate subject learning (Hennessy et al., 2005). Clearly, the teachers in this study were continuously negotiating whether to explicitly teach students specific technical skills or to rely on students' perceived technical expertise when new tools were introduced as tools to facilitate the learning of curricular content. Evidence gathered during observations when students were explicitly shown how to use unfamiliar tools indicated that students spent the majority of their class time making progress toward the goals of the activity, whether these objectives were learning how to use the new digital tools or engaging with curricular material. Jack's method of using the data projector in the computer lab to demonstrate basic procedures for using new software, then allowing students to explore and work with the software in a familiar context allowed students to familiarise themselves with the new tool and to spend the majority of their class time working on the assigned activity. Conversely, students spent less time progressing toward intended curricular objectives on occasions when they were asked to use new tools without explicit instruction in using the tools. At the

same time, students engaged in problem solving during these activities in order to learn how to manipulate the new digital tool and were often successful in doing so; however, this process consumed time allotted for the activity. This evidence indicates that there is a need for teachers to evaluate students' technical proficiency as well as to clarify their objectives and methods of introducing new technologies to students.

Differing technical abilities presented opportunities for cooperative learning and new roles for students

Students who participated in the focus groups in this study reported a high level of access to digital technologies in their home and had access to vast amounts of information and digital tools through mobile technologies and the Internet, corroborating previous studies (Erstad, 2003; Grimley & Allan, 2010; Selwyn, 2006). Additionally, these participants indicated that they utilised communication tools such as cell phones and social networking sites and used email outside of school, similar to previous research (Greenhow & Robelia, 2009a; Luckin et al., 2009). However, the research findings challenge the assertions that today's students "intuitively use a variety of IT devices and navigate the Internet" (Oblinger & Oblinger, 2005, p. 16) and that 'digital natives' are "native speakers of technology, fluent in the digital languages of computers, video games, and the Internet" (Prensky, 2005, p. 9). Such claims seemed to represent only some of the students, and this knowledge did not necessarily transfer directly to proficiency with the digital tools used in the participating classrooms.

Data from this study indicated that about a quarter of the students in the focus groups were proficient technology users outside the classroom and quickly recognised the affordances of new digital tools that were introduced and how to manipulate the tools as their teachers requested. Each classroom contained both Year 7 and Year 8 students which meant that about half the students in each class had been at the school the previous year (and in the same teacher's classroom in the case of School A) and had learned how to operate some of the technologies used at the school during that time. This situation provided an opportunity for teachers to ask students to work collaboratively so that more experienced students could assist their less

technologically able peers, and they hoped that through this experience the less capable students would build their own knowledge.

This pedagogical practice is consistent with best practice recommendations in the New Zealand curriculum document that adopts a social constructivist philosophy for education and states: “Opportunities to develop the competencies occur in social contexts. People adopt and adapt practices that they see used and valued by those closest to them, and they make these practices part of their own identity and expertise” (Ministry of Education, 2007, p. 12). Within their multi-level classrooms, the teachers in this study provided opportunities for less knowledgeable students to develop technical skills and strategies from their more capable peers as suggested by Vygotsky (1978). In these situations, students were expected to scaffold, or support the learner in completing “those elements of the task that are initially beyond the learner’s capacity” (Wood, Bruner, & Ross, 1976).

Within this research, students were sometimes able to successfully scaffold the learning of their peers, but at other times they lacked either the technical skills or the collaborative skills to help their classmates successfully complete the task at hand. The participation and outcome for the less knowledgeable peer depended largely on the practices of the assistance given by the more capable student. While at times the learners were able to successfully complete the task together, there were situations in this study when the more capable peer either lacked the appropriate knowledge (i.e., knowledge of the programme being used, knowledge of the content being taught or practised) or lacked the scaffolding skills necessary to help the less capable student reach their potential (i.e., one or more students in the group completed the task, but was unable to explain to one or more of the other group members how the problem was solved).

While these issues have not been widely documented in discussions of learning with digital technologies, studies in other fields have identified similar concerns. In a study involving peer scaffolding of second language learners, Ohta (2000) found that the expertise of the helper, whether ‘expert’ or peer, influenced the effectiveness of the assistance given, and that before being expected to scaffold one another, students should receive explicit instruction on how to do so successfully. Furthermore, Ferreira (2008) points out that “scaffolding requires a planned socialization phase if students

are inexperienced with this practice. Teachers consciously have to instruct them about its importance for learning and for interaction and about how to achieve it" (p. 24). As the researcher in this current study, I spent only a limited time within each classroom; however, there were no indications that teachers provided students with explicit instruction in effectively assisting one another when digital technologies were included in lessons. Data from observations, interviews, and focus groups suggested that the teachers not only assumed technical expertise from at least some of their students, but also believed that students were experienced, skilled collaborators and peer tutors prior to entering their classrooms. During some lessons, both peer and teacher scaffolding were combined during the observed activities (i.e., directions were projected at the front of the room and students were also expected to ask one another for assistance when help was needed), and this combination of scaffolds proved to support the intended outcomes. However, other situations occurred that suggested students would benefit from training in appr2opriate scaffolding when they were given this role (i.e., episode when one student of the three who worked together to solve estimation problems had not learned how to solve the problems independently by the end of the activity; situation in which students expected to critique each other's goals were observed working independently instead).

Additionally, the success of collaboration also depended on group dynamics, such as which students were more dominant or comfortable in group settings. Research has demonstrated that the interpersonal dimensions of scaffolding (i.e., the participants sharing the same perspective of the task and respecting each other's perspective; the less capable person's acceptance of the more capable peer's assistance; and the meaningfulness of the task) have an impact on the outcome of the activity (Stone, 1993), and evidence indicates that these factors impacted on the students' interaction and progress toward the objectives during lessons. Students in Helen and Jack's classroom were observed taking turns rather than collaborating during various cooperative activities, and students in Zoe's room were unsure about the objective of the task during selected learning activities. Additionally, the group of three students in Helen's room who worked to solve estimation problems were primarily concerned with obtaining points for their team rather than ensuring that all three of the students understood how to solve the problems. This dilemma was also

noted by Ferreira (2008) who observed that one of the students in her study ignored his job of scaffolding and viewed it as an obstacle to completing the exercise in the allotted time.

Within this study, each of the teacher participants planned cooperative activities when integrating digital technologies in part to facilitate opportunities for peer to peer scaffolding. This provided new roles for students, which could arguably unsettle their own perspective on the activity system they engaged in, and the success of the learning of the less capable student depended primarily on the ability of the more capable peer to appropriately assist the less skilled peer.

Digital technologies to facilitate engagement

The four teachers in this study made use of digital technologies to motivate students and engage them more fully in classroom activities. As other researchers have suggested, these teachers believed that simply including digital tools into lessons had the potential to keep students engaged and interested in the learning task (Ertmer et al., 1999; Millstone, 2012; Oblinger, 2004; Ottenbreit-Leftwich et al., 2010). However, data from students indicated that simply including digital tools did not necessarily increase engagement with the learning task or motivation to complete the task, consistent with previous findings (Moss et al., 2007; Zhao et al., 2002). Instead, in-depth analysis indicated that student attributes, characteristics of the learning task, and physical features of the learning environment impacted on students' levels of engagement during the activity and motivation for the activity when digital technologies were integrated into classroom activities.

The students in this study exhibited the highest engagement in tasks when:

- they possessed the required pre-requisite skills, both technical and content-based, needed for the activity;
- the purpose and objective of the activity were clear and appropriate support was provided to students;
- the ratio of students to computers was appropriate for the activity; and
- students were creating or constructing new knowledge as opposed to practising skills or searching for specific information.

These concepts can be interpreted through Whitton's (2011) model of engagement with learning. Although Whitton's work in developing this framework is based specifically on research with adults in the area of game-based learning, the principles can be applied to the broader context examined in this research, and thus the model can be extended. Whitton's (2011) five-factor model of learning engagement assumes that each of the following factors "contribute to an overall sense of engagement with an activity and that the greater the extent to which each factor is present the greater the engagement" (p. 605):

- Challenge – the motivation to undertake the activity, clarity as to what it involves, and a perception that the task is achievable;
- Control – the fairness of the activity, the level of choice over types of action available in the environment, and the speed and transparency of feedback;
- Immersion – the extent to which the individual is absorbed in the activity;
- Interest – the intrinsic interest of the individual in the activity or its subject matter;
- Purpose – the perceived value of the activity for learning, whether it is seen as being worthwhile.

The students in the current study were more engaged in the learning task when they possessed the knowledge required to complete the task as well as when learning objectives and the purpose of the activity was clear; this is congruent with the concept of challenge. While Whitton suggests that learners must *believe* that the task is achievable, this research indicates that engagement also depended on students' actually possessing the prior knowledge required to complete the task. Additionally, clarity around the goals and objectives of the activity were key to student engagement, and further research is needed to determine exactly why teachers did not always clearly define the learning task for students. From the data collected, one possible explanation for this may be that on these occasions teachers were aiming to create a student-centred climate in the classroom by allowing for choice in the activity, but in doing so students were not provided with enough information to understand the end objective the teacher sought.

The third and fourth factors mentioned above that influenced engagement in the current study suggest additions to Whitton's model when referenced within the

current context. While working in a game-based learning environment generally involves the acquisition of new knowledge, the learners in this study were more engaged when digital technologies were integrated to support new knowledge construction rather than practising skills or locating specific information. This is consistent with the idea that digital technologies are most effectively utilised as 'mindtools' or 'cognitive tools' that interact with learners to construct new knowledge (Jonassen & Reeves, 1996; Kim & Reeves, 2007).

Finally, student engagement was higher when level of access to digital technologies was appropriate for the activity and objectives identified by the teacher. This did not necessarily equate to a one-to-one learning environment, as there were instances when students were highly engaged in the activity when the student to computer ratio was four to one. Instead, engagement depended on the match between the nature of the task as well as the outcomes desired with the digital tools needed to complete the task effectively. This applied not only to hardware (i.e., computers, tablets, digital video cameras), but also to the programmes and digital educational tools being utilised (i.e., web-based games, video editing software). While providing students control over the tools they used facilitated engagement as suggested by Whitton (2011), attributes of digital technologies that provided opportunities to go off-track decreased engagement (i.e., adverts on online games distracted students; a website requiring a teacher password was inaccessible without help).

Data collected in the current study did not address Whitton's (2011) factors of immersion, interest, and purpose, although future research could ascertain whether they are germane to the current context of intermediate students' learning with digital technologies. However, the current study validates the challenge and control factors as proposed by Whitton and from this research, two additional factors that the author hypothesises contribute to student engagement can be identified when digital technologies are integrated in intermediate classrooms. First, the factor of 'knowledge construction' is the idea that students are more fully engaged when digital technologies are used to support the creation and construction of new knowledge, rather than the acquisition of knowledge. Second, the factor of 'access' is the idea that learners are more engaged when they have access to a level of technology appropriate

for the learning task, including elements of both hardware and attributes of the programme or digital educational tool being utilised. While further research is necessary to determine the validity of these concepts and their application within a variety of settings, the current research provides evidence that a number of factors impact on student engagement when digital technologies are integrated in intermediate classrooms.

Clearly, including digital technologies in place of traditional materials for the primary purpose of motivating or engaging students may not have the desired effect. Instead, the integration of digital technologies requires careful and thoughtful planning to ensure that conditions of the learning activity will facilitate the desired outcomes.

Implications

The results of this research are significant to the schools and classrooms in which the study was conducted, and Lincoln and Guba's (1985) concept of transferability provides the basis for identifying implications for similar educational settings. Based upon the findings of this research, suggestions can be made at both the school and classroom levels.

School-based recommendations

This research illustrates that aspects of the school culture can impact the level of technology integration at the school, supporting previous findings (e.g., Becker, 1998; Lumpe & Chambers, 2001; Means, 2010; Norris et al., 2003; Palak & Walls, 2009; Scrimshaw, 2004; Starkey, 2010b; Zhao et al., 2002). Additionally, this study reveals that a supportive school environment has the potential to increase teacher knowledge and to facilitate changes in technology-related and pedagogical beliefs, which is key to increasing meaningful uses of technology (Ertmer, 2005). This support can be realised by providing adequate and reliable digital tools and technical assistance, access to technical and pedagogical professional development, opportunities to collaborate with peers, time for teachers to reflect explicitly on teaching with technology, and chances to assist in the creation of school policies around digital technologies.

Financial backing to provide access to the needed hardware and technical support to ensure technology was available when needed were key to the teachers in this study, consistent with previous findings (Miranda & Russell, 2011; Norris et al.,

2003; Smarkola, 2008). In contrast to findings from a recent study suggesting that classroom placement of computers facilitates technology use more than placing computers in a centralised lab (Petko, 2012), this study foregrounded the importance of teachers' pedagogical preferences and lesson objectives on decisions around access to classroom-based or lab-based computers. This suggests the need to consult with teachers to understand their preferences or to include them in the decision making process around this issue (i.e., types of devices purchased, location of devices). As providing the necessary funds to fulfill this need is often substantial, Bring Your Own Device (BYOD) policies can be considered. Second, technical and integration support needs to be readily available when problems occur and alternative methods of providing technical and pedagogical support should be explored and implemented.

Both formal and informal learning experiences were essential to technology integration in this study, and recommendations can be made regarding aspects of professional development that would benefit teachers. In line with previous research, professional development needs to include both instruction in how to use digital tools and pedagogical guidance in integrating the tools within the existing curriculum (Jacobsen et al., 2002; Mishra & Koehler, 2006; Zhao et al., 2002). This would be most beneficial as ongoing long-term training since the continuously evolving nature of digital resources requires continual development in that area (Scrimshaw, 2004). As Ertmer (2005) suggests, time to reflect on one's teaching practice as new technical and pedagogical knowledge is learned can create opportunities for shifts in beliefs; therefore this is recommended as part of the professional development process. Additionally, technology integration should be encouraged through the support of informal learning opportunities (i.e., attending technology-based conferences, being given time to research appropriate educational online resources to support the curricular goals).

This and other research highlights the benefit of collaboration between colleagues when deciding how to integrate technology into classroom practices (Hadley & Sheingold, 1993; Murphy & Lebans, 2008; Zhao et al., 2002). Therefore it is recommended that school leaders provide teachers time and the opportunities to convene and discuss their pedagogical practices, particularly around technology use. This can occur both face to face at the school site or online through the use of online

tools. Furthermore, teachers should be invited to showcase and share their new knowledge with their colleagues as suggested by Ertmer (2005) in order to support shared goals of integrating digital in ways that align with the school curriculum and mission (Parr & Ward, 2011; Staples et al., 2005).

Finally, school policies and other formal expectations for the use of digital technologies influenced the inclusion of digital tools within the participating classrooms. This research demonstrated that teachers were committed to fulfilling school policies around digital technologies in part because they were included in the decision making process in creating these policies and that successful advancement of the integration of technology can be achieved when specific policies requiring the use of school-adopted tools are coupled with adequate technical and collaborative pedagogical support for their use. Therefore, school leaders are encouraged to include teachers in the creation of policies mandating the use of digital tools to ensure that value in the tools are perceived by all who help to create the policies. School-wide implementation of digital tools is more likely to take place in a school culture in which the use of digital technology is a requirement rather than a request.

Classroom-based recommendations

Data from student interviews and observations revealed several factors that impacted on their learning and experiences when digital technologies were integrated into classroom activities. This information provided the basis for several suggestions for teachers including the need to assess students' technical skills, clarify lesson objectives, and carefully consider the best times and methods for integrating technology to maximise student engagement.

This research found that students possessed varied technical knowledge within the classroom, although many were proficient with a range of digital technologies outside of school, consistent with prior research (Erstad, 2003; Grimley & Allan, 2010; Selwyn, 2006). However, these skills did not necessarily transfer to classroom activities and this affected student activity toward teacher objectives. It is recommended that teachers conduct formative assessments with students early in the school year to ascertain their technical abilities so that they may appropriately plan lessons that incorporate digital tools. Having a thorough understanding of students' technical

capabilities will allow for more effective pairings when asking students to scaffold one another and will provide teachers the opportunity to build on students' prior knowledge when introducing new digital tools. As Ohta (2000) suggests, students should receive explicit instruction on how to scaffold one another successfully, and including this training early in the year will facilitate a transition phase in which students can become more comfortable with the process (Ferreira, 2008). Assessing student skills early on will also alleviate frustration for students who feel that their teachers underestimate their technology skills and will allow teachers to assist students in transferring skills from their home experiences to school-based tools.

Second, it is a recommendation that teachers identify overarching objectives and goals they have for students over the course of the year so that classroom activities can be planned that support these aims. As Hennessy et al. (2005) suggest, teachers are often conflicted as they decide whether their responsibility is to utilise digital tools to teach technical skills or to facilitate subject learning and given the time constraints of the school year, teachers often find it challenging to plan and teach with digital technologies while still trying to meet other curricular demands (Becker, 1998; Ertmer, 2005; Hadley & Sheingold, 1993; Hardman, 2005). To maximise student learning time, lesson objectives must be well-defined and cognisant of student prior knowledge. While technical skills may not always be cited objectives when digital technologies are integrated into lessons, they should be included as goals when new tools are introduced to students as research has shown that students are often only proficient using technologies that are available to them in settings outside of school (Feiertag & Berge, 2008). Furthermore, various methods of introducing new digital tools to students must be considered to fulfil the desired objectives. This may include allowing students to explore new programmes or web-based educational tools to foster problem solving and self-directed learning or explicitly demonstrating how to use unfamiliar tools before their use if engaging with curricular content is the primary goal. Additionally, ample time must be given for students to engage with the activity to ensure that all goals are met (e.g., when students must learn how to use a new digital tool and complete a particular curriculum-related task).

Finally, it is recommended that digital technologies are not exclusively incorporated into classroom activities to facilitate student engagement. Similar to

Whitton's (2011) findings, this study reveals that a number of factors around lesson design and execution impact on students' level of engagement when working with digital technologies. Therefore, there is a need for thoughtful consideration of how to organise activities to maximise engagement. Assessing student prior knowledge is key to ensuring that the task is neither too simple nor too difficult for students' current technical and content-based levels. Additionally, clear objectives and purpose must be communicated to students so that they may purposefully engage in activity to reach the goal. Furthermore, teachers must consider the levels of access that will best facilitate the intended goals to prevent students from losing interest in the activity.

Limitations

Several limitations of this research impact on its application to similar environments. First, the subject matter studied is part of a constantly evolving field as new devices and applications are being introduced on a regular basis. Many new technologies are being adopted at a rapid pace as others become obsolete. Therefore, the transferability of the findings may be limited due to the static nature of the field.

This study has a number of limitations central to its methodological choice. Multiple case studies were useful for this study because they permit a thorough understanding of the interactions of multiple aspects of a bounded system (Stake, 1995). Thirty classroom lessons were observed (seven to eight in each classroom) and 83 of the students within the four classrooms were interviewed individually or within a focus group in an effort to collect as much data as possible from the four classroom environments. However, this is only a small sample of these teachers' classroom lessons and of students' perspectives over the course of the year. Thirty-three of the students did not return consent forms, and the number of forms returned was disproportionate across classrooms. Additionally, this research examined a small sample of cases and is constrained to a selection of intermediate school classrooms within one area of New Zealand; therefore the transferability of the findings is limited.

Selection of teacher participants was restricted due to time constraints and the limited accessibility to schools by the researcher. Teacher participants were recommended by the principals of each participating school and while principals were asked to choose teachers based on the frequency of their technology integration, they

may have had other specific reasons for choosing teachers unbeknown to the researcher. Furthermore, two of the four teachers held formal technology-related leadership positions at their schools, which may have altered their perspectives. Teachers may have agreed to participate primarily to comply with the principal's wishes and they may have been motivated to present the school in a positive light rather than being entirely honest throughout the data collection process. Data collection was also organised at times that were convenient for each teacher; therefore, they may have altered their teaching behaviour in anticipation of the researcher's visit rather than carrying out their normal routines.

While the year-long duration of this study is a strength of the research, it can also be viewed as a limitation. A significant finding was that teachers' knowledge and beliefs changed or had the potential to change over the course of the school year, but deep-seated beliefs in particular transform slowly over time (Nisbett & Ross, 1980; Rokeach, 1968). Therefore, longitudinal research of two or more consecutive years designed to measure teachers' beliefs and knowledge over a longer period would be informative.

Finally, the teachers in the study were frequently being interviewed and observed throughout the duration of the study. This may have raised their awareness of the way they were using digital tools to support their classroom practices and may have caused them to be more reflective of the process, which in turn may have influenced their use of digital technologies over the course of the study.

Suggestions for further research

Many ideas for future research at both the school and classroom levels have emerged through this study. Further understanding in this field could be gained by investigating:

- how and why teachers determine learning objectives (i.e., gaining technical skills, learning content knowledge) when digital technologies are included;
- how teachers' technical and pedagogical knowledge, beliefs, and practices shift over time while involved in the the Information and Communications Technology Professional Development (ICTPD) cluster and in the years following the training;

- the role of school-driven and self-guided learning opportunites in shaping teachers' beliefs, knowledge, and teaching practices when integrating digital technologies;
- in what manner do new roles for teachers and students that are created when they are perceived as knowledgeable technology users influence classroom activity and student learning;
- aspects of the school culture from the perspectives of both school leaders and staff members in an effort to discern the practices and processes needed for successful technology integration;
- multiple perspectives (i.e., principal, technology coordinator, parents, teachers, students) of technology integration within a school setting through the third generation of activity theory (Engeström, 2001) in an effort to raise awareness of contradictions and to stimulate change in order to resolve them (Sannino et al., 2009);
- classroom lessons over two or more school years to elucidate the transition process for schools and teachers and to identify specific phases of technology integration within the digital age;
- contexts other than intermediate schools and outside New Zealand to discover whether aspects of the findings are present in other settings;
- factors that impact on student learning outcomes when digital technologies are integrated into classroom activities.

Summary

Teachers' decisions to integrate digital technologies within their classroom activities are influenced by both personal beliefs and knowledge and contextual factors within the surrounding environment (e.g., Bauer & Kenton, 2005; Ertmer, 2005; Ertmer et al., 1999; Means, 2010). This research, which examined the activity of experienced intermediate school teachers identified as using digital technologies often in their classrooms, both confirmed and extended these understandings. Ultimately, teachers' perceptions about how digital technologies could be effectively integrated into their classroom practices and beliefs about students' needs and capabilities underpinned

the inclusion of digital tools, and external factors within the environment mediated these activities and contributed to an evolution of teachers' pedagogical beliefs over the duration of the year-long study.

The use of Cultural Historical Activity Theory (CHAT) provided a lens to explore the relationships between internal and external factors and the tensions that emerged within the system when contradictions occurred. The analysis revealed that school culture played a central role in teachers' methods of incorporating digital technologies and reiterated previous findings that adequate technical access and support as well as backing from school leadership is necessary from school leaders to facilitate classroom technology use (e.g., Groff & Mouza, 2008; Means, 2010; Miranda & Russell, 2011; Palak & Walls, 2009). New findings included the revelation that these teachers accepted additional roles and responsibilities within the school environment in an effort to facilitate school-wide technology integration, although these impacted on their classroom responsibilities. Additionally, teachers were included in decision-making around digital tools at the school level, providing them with a sense of agency and dedication to achieving school-wide goals.

This study illustrates that a shift in teachers' pedagogical beliefs and technology use in the classroom is possible over time when contextual factors supported this transition. The participating teachers sought out formal and information learning experiences around the use of digital tools and were able to rethink their pedagogical practices when they learnt about new tools or the affordances of familiar tools. Furthermore, school policies around digital technologies at one school coupled with sufficient technical and pedagogical support also led to increased student-centred use of school-adopted digital tools over the course of the year.

Teachers integrate digital technologies both to build students' technical skills so that they may function in their future lives and careers and to invigorate classroom learning time. This research found that objectives and attributes of learning activities that include digital tools impact on student engagement and the learning that takes place during these lessons, suggesting that careful thought and planning are required to fully take advantage of the potential of these tools. A formative assessment of students' technical and collaborative skills can provide necessary information to create appropriate lesson objectives and procedures to meet the needs of students, whether

the goals of these activities are to build students' technical skills or competency in other curricular areas. While teachers continue to incorporate digital technologies in an effort to motivate students and increase engagement (Ertmer et al., 1999; Millstone, 2012; Oblinger, 2004; Ottenbreit-Leftwich et al., 2010), student interest and involvement is much more complex than simply substituting traditional materials for digital ones. Instead, engagement can be facilitated through learning tasks in which students create or construct new knowledge, access is appropriate for the activity, the purpose and objective of the activity is clear, and students possess the required pre-requisite skills.

Chapter 10. Conclusion

Within the current educational context, digital technologies are being integrated into classroom activities with the intent of improving student learning. The purpose of this thesis was to explore the everyday reality for intermediate school teachers and their students when digital tools were incorporated into learning environments over the course of a school year. The aim of the research was to understand teachers' motivations for integrating digital technologies into their teaching practice, how they accomplished this, and what environmental and personal factors underpinned these decisions. In addition, this research investigated students' experiences as they participated in teacher-planned lessons in an effort to learn more about features of classroom activities that impact on student learning when digital technologies are utilised. This research explored the following four research questions:

1. *Why do teachers integrate digital technologies into their teaching practice?*
2. *How do teachers integrate digital technologies into their teaching practice?*
3. *What do students experience as they participate in lessons that integrate digital technologies?*
4. *What underlying processes within a system influence teachers' choice and use of digital technologies in their classrooms?*

The first two research questions were intertwined and were concerned with identifying teachers' motivations for integrating digital technologies and how they chose to incorporate digital tools into their classroom activities. The intermediate school teachers within this study chose to integrate digital technologies in an effort to support their existing pedagogical practices as they believed that digital tools facilitated student collaboration, motivated and engaged students, facilitated student agency or autonomy, offered alternative ways for students to practise content-based skills, provided access to information, allowed for individualised instruction, and provided a repository for student work. Additionally, technology was utilised to communicate with parents, to comply with school policies or expectations, and to prepare students for a digital world in which they would need to function in the future. As a result, a variety of hardware and digital programmes were used in each classroom. During classroom lessons, students made use of classroom-based laptop and desktop

computers connected to the Internet, a centralised computer suite, and digital video and still cameras. Additionally, Internet-based educational tools such as Google Docs, interactive skill-based games, YouTube, a Learning Management System (LMS), an e-portfolio system, and digital learning objects were used to support teachers' intended learning objectives.

The third research question required examining students' perspectives to discover how they interacted with digital technologies within their classroom learning environment. Evidence indicated that students were proficient with a range of digital tools outside of school, but this did not always translate to technical proficiency within the learning environment. A number of attributes inherent to the learners including content knowledge, technical expertise, and collaborative skills influenced student participation when digital tools were included in learning activities. Additionally, student understanding of the purpose and objective of the activity as well as support provided to students during learning time affected the ways in which students interacted with teacher-planned lessons. Students exhibited the highest engagement in tasks when the ratio of students to computers was appropriate for the activity and during learning activities in which they were creating or constructing new knowledge as opposed to practising skills or searching for specific information.

To answer the fourth research question, a Cultural-Historical Activity Theory (CHAT) framework was applied to the data to identify underlying factors which affected teachers' choice and use of digital technologies in their classrooms. School leaders were important members within each activity system and communicated expectations for the use of digital tools to each of the teacher participants who altered their activity accordingly. Additionally, teachers' perceptions of the affordances of the technology available in their classrooms as well as adequate technical support and access provided affected the ways in which they were able to integrate these tools into their classroom practices. Due in part to their commitment to fulfil school policies around the integration of specific digital tools, the teachers in this study accepted new roles and responsibilities within their school. Whether these roles were formal or informal, at times the additional responsibilities interfered with their classroom obligations. Finally, school directives to integrate technology coupled with adequate

technical and pedagogical support led to evolutions in technology use over the course of the year.

This study indicates that teachers who are committed to integrating digital technologies into their classroom practices and perceive value in its use rely on their technical, content, and pedagogical knowledge and beliefs when initially designing learning objectives and procedures for students, consistent with previous research (Ertmer et al., 2012; Kim et al., 2013; Niederhauser & Stoddart, 2001; Ottenbreit-Leftwich et al., 2010). However, this research extends previous research by elucidating *how* sociocultural factors such as access to digital technology, policies which require the use of technology, and technical and pedagogical support can mediate and shape teachers' actual classroom practices.

While previous research has revealed the importance of contextual factors in teachers' decisions to utilise digital technologies (e.g., Bauer & Kenton, 2005; Baylor & Ritchie, 2002; Becker, 1998; Ertmer et al., 1999; Means, 2010; Sandholtz et al., 1997; Smarkola, 2008), this research contributes to understanding the relationships between these elements. The yearlong duration of this research demonstrated that tensions that are created as teachers alter their practice in response to environmental factors have the potential to lead to transformative learning situations in which the teachers' technical and pedagogical knowledge and beliefs can develop and evolve.

Another key finding in this study was that despite the fact that research has confirmed that the majority of young people in New Zealand have a high level of access to digital technologies in their home and school environments (Grimley & Allan, 2010), the student participants within this research possessed varying levels of proficiency with digital tools and were not always able to interact with technology in the way the teacher intended. Teachers in the study were often guided by the assumption that students are highly proficient technology users, or 'digital natives' with unique qualities directly related to their experiences with digital technologies (Feiertag & Berge, 2008; Oblinger, 2004; Prensky, 2001). Thus, the claims of Prensky and others must be critically considered in conjunction with a thorough assessment of students' technical proficiency in order to best utilise the knowledge of those advanced students, to fully engage students in classroom activities, and to design

learning activities with these varying skills in mind. Students may need to be explicitly taught how to use a programme or technology.

In this digital age, technologies have facilitated a shift in the acquisition of knowledge from a positivist position characterised by the passive transfer of information from the teacher to their students to an interactive constructivist one in which learners are actively involved in a process of meaning and knowledge construction (Starkey, 2012). For over three decades, proponents of this shift have recognised the capabilities of digital tools to support this transition within education, but the widespread adoption and use of digital tools to support this form of learning has yet to come to fruition. However, this research provides evidence that the pedagogical practices of teachers who are making use of digital tools in their classroom environments are evolving toward a student-centred approach. Through elements of their environment, including formal and informal learning experiences, school policies aimed at encouraging the use of technology, increasing access, and technical and pedagogical support, pedagogical practices have the potential to change over time. This has implications at the school level as providing these forms of support concurrently can cultivate changes within classrooms.

Learning in the digital age requires that students engage in their classroom environments in new ways which might be unfamiliar and different from their prior experiences in the classroom (Åkerlind & Trevitt, 1999; Groff & Mouza, 2008) as they are often required to complete open-ended tasks, collaborate with others, direct their own learning, and assume new leadership roles which do not align with traditional positivist beliefs that have been reinforced through traditional classroom activities and assessment (Groff & Mouza, 2008; Kennewell et al., 2008). This research illustrates that students are often unprepared to engage with digital technologies without guidance and that care must be taken to ensure that student technical and content-based abilities are assessed and lesson objectives and procedures are meticulously designed to meet student needs. Additionally, teachers must carefully consider their motivations for including digital technology in learning tasks, as simply exchanging traditional materials for technological tools may not facilitate learning or engagement

as envisioned. These understandings can assist teachers in fully employing the potentials of digital tools within their classroom environments to facilitate learning.

While there remains the tension that digital technologies are not being integrated into classroom activities to their full capacity (Ertmer & Ottenbreit-Leftwich, 2010; November, 2010), many teachers, including those within this study, are dedicating their time and effort to integrate these modern tools in ways that support their beliefs about effective teaching and learning. Being part of such a reform can create tensions and perceived pressures, but through this struggle, evolutions can occur. Through rigorous investigations, much can be learned from the day-to-day realities of such experiences, helping to create experiential models of practice that can be guides to understand, improve, enhance and maximise technology-enhanced instruction throughout a variety of educational environments.

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Appendices

Appendix A: Letter to principals

FACULTY OF EDUCATION

Tara Evans
Victoria University
Wellington College of Education
P O Box 17-310, Karori
Wellington
1 December 2010

Re: Permission from principal to research the use of digital technologies in intermediate classrooms

Dear (Principal name),

My name is Tara Evans and I am a doctoral student at Victoria University of Wellington conducting research in the use of digital technologies in intermediate classrooms. I am writing to you to ask your permission to conduct some of my research at your school during Terms 1 and 2 of the 2011 school year.

At present digital technologies such as computers, interactive whiteboards, and the Internet are used by some teachers to support the learning of their students. Research has shown that the use of digital technologies can be beneficial to student learning. Despite this there is not a great understanding regarding the reasoning behind teachers' decisions to use digital technologies with their students and the learning that occurs as a result of using these tools in their lessons.

My project aims to explore the use of digital technologies in Intermediate School classrooms. It is hoped that this information will help inform school leaders who wish to create a supportive environment for their teachers and will provide guidance for teacher educators in developing training programs. In addition, this research may be beneficial to teachers as they consider using digital technologies in their classrooms. This research is being conducted as part of a PhD thesis with the School of Educational Policy and Implementation at Victoria University of Wellington.

In order to conduct this research I am approaching intermediate schools to take part in the study. Selected teachers and their students in each school will participate in interviews, observations and think alouds during the first two terms of 2011. I plan on interviewing each teacher at the beginning of the school year and then observing a maximum of 10 lessons in order to observe a variety of activities in which digital technologies are used. Teachers and students will be observed as the lessons proceed and they will also be interviewed after the lessons to learn more about the goals for the lessons and the learning that occurred during the lessons.

If you agree to allow two teachers and classes to take part in the study the expected impact on your students and teachers should be minimal. Actually, focusing teachers' attention on student learning and having them articulate their reflections is likely to be beneficial to their practice. Teachers will

be selected to participate by the end of the current school year. Upon your recommendation, teachers who use digital technologies often will be approached and asked to participate in the study. Formal data collection using the methods described above will take place beginning in February of 2011.

Throughout the project all attempts will be made to minimize the disruptive impact on your students' learning. Once the study is complete your school will be provided with a summary of the research findings and any publications that result from the study. All those involved in the study will sign confidentiality forms. Your school will not be identified in any work generated from this study. All digital files generated in this study will be securely stored on a password-protected computer, and hard copies will be kept in secure storage for two years after the conclusion of the research before being deleted or destroyed. This project has been approved by the Victoria University of Wellington Faculty of Education Ethics Committee, application no 18122.

If you do agree to allow your school to take part in the study please complete the consent form included with this letter and return it in the stamped and addressed envelope provided. If you do not wish to take part in the study your and your school's relationship with Victoria University of Wellington will not be affected in any way.

I would like to thank you for taking the time to read this overview of the project. If you have any questions about the study now or at any time in the future, please feel free to contact me using the following contact information: Tara Evans, School of Educational Policy and Implementation**,** Faculty of Education**,** Victoria University of Wellington**,** PO Box 17-310, Karori**,** Wellington, NZ**,** +64 4 463 5233 ext. 8127**,** tara.evans@vuw.ac.nz or my supervisor Dr Louise Starkey, Associate Dean Primary and Secondary**,** School of Educational Policy and Implementation**,** Faculty of Education**,** Victoria University of Wellington**,** PO Box 17-310, Karori**,** Wellington, NZ**,** +64 4 463 5179**,** louise.starkey@vuw.ac.nz.

Sincerely,

Tara Evans
PhD student
Victoria University of Wellington
College of Education

Appendix B: Information sheet for principals

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

FACULTY OF EDUCATION

Project Title: An examination of factors influencing teachers' integration of digital technologies

This project has been approved by Victoria University of Wellington Faculty of Education Ethics Committee application no. 18122.

Thank you for your interest in this project. The purpose of this study is to explore the use of digital technologies in Intermediate School classrooms. It is hoped that this information will help inform school leaders who wish to create a supportive environment for their teachers and will provide guidance for teacher educators in developing training programs. This research is being conducted as part of a PhD thesis with the School of Educational Policy and Implementation at Victoria University of Wellington.

Participation: If you choose to participate in this study, one or two classrooms at your school will be involved in case study research conducted over Term 1 and Term 2 during the 2011 school year. The teachers will be interviewed at the beginning of the school year to discuss their use of digital technologies and what factors influence them when planning lessons. In addition, they will be asked to provide lesson plans to the researcher and lessons that involve digital technologies will be observed a maximum of 10 times over the two terms. A follow-up interview after each lesson will be conducted to gather information about the intentions for the lesson. Both teachers and students will be observed and interviewed during these activities to better understand the activity from multiple perspectives. Teachers and students may also be asked to share their thoughts as they work on activities so the researcher can better understand what they are thinking during these activities. All observations and interviews will be audio or video recorded. Participants will be given an opportunity to review and modify the comments from their interviews. In addition, school documentation regarding technology use at your school will be examined.

Confidentiality: Teachers, children or the school will not be identified in any way in the reporting of this research. The results of this research will be presented in written and oral form as part of the PhD thesis, but it will not identify participants by name. No personal information that would enable anyone to identify your school will be used in any report generated from this research.

Please note that your school is under no obligation to take part in this study. Your decision about whether or not you want your school to participate in this project will not affect your present or future relationship with Victoria University of Wellington. If you give consent to allow your school to participate in this study you have the right to withdraw that consent at any time during the data collection process.

Ethics: If at any time you have any questions or concerns about the involvement of your teachers or students during this study, contact Dr Judith Loveridge who is the Chair of the Faculty of Education Ethics Committee (telephone: +64 4 463 6028).

Data Storage and Deletion: All digital files will be securely stored on a password-protected computer, and hard copies will be kept in secure storage for five years after the conclusion of the research before being deleted or destroyed.

Reporting/Dissemination: The results of this study will be submitted as part of a PhD thesis. Aspects of this study may also be submitted for publication in research journals or presented at educational conferences. If you are interested in receiving a copy of the reports generated from this study you can do so by contacting Tara Evans.

If you have any questions about the study now or at any time in the future, please feel free to contact me using the following contact information: Tara Evans, School of Educational Policy and Implementation**,** Faculty of Education**,** Victoria University of Wellington**,** PO Box 17-310, Karori**,** Wellington, NZ**,** +64 4 463 5233 ext. 8127**,** tara.evans@vuw.ac.nz or my supervisor Dr Louise Starkey, Associate Dean Primary and Secondary**,** School of Educational Policy and Implementation**,** Faculty of Education**,** Victoria University of Wellington**,** PO Box 17-310, Karori**,** Wellington, NZ**,** +64 4 463 5179**,** louise.starkey@vuw.ac.nz.

Sincerely,

Tara Evans

Appendix C: Principal consent form

Participant consent form (principal)

Project Title: An examination of factors influencing teachers' integration of digital technologies
Ethics Application #18122:

(Please tick the circles to indicate your understanding and agreement with each of the following statements).

- o I understand that any information students or teachers provide will be kept confidential and that neither they nor the school will be identified in the research or in any reports on the project or to any party.

- o I understand that any information from this project will be destroyed five years after the completion of the study.

- o I understand that names of teachers, students, and school will remain confidential.

- o I understand that teachers and students can withdraw from the study at any time up until the final point of data collection.

- o I understand that the research findings will be published and shared with teachers and other interested people.

- o I agree to allow teachers and students at my school to take part in this research project.

Name:_____ Date: _____

Signature:_____

Appendix D: Letter to teachers

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

FACULTY OF EDUCATION

Tara Evans
Victoria University
Wellington College of Education
P O Box 17-310, Karori
Wellington

January 2011

Re: Permission from teacher to research the use of digital technologies in classrooms

Dear

My name is Tara Evans and I am a doctoral student at Victoria University of Wellington conducting research in the use of digital technologies in intermediate classrooms. I was a classroom teacher and a technology specialist in an intermediate school in the U.S. for over 10 years and I am now pursuing a PhD to further understanding in this area. I am writing to you to ask your permission to conduct some of my research in your classroom during Terms 1 and 2 of the 2011 school year.

Currently digital technologies such as computers, interactive whiteboards, and the Internet are used by some teachers to support the learning of their students. While research has shown that the use of digital technologies can be beneficial to student learning, there is not a great understanding regarding the reasoning behind teachers' decisions to use digital technologies with their students and the learning that occurs as a result of using these tools in their lessons.

My project aims to explore in-depth how and why digital technologies are utilized in intermediate school classrooms. It is hoped that this information will inform school leaders who wish to create a supportive environment for their teachers and will provide guidance for teacher educators in developing training programs. In addition, this research may be beneficial to teachers as they consider using digital technologies in their classrooms. This research is being conducted as part of a PhD thesis with the School of Educational Policy and Implementation at Victoria University of Wellington.

In order to conduct this research I am approaching intermediate teachers to take part in the study. You have been asked to participate as your principal has recognized that you use technology regularly with your students in a variety of ways. If you decide to

participate I will interview you regarding how and why you use digital technologies with your students. In addition, I will visit your classroom up to 10 times over the first two terms of 2011 to observe students participating in lessons that integrate digital technologies. I may also ask you to articulate your thoughts during lesson planning to better understand your thoughts during this process. After the lessons I will interview both you and selected students to learn more about the learning intentions and the learning that occurred during the lesson.

Throughout the project all attempts will be made to minimize the disruptive impact on your students' learning. In fact, reflecting on your practice through this study is likely to be beneficial to you and your students. Once the study is complete you will be provided with a summary of the research findings and any publications that result from the study. You or your school will not be identified in any work generated from the study. All digital files generated in this study will be securely stored on a password-protected computer, and hard copies will be kept in secure storage for two years after the conclusion of the research before being deleted or destroyed. This project has been approved by the Victoria University of Wellington Faculty of Education Ethics Committee, application no 18122.

If you do agree to participate in this study please complete the consent form included with this letter and return it in the stamped and addressed envelope provided. If you do not wish to take part in the study your and your school's relationship with Victoria University of Wellington will not be affected in any way.

I would like to thank you for taking the time to read this overview of the project. If you have any questions about the study now or at any time in the future, please feel free to contact me using the following contact information: Tara Evans, School of Educational Policy and Implementation, Faculty of Education, Victoria University of Wellington, PO Box 17-310, Karori, Wellington, NZ, +64 4 463 5233 ext. 8127, tara.evans@vuw.ac.nz or my supervisor Dr Louise Starkey, Associate Dean Primary and Secondary, School of Educational Policy and Implementation, Faculty of Education, Victoria University of Wellington, PO Box 17-310, Karori, Wellington, NZ, +64 4 463 5179, louise.starkey@vuw.ac.nz.

Sincerely,

Tara Evans
PhD student
Victoria University of Wellington
College of Education

Appendix E: Information sheet for teachers

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

FACULTY OF EDUCATION

Project Title: An examination of factors influencing teachers' integration of digital technologies

This project has been approved by Victoria University of Wellington Faculty of Education Ethics Committee application no. 18122.

The purpose of this study is to explore the use of digital technologies in intermediate classrooms. It is hoped that this information will help inform school leaders who wish to create a supportive environment for their teachers and will provide guidance for teacher educators in developing training programs. This research is being conducted as part of a PhD thesis with the School of Educational Policy and Implementation at Victoria University of Wellington.

Participation: If you choose to participate in this study, you will be involved in case study research conducted over Term 1 and Term 2 during the 2011 school year. You will be interviewed at the beginning of the school year to discuss your use of digital technologies and what factors influence you when planning lessons. In addition, you will be asked to provide lesson plans to the researcher and a maximum of 10 lessons that involve digital technologies will be observed over the duration of the two terms. A follow-up interview after each lesson will be conducted to gather information about the intentions for the lesson. Both you and your students will be observed and interviewed during these activities to better understand the activity from multiple perspectives. You and your students may also be asked to share your thoughts as you work on activities such as lesson planning so the researcher can better understand what you are thinking during these activities. All interviews and observations will be audio or video recorded. You will be given an opportunity to review and modify the comments from your interviews.

Confidentiality: Neither you nor the school will be identified in any way in the reporting of this research. The results of this research will be presented in written and oral form as part of the PhD thesis, but it will not use your name or your students' names. No personal information that would enable anyone to identify you or your students will be used in any report generated from this research.

Please note that participation in this study is voluntary. You are under no obligation to take part in or complete this study. Your decision about participating in this project will

not affect your present or future relationship with Victoria University of Wellington or with your school. If you give consent to participate in this study you have the right to withdraw that consent at any time during the data collection process.

Ethics: If at any time you have any questions or concerns about the treatment of your students during this study, contact Dr Judith Loveridge who is the Chair of the Faculty of Education Ethics Committee (telephone: +64 4 463 6028).

Data Storage and Deletion: All digital files will be securely stored on a password-protected computer, and hard copies will be kept in secure storage for five years after the conclusion of the research before being deleted or destroyed. The data will not be identifiable in any way.

Reporting/Dissemination: The results of this study will be submitted as part of a PhD thesis. Aspects of this study may also be submitted for publication in research journals or presented at educational conferences. If you are interested in receiving a copy of the reports generated from this study you can do so by contacting Tara Evans.

If you have any questions about the study now or at any time in the future, please feel free to contact me using the following contact information: Tara Evans, School of Educational Psychology and Pedagogy, Faculty of Education, Victoria University of Wellington, PO Box 17-310, Karori, Wellington, NZ, +64 4 463 5233 ext. 8127, tara.evans@vuw.ac.nz or my supervisor Dr Louise Starkey, Associate Dean Primary and Secondary, School of Educational Policy and Implementation, Faculty of Education, Victoria University of Wellington, PO Box 17-310, Karori, Wellington, NZ, +64 4 463 5179, louise.starkey@vuw.ac.nz.

Sincerely,

Tara Evans

Appendix F: Teacher consent form

Participant consent form (teacher)

Project Title: An examination of factors influencing teachers' integration of digital technologies
Ethics Application #18122:

I agree to take part in the above research. I have had the project explained to me and I have had a chance to ask questions. I understand that agreeing to this means that I will be willing to do the following:

- I agree to take part in this research project and to allow my answers to be collected and analysed.
- I understand that I do not have to take part in the research and that I may withdraw from this project up until the final point of data collection.
- I may withdraw from this project without having to give a reason.
- I understand that any information I provide will be kept confidential and that I will not be identified in the research or in any reports on the project or to any party.
- I understand that any information from this project will be destroyed five years after the conclusion of the study.
- I understand that I will be given a chance to review a transcript of my interview and I will be able to make changes to the wording of my responses if I wish.
- I understand that the research findings will be published and shared with teachers and other interested people.

Name:_____ Date: _____

Signature:_____

Appendix G: Letter to students

FACULTY OF EDUCATION

Tara Evans
Victoria University
Wellington College of Education
P O Box 17-310, Karori
Wellington

Re: Permission from student to research the use of digital technologies in classrooms

February 2011

Dear Student,

My name is Tara Evans and I am a doctoral student at Victoria University of Wellington doing research on how technology such as computers, interactive whiteboards, and the Internet is being used with students in intermediate classrooms. I was a teacher in an intermediate classroom for over 10 years in the U.S. and am very interested in how teachers and students use technology in the classroom to learn.

I am writing to ask if you would be willing to participate in my research. Your principal and teacher have consented to take part in this research that is taking place in your classroom. My experience as a classroom teacher has taught me that both teachers and students have a part in what happens in the classroom. What the teacher does is very important, but what you bring to the activity is equally valuable which is why I am so keen to include you in this study.

I want to understand what students do during learning activities. Therefore, if you decide to participate I will sit nearby while you are working with tools like computers, digital cameras, and electronic whiteboards and may ask questions about what you are doing as you work. I may also ask you to tell me what you are thinking as you work so I can understand your actions more clearly. I will be doing this so that I can understand the lesson from your point-of-view and to find out about what you learn during the lesson. After the lesson, I may ask you some questions about what you learned and how you used the technology during the lesson.

If you decide to participate, you, your teacher, or your school will not be identified in any way.

Thank you very much for taking the time to read about my project. If you would like to participate in the study please complete the consent form with your parents and return it to your teacher.

Sincerely,

Tara Evans
PhD student
Victoria University of Wellington
College of Education

Appendix H: Student and parent information sheet

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

FACULTY OF EDUCATION

Project Title: An examination of factors influencing teachers' integration of digital technologies

This project has been approved by Victoria University of Wellington Faculty of Education Ethics Committee application no. 18122.

The purpose of this study is to explore the use of digital technologies in intermediate classrooms. It is hoped that this information will help inform school leaders who wish to create a supportive environment for their teachers and will provide guidance for teacher educators in developing training programs. This research is being conducted as part of a PhD thesis with the School of Educational Policy and Implementation at Victoria University of Wellington.

Participation: Children who participate in this study will be observed participating in regular classroom lessons that use digital technologies (e.g., computers, interactive whiteboards, and digital cameras) over Terms 1 and 2 of the 2011 school year. During this time these children may be asked questions during or after the lesson to better understand their thoughts about the activity and their previous experience using digital technologies. Your child may also be asked to share their thoughts as they work on activities so the researcher can better understand what they are thinking during these activities. Interviews will be recorded by audio or video devices and will be conducted within the regular classroom setting and children will be given an opportunity to review and modify the comments from their interview(s).

Confidentiality: Neither your child nor the school will be identified in any way in the reporting of this research. The results of this research will be presented in written and oral form as part of the PhD thesis, but it will not use your child's name. No personal information that would enable anyone to identify your child will be used in any report generated from this research.

Please note that your child is under no obligation to take part in this study. Your decision about whether or not you want your child to participate in this project will not affect you or your child's present or future relationship with Victoria University of Wellington or with your child's school. If you give consent to allow your child to participate in this study you have the right to withdraw that consent at any time during the data collection process.

Ethics: If at any time you have any questions or concerns about the involvement of your child during this study, contact Dr Judith Loveridge who is the Chair of the Faculty of Education Ethics Committee (telephone: +64 4 463 6028).

Data Storage and Deletion: All digital files will be securely stored on a password-protected computer, and hard copies will be kept in secure storage for five years after the conclusion of the research before being deleted or destroyed.

Reporting/Dissemination: The results of this study will be submitted as part of a PhD thesis. Aspects of this study may also be submitted for publication in research journals or presented at educational conferences. If you are interested in receiving a copy of the reports generated from this study you can do so by contacting Tara Evans.

If you have any questions about the study now or at any time in the future, please feel free to contact me using the following contact information: Tara Evans, School of Educational Psychology and Pedagogy**,** Faculty of Education**,** Victoria University of Wellington**,** PO Box 17-310, Karori**,** Wellington, NZ**,** +64 4 463 5233 ext. 8127**,** tara.evans@vuw.ac.nz or my supervisor Dr Louise Starkey, Associate Dean Primary and Secondary**,** School of Educational Policy and Implementation**,** Faculty of Education**,** Victoria University of Wellington**,** PO Box 17-310, Karori**,** Wellington, NZ**,** +64 4 463 5179**,** louise.starkey@vuw.ac.nz.

Sincerely,

Tara Evans
PhD student
Victoria University of Wellington
College of Education

Appendix I: Student and parental consent form

Participant consent form (student)

Project Title: An examination of factors influencing teachers' integration of digital technologies
Ethics Application #18122:

(Please tick the circles to indicate your understanding and/or agreement with each of the following statements).

- o I have had the project explained to me and I have had a chance to ask questions.
- o I understand that taking part in this project will not affect my grades in any way.
- o I understand that I do not have to take part in the research and that I may withdraw from this project without having to give a reason up until the final point of data collection (June 2011).
- o I understand that any information I provide will be kept confidential and that I will not be identified in the research or in any reports on the project or to any party.
- o I understand that any information from this project will be destroyed five years after the completion of the study.
- o I understand that if I am interviewed the researcher will summarize the key points at the end of my interview and that I will be able to make changes to the wording of my responses if I wish.
- o I understand that if I am interviewed I will be given a chance to review a transcript of my interview and I will be able to make changes to the wording of my responses if I wish.
- o I understand that the research findings will be published and shared with teachers and other interested people.

Name:_____ Date: _____

Signature:_____

Parental Consent

(Please tick the circles to indicate your understanding and/or agreement with each of the following statements).

- o I understand that participation in this project will not affect my child's grade in any way.
- o I understand that my child does not have to take part in the research and that he/she may withdraw from this project up until the final point of data collection (June 2011).
- o I understand that any information my child provides will be kept confidential and that he or she will not be identified in the research or in any reports on the project or to any party.
- o I understand that any information from this project will be destroyed five years after the completion of the project.
- o I understand that the names of students and school will remain confidential.
- o I understand that the research findings will be published and shared with teachers and other interested people.
- o I agree to allow my child to take part in this research project and to allow my child's answers to be collected and analyzed.

Name of caregiver:_____ Date: _____

Signature of caregiver:_____

Appendix J: Example of inductive qualitative analysis coding

Case study B (Fiona): How and why digital technologies were used in the classroom

Source	Quote	Number of references	Code	Concept
Interview 1	So it's a program that we, that we use called CSI. And we're encouraged to use it because it's got a really good reputation for helping kids understand different reading strategies.	7	School policy	School policy
Interview 2	Also it helps them to categorize. When they're up on the screen they can see, because, you know, they were given a student, they were given a task to do, and they said, "Now you have to put it under a certain place." So they're learning skills, they're learning technical skills as well as it transferring to their own writing.	6	Technical skills	Teaching/learning in a digital world
Interview 3	And they're, but what we need to do is help them to see, help them to interpret the visual stuff that they're being bombarded with. Even if it's things like understanding how they're being manipulated through advertisements, for example.	3	Media literacy	
Interview 3	Well, I guess it comes down to one of the other questions here which was, um, I just think this, that if the kids are, we're so, they're so much part of a visual world, they don't have the same facility, like somebody like me who did not grow up even with a television.	8	Visual	
Interview 3	And it's not, you know, it becomes an unreal world in the classroom if they're sitting down just with their pencil and their paper. It's not what they do normally and that's not how they're learning anymore.	4	Digital tools are used outside classroom	
Interview 1	Yeah, so one of the reasons why, so to get back to your question about why they were doing a PowerPoint at home, that's to make the connection so that they can get home and they can show their mum and dad, "This is some of the stuff I've been doing," you know.	9	Communicating with parents	Communication
Interview 3	I'll just come out of that, but one of the things that happens is that you play against, you can choose to play against somebody from around the world.	1	Communicating with others outside the classroom	

Source	Quote	Number of references	Code	Concept
Interview 3	Sites such as Mathletics give students other opportunities to practise their maths and this can be accessed from home.	28	Practice skills	Supports pedagogical practices
Interview 3	And if they get a chance to see other people's up on the screen, then they get a few ideas for themselves as well. So it's very motivating for them. They can see, um, "Ah, yeah, I can write that kind of thing as well," you know. So it's really motivating for that.	17	Motivation/ engagement	
Interview 2	Yeah. And that will be projected up one they've all got them on. I mean I had it up there yesterday for example and so they could see them on the screen all being added, you know.	14	Sharing of work	
Interview 5	Once the technological glitches are over with, the kids themselves help each other, and you see that. And I love that negotiation that happens in the classroom, cause that's when they're really learning, you know. It's needs-based and then they go for it, don't they?	13	Collaboration with other students	
Interview 3	We are networked to a school online environment but with the facility to go wider afield. This gives possibilities for accessing other teaching and learning sites such as BBC Skillswise for maths and literacy, also the Mathletics site.	4	Access to information	
Interview 3	I can do it with the books and things, but the immediacy of the computer, especially for something like maths or science or problem solving, means they get the feedback straight away. If they're waiting for me to give the feedback from a booklet that they've done, it's not as quick for them.	11	Immediate feedback	
Interview 2	And that will be projected up one they've all got them on. I mean I had it up there yesterday for example and could see them on the screen all being added, you know.	3	Monitoring students as they work	
Interview 3	When you use assessments, online assessments such as e-asTTLe, and PATs actually, they give you detailed information for next steps. So they say, "This is what you've missed in this particular question and this is what you need to do." So it's all very precise. So you get that information and it's handy because it helps you as a teacher give them their next steps.	12	Individualize instruction	
Interview 2	And I try to get them on the computer, each group on the computer once a week, because then they can practice, um, sometimes they might just practice their mult, div or something and timed sequences or whatever, you know. Whatever it is, it's just another way, another arsenal really, it's all in the arsenal, isn't it? It's the arsenal, it's all in the toolkit!	7	Alternative teaching method	
Interview 3	This technology encourages students to be more responsible for their own learning. They can engage in inquiry easier without having to rely on the teacher to provide all the resources as they can access them by themselves.	18	Student agency	

Appendix K: Activities observed in Helen's classroom

	Observation #1 Setting up e-portfolio profile	**Observation #2** Internet-based mathematics games	**Observation #3** e-portfolio, blog, & class survey	**Observation #4** Small-group lesson on e-portfolio
Rationale	*Students needed a completed profile on the e-portfolio *Experienced students could assist less experienced students	*Practise mathematics skills (different specific skills for each ability group) *Provide variety in learning tasks *Individualise instruction	*Students needed a completed profile on the e-portfolio *Students could introduce themselves on the class blog *Request formative feedback from the students in the form of a class survey	*Teach students how to create folders, upload work, and post to the learning blog in the e-portfolio system *Students learned more readily with explicit instruction
Method	*Helen demonstrated the process of logging in through projector in the library *Year 7 and Year 8 students were intentionally paired up so they could assist each other *Each student worked on their own computer	*Helen showed all students links to the games on the mathematics timetable using the data projector *Students from the same ability group worked in pairs to play Internet-based mathematics games *Students worked individually or with a partner	*Students who had not yet created their profile in the e-portfolio or posted their blog entry had their names listed on the board *Students rotated through learning centres (the computers were one centre) *Each student worked on their own computer to complete an online student survey, create their e-portfolio profile, and/or write an introductory blog post	*All of the laptops and netbooks were lined up on desks in front of the data projector *Helen demonstrated each step to the students, then they completed the step on their own computer
Student experiences	*Computers were slow to login *Five students were unable to login *Students assisted each other as needed *Some of the students successfully setup their profiles including a picture	*Computers were slow to login *Students were distracted by advertisement link on site which appeared to be part of the game *Students tried to solve the problems that the games presented, but sometimes didn't understand the underlying concept *Students made limited use of feedback to help them progress *The computer restarted unexpectedly	*Students completed the survey *Students assisted each other as needed with the e-portfolio – this was easier because students with computers were grouped together near power outlets *When additional help was needed, Helen assisted students *Class blog was not loading for one student	*All students in the group added folders, uploaded work, and added the first entry to their learning blog in their e-portfolio
Underlying factors	*School policy regarding the e-portfolio system *Student knowledge of the e-portfolio system *Access to the data projector, computers, and the e-portfolio	*Access to computers and Internet-based resources *Student knowledge of the games	*School policy regarding the e-portfolio system and class blogs *Access to power outlets *Access to the e-portfolio, the class blog, and computers	*School policy regarding the e-portfolio system *Access to computers, the data projector and the e-portfolio

	Observation #5 Internet-based estimation games	**Observation #6** Assisting neighbouring class with e-portfolio	**Observation #7 (end of year)** "Amazing Race" activity
Rationale	*The students will improve estimation skills *Team building between students that do not normally work together *Variety of Internet sites available *Engage students by using the Internet-based game and competition	* Sense of collegiality; helping peer who is not as comfortable using digital technology *Gives students additional exposure to the e-portfolio system	*Help students make connections at higher levels *Utilise e-portfolio system *Team building between students that do not normally work together *Build key competencies
Method	**Part 1**: Students worked in groups to solve estimation problems Helen showed them using the data projector **Part 2**: Students worked in their same small group to solve puzzles on the "Weigh the Wangdoodles" website *Both parts of the activity were part of a game in which teams earned points when they answered questions correctly	*Helen's students were paired with students from the other class *The data projector was used to demonstrate how to log in *Helen's portable computers were brought in	*Students worked in pairs to access a page and complete a task that Helen had prepared in the e-portfolio system *Students accessed various travel websites to plan a trip that took them along the silk route
Student experiences	*Students worked together to solve problems *Students were motivated to earn points *One student who appeared to be participating did not contribute to the group and revealed later that she did not understand how to solve the problems	*Helen's students were successfully helping students in the other class log in and create their profiles	* Computers were slow to login *Some students were unable to login *Students worked together toward completing the task *Students saved their work in the e-portfolio system
Underlying factors	*Group dynamics *Access to computers and Internet-based resources	*School policy regarding the e-portfolio system *Supportive nature of school community *Access to computers	*School policy regarding the e-portfolio system *Group dynamics *Access to computers and Internet-based resources

Appendix L: Activities observed in Fiona's classroom

	Observation #1 CSI literacy lesson: Making connections	**Observation #2** Typing stories into GoogleDocs	**Observation #3** Playing mathematics games	**Observation #4** Writing with descriptive verbs in GoogleDocs
Rationale	*Make connections between text and students' own life experiences *CSI software captures students' attention visually and allows text to be exposed to students gradually	*Provide practice using GoogleDocs (technical skill) *Students are motivated by seeing each other's stories	*Understand statistical investigation *Practice interpreting graphs *Provide students with an alternative way of practising skills	*Practice using descriptive verbs *Students are motivated by seeing their own and other students' work projected immediately in front of the class
Method	*Fiona directed a whole group lesson that utilised special computer software that allowed her to show part of the text through her data projector *Students discussed ideas with a partner 3 times during the lesson *Students took notes in their literacy notebooks	*Students worked on different small group activities around the room *One group of 6 students sat together at a table, each with a portable computer *One student setup a GoogleDoc and shared it with the other group members *All of the students in the copied stories they had previously handwritten into the shared document	*Fiona demonstrated a mathematics learning object in class the previous day and posted a link to the learning object on the LMS *As one of the mathematics rotations, students worked in pairs or individually to access and work through the learning object on the MoE website	*Fiona shared a GoogleDoc with the class and projected it at the front of the room *Each table of 4-6 students had a portable computer *After an introduction, students highlighted strong verbs within the document *In groups of 2 or 3, students wrote sentences based on Fiona's sentence starters using descriptive verbs and typed them into the bottom of the document *At end of lesson, Fiona corrected grammatical errors in the sentences in front of class
Student experiences	*Many students were engaging in teacher-led discussion *The observed group discussed connections between the text and their recent experiences with the Christchurch earthquake *Students took notes in their literacy notebooks	*Some students finished typing their stories into the shared document *Students assisted each other while working *One student could not log in as the wireless was not working on that computer	*Students worked together successfully to complete the learning object *Students took turns controlling the computer *One student who was working individually progressed through the learning object several times and was able to explain his answers	*By the end of the activity, 20 of the 30 students contributed to a sentence in the document *Students reported that they enjoyed viewing their own and others' work in this way
Underlying factors	*Access to CSI software, computer, and data projector	*Access to GoogleDocs and portable computers *Student knowledge of GoogleDocs	*Access to the learning object and computers *Student knowledge of the LMS and the learning object *Student knowledge of creating and interpreting data and graphs	*Access to portable computers, the data projector, and GoogleDocs *Student knowledge of GoogleDocs

	Observation #5 Typing and uploading stories to MyPortfolio	**Observation #6** Virtual field trip to Kupe oil field	**Observation #7** **(end of year)** CSI literacy lesson: Visualising
Rationale	*Put stories in a format that could be uploaded to the e-portfolio *Provide practice typing *Upload document to the school's e-portfolio program	*Learn about the Kupe oil field *Provide students with visual tools (short movie clips in virtual field trip) to assist learning	*Teach students how to visualise when reading *Students are motivated by seeing each other's ideas
Method	*Fiona explained process of uploading a document to the e-portfolio and projected directions at the front of the room *Students copied a previously written story from their writing notebooks to a Word document *Students uploaded their Word document to their e-portfolio account	*Fiona reviewed introduction questions with students who wrote these into notebooks *Fiona played a short video clip about the Kupe oil field through the data projector twice * Students were told to answer the questions as they watched as answers were embedded in the clip *Students accessed the Internet site with the virtual field trip on their own computers (some were sent to the library) to view the remaining videos and answer questions about them	*Fiona directed a whole group lesson using the data projector and special computer software that allowed her to roll over vocabulary for a definition *The projector was turned off and students were asked to recall information from the reading *Students were asked to visualise being sick and worked in pairs to write sentences into a shared GoogleDoc about what they would see, hear, etc. if someone was sick
Student experiences	*Some students had trouble accessing the e-portfolio *Some students finished typing their stories and uploaded them to their e-portfolio accounts *Students referred to the projected directions when uploading their work *Students assisted one another	*Students were unable to access the website without a password *Sound was not accessible on some computers *Students eventually worked out the problem with the sound, but time allotted for the activity expired before all students could access the videos	*Students worked together to write descriptive sentences in GoogleDocs
Underlying factors	*School policy regarding e-portfolio system *Access to computers and e-portfolio *Student knowledge of word processor	*Access to computers and virtual field trip Internet site *Student troubleshooting ability *Teacher familiarity with website	*Access to computers, CSI software, and GoogleDocs *Student knowledge of GoogleDocs

Appendix M: Activities observed in Jack's classroom

	Observation #1 Setting up profile in KnowledgeNet	**Observation #2** After school program – SweetHome 3D (meets in ICT suite)	**Observation #3** Creating video for Christchurch victims	**Observation #4** Editing and uploading Christchurch videos
Rationale	*Students set up profile in KnowledgeNet *Familiarise students with KnowledgeNet as it will be used often throughout year	*Part of an after-school enrichment program with an enrolment fee *Students learn how to use different animation programs *Students learned how to use the program SweetHome 3D and created a floor plan for a house suitable for the year 2100	*The students will learn to operate video camera and download video *The students will practise sharing their thoughts on video *If students learn these technical skills in a simple context they will be able to use the skills later for more content-based work	*The students will learn to download video, convert between formats, and then uplaod video to KnowledgeNet *If students learn these technical skills in a simple context they will be able to use the skills later for more content-based work
Method	*Students worked in the ICT suite *Year 7 and Year 8 students were paired so Year 8 students could assist Year 7 students *Jack distributed passwords to students, then circulated and assisted students as well as informally assessing their technical knowledge	*Jack introduced the students to SweetHome 3D with the large TV connected to a computer *Jack demonstrated the basics of the program *Students were given 15 minutes to explore the program *Jack presented the task of creating a house for a millionaire in the year 2100 and led a quick discussion about what the house might include *Students worked on task for remaining 40 minutes	*Jack presented the task to students, then gave them the video cameras and sent them to record *Students worked in groups of three and dispersed around the school to record their thoughts on the Christchurch earthquake *As they finished, students brought the cameras back to the ICT suite where Jack worked with each group to upload the videos as they came in	(students had been given instruction on editing, converting, and uploading the previous day) *Students worked with their groups completing their video editing, conversion, and uploading while Jack circulated and helped where needed
Student experiences	*Most students accessed their KnowledgeNet page and worked on their profile page *Two Year 7 students who were working together were working away from the other students and shared that they did not know what to do	*All students were engaged and on-task the entire lesson *Students worked proficiently with the tool by the end of the session *Students shared aspects of the tool with one another and assisted each other when needed	(one group of 3 was observed) *Students did not know how to use the video cameras initially, but were able to figure them out *Students recorded their videos and saved the videos with Jack's help (although videos were later redone)	*Many students had finished their videos *Students shared that they had learnt how to edit, convert, and upload their videos through the project *Students who had to re-record video were able to capture more appropriate video the second time
Underlying factors	*Access to ICT suite *Year 8 students' knowledge of KnowledgeNet *Students' cooperative skills	*Access to TV connected to computer, ICT suite, and SweetHome 3D program *Teaching method – instruction, exploration, purposeful use of tool	*Access to the video cameras *Student knowledge of digital devices *School culture allowing students to be working away from teacher	*Access to the video cameras and ICT suite *Student knowledge of digital devices

	Observation #5 Writing goals in KnowledgeNet	**Observation #6&7** Enrichment activity – creating animation in Fluxtime	**Observation #8** Mathematics practise – graphing	**Observation #9** Writing reports in a Word document
Rationale	*The students will: - create personal learning goals within KnowledgeNet - practise giving constructive feedback - practise using KnowledgeNet	*The students will: - learn how to create an animation in Fluxtime -create an animation that tells a story	*Provide students practise reading different types of graphs *Students learnt the skill in previous lessons and practicing will reinforce this	*Provide students experience writing reports in MS Word as they will need to know how to use it for their future schooling and careers *Provide students an opportunity to reflect on and write about their field trip experience
Method	*Previous to the observation, Jack gave students their PAT results and gave them instruction on creating learning goals from these *Students had written goals in notebooks and brought them to the ICT suite *Students were to work in pairs to critically evaluate each other's learning goals and type goals into KnowledgeNet as Jack circulated around room and assisted	Session 1: *Jack and another teacher discussed animations in general with students *Jack gave 5 min demonstration of Fluxtime to students *Students explored program *Jack requested that students complete story board for next session Session 2: *Jack gave quick reminder and requirements on carpet for animation (story boards were not checked) *Students worked on their animation as teachers circulated to assist	*Students in each group are given a task *Jack teaches one group at the IWB while other groups work on the computers or on bookwork at their desks *Students work on laptop or desktop computers in pairs on thatquiz.org *Students are to choose graphs on the game that they had been taught in previous lessons *Halfway through the lesson students rotated and a new group worked on the computers, also in pairs on the same website	*Students had been on a field trip to environmentally friendly buildings the previous day *Jack led a discussion about the field trip in the class *Students were taken to the ICT suite where Jack gave them instructions on how to write a report about the field trip *Students worked independently on their reports in MS Word while Jack circulated and helped when needed
Student experiences	*Students worked successfully in KnowledgeNet *Some students worked together, but others worked more independently *Students were not observed giving critical feedback, although they were successfully re-evaluating their own learning goals	*All students were on-task *Most students explored independently while 1 or 2 students asked for help *Students created a simple animation during the 1st session and were able to use the program successfully *Students did not bring storyboard to session 2 *Many students stated that their story was based around the pictures that were available in the program *Students were unable to save their animations	*Students experienced a long log-in time on the laptops *Most of the time students took turns answering questions on the website rather than working collaboratively *Students almost always completed their chosen activities with a score of 80-100% *One student who increased the difficulty one time and scored 60% lowered the difficulty afterwards *Game provided general feedback that did not tell students what they did incorrectly	*All students created a document and saved it before leaving *Some students wrote a significant amount about the field trip *Some students spent most of the time modifying the format of the document *Most students worked independently, but some students discussed the field trip or an aspect of the application with the person beside them
Underlying factors	*Student knowledge of KnowledgeNet *Experience setting goals and critically evaluating others' work	*Access to Fluxtime, ICT suite, and TV projection *Attributes of Fluxtime (inability to save)	*Access to computers in classroom, IWB, and thatquiz.org *Type of feedback provided *Student experience with thatquiz.org	*Access to ICT suite *Student experience with MS Word

Appendix N: Activities observed in Zoe's classroom

	Observation #1 Writing the storyline for a camp advertisement	**Observation #2** Inquiry project: Evaluating advertisements on YouTube	**Observation #3** Literacy activity: Creating an escape plan	**Observation #4** Literacy activity- Kindy Kids article
Rationale	*The students will practice skills from the school's curriculum: -create a plan to meet a purpose -create innovative ideas	*Promote student understanding of the following concepts: -social influences of the media -stereotyping present in the media -the implications of instant communication of knowledge through the Internet	*The students will make a connection between text and what they already know *Using the computer-based Paint program will engage students more than traditional methods *Build students' problem solving skills	*Teach students to ask high-level questions of text they have read *Give students practice using KnowledgeNet *Save paper *Make student work available to parents
Method	*Zoe explained project: to create an advertisement for the overnight camp they were going to later in the week *Self-selected groups of 4 to 5 students worked together to write a storyline for the advertisement in a KnowledgeNet page that Zoe created for each group	*Zoe had previously set up three pages in KnowledgeNet with tasks that included links to YouTube video clips and questions *Students worked in groups of 4 or 5 to access the pages and complete the tasks **This was the second block of time that students had to work on the project, so instructions were not observed	*Zoe read a section of a children's bookled a class discussion using a projected Word document in which students compared prisons to the witch's tower *Students worked in groups of 3 in drawing programs on the laptops to create an escape plan for the children in the story (one group worked through the IWB) *Students shared their escape plan with the class	*Students were broken into groups and were assigned 1 of 3 activities *Students working in pairs on a laptop and worked in pairs on KnowledgeNet *Students read the article and completed the activity in their own page they created in KnowledgeNet
Student experiences	*All students appeared to be engaged in the task *Initially, some groups opened the video editing software rather than KnowledgeNet *Students worked together successfully to begin their story	*The Internet was not working on the first computer so the students had to get a second computer from Zoe *Students were initially searching for videos rather than completing the tasks *Students near the computer were engaged, but others were not *Tasks were not completed	*Students using the IWB took turns manipulating the device *Students worked together to create their escape plan *Some students created detailed pictures, but their ideas were simple while other groups had detailed ideas, but simple pictures *Two groups of students did not finish their plan *Two groups lost their pictures	*Students had problems connecting to the Internet *Students accessed and read the article online *One group of students did not access all the instructions *Students answered some of the questions that were provided *Observed students did not finish the activity *Students assisted each other when help was needed
Underlying factors	*Access to computers and KnowledgeNet *Students' experience using KnowledgeNet *Student understanding of the task	*Access to computers, the Internet, and KnowledgeNet *Student understanding of the task *Number of students per group	*Number of laptops available *Student experience with drawing programs *Time of battery life in portable computers	*Student experience using KnowledgeNet and the Internet *Unreliable Internet access

	Observations #5 Watch and review assembly video	**Observation #6** Researching for cereal box project	**Observation #7** Researching Wellywood sign	**Observation #8 (end of year)** Exploring online audio tools for radio show
Rationale	*Provide students practice critiquing each others' work *Teach students to reflect on their own work	*Provide students practice writing high-level questions *Give students practice communicating with community members via online tools (e.g., email)	*Provide students practice searching for information on the Internet *Provide students practice with creating an argument with supporting facts *Watching a video initially will engage students and introduce the topic	*Allow students to explore and become familiar with the attributes of a variety of web-based audio recording tools *Students have some choice in the way that they create their radio show
Method	*Students had recorded and edited a video that was played at the school production the day before *Zoe tried to play the 7-minute video to the students, but it would not play as there were problems with the connection *Students worked in groups of 3-4 with laptops to access the video and log into KnowledgeNet to write feedback about the videos	*Zoe led a discussion about what kinds of things the students needed to consider when creating their own cereal boxes *Zoe divided students into groups and gave each group a task *Students worked in pairs on computers to complete the task	*Zoe showed a video clip through the data projector explaining plans to build a sign reading "Wellywood" near the Wellington airport *Students were split into three groups: one group would argue for the sign, one against, and one would judge the arguments *Students spend several minutes on the computers researching the details of the sign *Students sat in groups of 3 (one from each group) and debated the topic	*Zoe showed students a website which listed several different audio recording tools using the data projector *Students worked in groups of 3 or 4 on computers trying out the different audio tools listed on the website *Students reported on which tools they tried, the attributes of the different tools, and which ones they liked best
Student experiences	*Most students could not access the videos because of the bad wireless connection *Some students who could access the videos wrote feedback in a KnowledgeNet page	*Some students were unsure of the task *Students successfully found email addresses on the Internet *Some students worked together to successfully write questions in a word processor *Some students did not write any questions	*Students found some information about the sign including pictures that they pasted into a Word document *Students mainly wrote down information that they already knew rather than information they had found online	*Students were able to find and access the website with links to the different tools *Most students tried using several different tools *One group of students could not access the Internet, so used GarageBand instead *Some groups were not able to successfully use some sites
Underlying factors	*Unreliable Internet access *Student experience using KnowledgeNet	*Student understanding of the task *Access to computers and Internet *Student experience researching information on the Internet	*Student experience researching information on the Internet *Student prior knowledge of the Wellywood sign	*Student experience searching the Internet and using web-based tools *Access to computers and web-based audio recording tools *Unreliable Internet access