

Teachers and iPads in the First Three Years of School: Using a teacher activity system to explore factors influencing the use of tablet technology in the classroom

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Declaration of Authorship and Sources

This thesis contains no material that has been extracted in whole or in part from a thesis that I have submitted towards the award of any other degree or diploma in any other tertiary institution.

No other person's work has been used without due acknowledgment in the main text of the thesis.

All research procedures reported in the thesis received the approval of the relevant Ethics/Safety Committees (where required).

Signed: _____

A black rectangular box redacting the signature of the author.

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Date: 13 Jan 2020

Statement of Appreciation

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Education is opportunity. Make the most of it!

X

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Abstract

This thesis seeks to examine the nature of the activity system experienced by primary teachers using tablet technology in junior primary classrooms. A qualitative research project, this study was conducted as a case study with four participant teachers of students in Prep to Year Two classes (the first three years of formal schooling in the state of Victoria). Activity theory provided the framework for understanding how elements of the teacher activity system mediate use of tablet technology in their classrooms. These elements are the artefact (iPads), the subjects (teachers), rules, community and the division of labour.

The object of the teacher activity system is the integration of tablet technology into junior primary classrooms. Much of the literature on technology integration in educational settings involves studies of intrinsic and extrinsic barriers and enablers facing individual teachers. Recognised barriers have included teacher skills and knowledge, attitudes and beliefs about the place of technology in the classroom, along with factors such as the type and quantity of technological resources available, including hardware, software and technology support.

The main finding of this study enhances thinking about barriers from the perspective of a system, rather than the individual teacher. This study found that there is a contradiction in the teacher activity system between the division of labour and the rules. Teachers in this activity system demonstrated they had the technological skills and knowledge to install software on student devices, but were prevented from doing

so by the rules in the activity system dictating the division of labour for software installation.

The implication of this contradiction is that the object of activity, that is integration of tablet technology in junior primary classrooms, results in an outcome whereby integration occurs less often than it otherwise might, should the contradiction be resolved. This suggests greater attention be paid to those aspects of the activity system resulting in the outcome, than a continued focus on the many internal and external barriers already known to confront teachers in their use of technologies in the classroom.

CHAPTER ONE:

INTRODUCTION

1.1 Chapter introduction

In this chapter, the study is introduced. A brief context of the education system in which the research sits is provided. The chapter then begins with a rationale for the research, followed by the researcher's personal orientation to the research. A brief overview of the theoretical model used is presented, leading to a statement of the research question. The structure of the thesis is then outlined.

1.1.1 Context in which the study was conducted

In Australia, the school year begins for children in January. In Victoria, children may start school if they turn five before the end of April, and must start school if they are turning six in the same calendar year. At the time of starting this research project, that first year of school for children was known as Prep, and is now known as Foundation, Schools in the state of Victoria follow The Victorian Curriculum F–10, which describes the content all children should learn from the Foundation year through to Year 10, including frameworks for two areas pertaining to technologies; Design and Technologies and Digital Technologies (Victorian Curriculum and Assessment Authority, 2019).

1.2 Rationale for the research

Visiting a school in May 2010, then-premier of Victoria, John Brumby, vowed to deliver “the latest in learning technology” so that “students remain one step ahead when it comes to emerging technology” (Office of the Premier of Victoria, 2010). The technology he was referring to was the Apple iPad. The iPad had debuted earlier in that year, was thinner and lighter than any laptop on the market at that time, was operated using a touch interface, had a built-in camera, Internet connectivity and had well over 100,000 software applications, referred to as ‘apps’, available for download (Apple Inc., 2010). Brumby announced a decision by the state government to purchase 500 of the devices to trial in eight schools as part of an information communication technology in education (Office of the Premier of Victoria, 2010).

One school selected to trial the iPads was a primary school in the outer eastern suburbs of Melbourne. The trial was viewed as a success in their school, with the Deputy Principal stating students were experiencing positive outcomes “with a medium which makes sense to them” (Brice, 2011, p. 31). In terms of staff at the school making use of iPads, the deputy said that he had observed an increase in collegial discussions and staff confidence with technology in the classroom. Further, he stated this had occurred with minimal professional development, because being a “technological guru” (Brice, 2011, p. 31) was not a requirement for operating the devices.

Outside of Australia, iPads quickly garnered attention in educational institutions. In America, universities purchased devices as loan items for their libraries and had staff and students lining up to borrow them, whilst other institutions offered iPads as price-friendly student device alternatives to laptops (Mathis, 2010). Schools from Scotland to

Hawaii purchased iPads for classroom use, excited by the apps on offer, the potential of tablet technology to replace traditional paper text books and the opportunity to provide a conduit for completing homework digitally, meaning students would have less paperwork and books to carry in their bags (Mathis, 2010).

Closer to home, at the same time in 2010, the Victorian Department of Education and Training (DET) was the only state government department committed to trialing iPads in educational settings. The West Australian and Queensland governments appeared to take a 'watch and wait' approach, indicating they had some interest in the potential of the technology as an educational tool, but were not implementing formal buying arrangements on behalf of their schools (Pitcher, 2010). Then Chief Information Officer of the New South Wales DET, Stephen Wilson, was reported as saying he saw the iPad as an entertainment device, expensive, fragile, and unlikely to equip students with skills transferable to their later working lives (Kennedy & Foo, 2010; Pitcher, 2010). Just a few years later, this was not the case. The iPad had well and truly made its way into the workforce, in use across industries from hotels to healthcare, retail to restaurants, law and more (Allen, 2010; Hill, 2014).

At the beginning of this project, given iPads were relatively new to the market, little formal literature was available examining their implementation in Australian primary schools, something I was very interested in as a primary teacher. Although I was on leave from teaching, I was aware through my professional networks that some of my colleagues had access to iPads for educational purposes and I wondered how they might be using them in their classrooms.

I located and read commentary on iPad use in universities (Mathis 2010), secondary schools, and primary schools (Brice 2011, Murray 2011), but it was difficult to find research literature specific to the use of iPads with children at the early stages of their school journey – the area of teaching in which I had been working. Much of the literature I read focused on the integration of varying types of technologies in classrooms, including research and commentary on obstacles to integration, referred to as barriers.

Reading about the integration of computers in classrooms, I noted that research by Ertmer (1999) and, later Hew and Brush (2007), was often referenced (Chen, Looi, & Chen, 2009; Earle, 2002; Kim, Kim, Lee, Spector, & DeMeester, 2013; Lowther, Inan, J., & Ross, 2008; Otto & Albion, 2002; Wang & Reeves, 2003). Narrowing my reading to mobile computing devices (prior to the emergence of tablet technologies), key areas were suggested that influence classroom integration. These were teacher professional knowledge (both general technological and pedagogical-specific technological knowledge) and availability of sufficient resources (such as hardware, software and technical support) (Finn & Vandenharn, 2004; Kincaid & Feldner, 2002). Finding out if these same barriers are applicable to tablet technology provided the rationale for this research project.

1.3 Personal orientation to the research

In 2010, not long after its Australian debut, along with John Brumby and many others in Australia, I too purchased an iPad. Home on maternity leave from my job as a primary school teacher, I watched my young son play on that iPad, his little fingers

deftly dancing around the screen chasing colourful alphabet letters. He touched the screen, landing on the letter A. “A! a! Alligator!” the device instantly responded, the animated letter A became larger, accompanied by music and animated singing alligators. “A! Look mummy, a alligator!” my son responded in turn. It didn’t take long for him to learn the whole alphabet. My home philosophy matched my teaching values when it came to technology, and I only installed apps for my children on the iPad that I believed held some educational merit. We moved on to learning upper and lower case letters, numbers and words. There were apps that even allowed children to use their fingers to trace letters and begin learning correct formations. I had to admit, listening to alphabet songs on the iPad was a lot more appealing than hearing the sing-song phrase “every letter makes a sound, A says ah” our LeapFrog toy emitted.

Having spent three years prior to having my son teaching in Prep to Year Two classes, I wondered at the affordances of this new tablet technology for education. What could this look like in my reading rotation activities? Certainly, I would have loved to replace the three clunky, old and unreliable desktops I’d had in my last Prep classroom with iPads. No waiting for machines to ‘boot up’. No need to interrupt my guided reading group to attend to log in issues. Not to mention the extra space I would have in the classroom if those machines, and the desk space required to house them, was gone!

I looked forward to a return to work with this new technology in place and hoped my school would be an early adopter. I did wonder though, would the Wi-Fi for the iPads be strong enough for Mrs H’s classroom to be able to use them? She was in a portable classroom, detached from the main school building and was often complaining that the Internet signal was weak in her classroom. Would our long-suffering IT technician

continue to make the thrice-hourly trek across the courtyard to push data cables firmly back into the wall to fix the signal? Would my Prep students need support mid-way through activities as often as they did with desktop computers? How many iPads might the school buy? Could I keep them in my classroom or would they have to go in a portable trolley bank like the laptops for the senior classes did? How would we make sure they were all charged? What might happen if a student dropped one? The wonderings/questions kept coming.

I didn't return to work at that school for a number of years, so I don't know if they were early adopters of tablet technology or not. However, I did find a school that was. A former colleague at another school told me they had purchased a bulk lot of iPads to implement school-wide. With that in mind, I had the impetus to begin this research project.

1.4 Theoretical framework

This research is interested in influencing factors on teacher decision making around the use of tablet technology as part of their teaching and learning programs. The lens through which these views are explored is that of cultural-historical activity theory. In this case, the activity theory model developed by Engeström and Miettinen (1999) has been adapted to suit the research, providing a framework for investigation of teacher motivation to incorporate tablet technology in junior primary classrooms (specifically, the first three years of school) and, conversely, barriers to the utilisation of said technology.

The resulting adaptation is a teacher activity system, which has junior primary classroom teachers as its **subjects**, who provide discussion of their views on a **mediating artefact**, a cultural tool (in this case, tablet technology) as an instrument that may be employed in their classrooms to support student learning.

The choice to use activity theory as a framework for examining barriers and obstacles to tablet technology integration is because it asks the researcher to take holistic view of the collective behaviour of the participants. Activity is investigated in the social context in which it is occurring, and considers the **division of** labour between the subjects, along with **community** views and **rules** by which they may be bound to “explore the dynamic relationship, and the tensions and contradiction, between the elements” (Kervin, Verenikina, Jones, & Beath, 2013, p. 137) of the teacher activity system that mediate the outcome. It is in this exploration and identification of “inconsistencies, friction, conflict, and points of tension” (Karasavvidis, 2009, p. 348) in the activity system that recommendations for further research and policy change can be made.

1.5 Research question

The aim of the study was to explore teachers’ use of tablet technology in lower primary classrooms. The research is important as it puts a spotlight on known barriers to technology integration in classrooms with a new technology. It uses activity theory as the lens from which to do this, examining how elements of the teacher activity system mediate integration of iPads in classrooms. Specifically, the research question is:

How does the activity system mediate primary teachers' use of tablet technologies in junior primary classrooms?

The research will be of interest and benefit to ICT Coordinators and leadership teams in primary schools who are responsible for ICT budgets, policies and implementation, so they may understand the perspective of the classroom teachers when making ICT related decisions.

1.6 Thesis structure

This thesis has seven chapters. Chapter 1 introduces the project, providing contextual background information regarding the rationale for the project and my personal orientation to the research. In Chapter 1, a brief overview of the theoretical perspective is presented, along with a statement of the research question. Chapter 1 concludes with chapter summaries to provide an indication of the structure of the thesis.

A review of literature relevant to the project forms Chapter 2. Definitions for key terminology used in the project are listed, then an historical background to the use of digital technologies in classrooms is provided. Following on, a discussion on the historical practicalities of technology integration in classrooms is provided, taking account of two key research projects on barriers to technology integration that inform much of this thesis. Current literature on tablet technologies is then reviewed, including how the technology is used as a tool, along with its perceived features and benefits. Available literature apprising the technology with barriers to integration is presented. The chapter concludes with a restatement of the research question.

Chapter 3 details the chosen theoretical perspective, cultural-historical activity theory. The chapter begins with an overview of the use of cultural-historical activity theory in educational research. The development of cultural-historical theory leading into cultural-historical activity theory is detailed. Engeström's (1987) second generation model of activity theory is presented, followed by an adaptation of the model as a teacher activity system, with discussion of the elements in the activity system for the context of this research project.

The research methodology and methods used for the project are described in Chapter 4. The chapter begins with an explanation of the research paradigms that inform the project, indicating that the qualitative research project sought to understand the viewpoints of participants in a case study, and as such following an interpretivist paradigm and ontological stance whereby knowledge is considered to be socially constructed. The chapter then describes how data was generated by conducting face to face interviews, a constructivist epistemological stance. The methods used for analysing the data are then detailed.

Chapter 5 details the findings of the project. In the chapter, key findings from the data are organised and presented according to elements of the activity system. It is noted that whilst all elements of the activity system are represented in the data, there is more voluminous data around the division of labour and the rules in the activity system.

In Chapter 6, the findings of the project are discussed in light of the research question. Key themes from the Literature Review (Chapter 2) are revisited, with consideration of how the literature on barriers to technology integration in classrooms fits with activity

theory. These are integrated in a graphical model. In the discussion of the findings, contradictions in the activity system are identified, in particular between the division of labour, the rules and the object, which presents an additional barrier to technology integration not identified in the literature. The integrated model is then updated to reflect this. The chapter concludes with a discussion that puts a spotlight on these contradictions in the teacher activity system.

The thesis concludes at Chapter 7. An overview of the project is presented, and the relationship of this project to previous research is identified. New insights this project is able to offer are described, namely the finding of a contraction in the teacher activity system that affects the outcome of tablet technology integration in junior primary classrooms. Limitations of the project are acknowledged and recommendations for further research are made. Finally, the chapter describes implications for future teaching practice arising from the findings of the research.

1.7 Chapter conclusion

In this chapter, the research project forming this thesis was introduced. The rationale for undertaking the study was offered and the personal orientation of the researcher to the project was detailed. The chosen theoretical model guiding the project was introduced. Next, the research question, incorporating the theoretical model, was presented. The introduction to the project concludes with a short detail of each chapter to outline the structure of the thesis.

CHAPTER TWO:

REVIEW OF RELEVANT LITERATURE

2.1 Chapter introduction

In this chapter, contemporary literature relevant to the research project is presented. The chapter begins by defining key terms used throughout the project. Following is a timeline of histories of technologies in classrooms, and historically understood barriers to technology integration in classrooms are detailed. Next, the chapter explores the debut of the iPad as a tablet technology and perceptions of its value as an educational tool are discussed. Known barriers to implementation of iPads in classrooms are presented. Finally, the research question is asked.

2.2 Definitions

This project, with the brand name “*iPad*” in its title, focuses on *tablet technology* and *junior primary classrooms*. At this point it would be pertinent to define what is meant by both. At the time of data collection, the participants were teachers of classes at the Prep, Year One and Year Two level. At that time in Victoria, Prep referred to the entry level of formal school education (for children who had turned five before the cut-off date of April 30th). Prep has since had a name change to Foundation and, for comparative purposes, is known in other states and territories around Australia as Reception, Kindergarten, Pre-primary and Transition. In terms of this research project, the focus was on the junior primary levels – specifically the first three years of formal schooling. The decision to focus on only three year levels and not all primary school

levels is a reflection on commonly accepted clustering of the first three years of education for curriculum purposes. For example, in Victoria, Prep to Year Two are known as the Foundation years (Victorian Curriculum and Assessment Authority, 2019), and in NSW, Kindergarten, equivalent to Prep in Victoria, is known as Early Stage 1 and Years One and Two are Stage 1 (NSW Education Standards Authority, 2019).

Discourse around mobile technologies in current educational settings uses several terms to describe tablet technology; from more generic terms such as ‘mobile device’ and ‘tablet’ through to the specific brand name ‘iPad’ from the technology company Apple. Whilst this review examines all brands of tablet technology in the classroom, it is important to note that much of the research is centric to the iPad-branded devices. As Burnett and Merchant (2017) write, this is because the “brand name [has] become synonymous with the product itself” (p. 1). In much the same way, the product name Google has become a verb for searching in the Internet, despite the existence of other search engines in the market. In this project, participants were using Apple iPads, and whilst most literature refers to the iPad brand, the term iPad is used interchangeably with the specific terminology adapted by various writers and researchers in the works examined here.

2.3 Digital technologies in classrooms

This part of the chapter has three subsections:

- a timeline of technologies in classrooms,

- a review of historical beliefs and attitudes regarding technologies in classrooms, and
- a discussion of the historical practicalities (including barriers) to the implementation and use of technologies in classrooms

2.3.1 A timeline of technologies in classrooms

In April 2010, global technology company Apple launched a new computing device known as the iPad. The iPad, with its touch responsive screen, Internet connectivity and true portability, quickly established itself as player in the education field as a mobile technology with the potential to transform learning (Brice, 2011; Mathis, 2010; Pitcher, 2010). The iPad, however, was not the first mobile technological device that was hailed as a tool to transform learning in the classroom.

The introduction of machine technologies occurred almost a century ago, when film and radio were introduced to classrooms (followed by instructional television in the 1950s and 60s), and, at that time, it was suggested they would offer opportunities to revolutionise learning (Cuban, 1993).

In the 1970s, so-called ‘mini calculators’ began making their way into classrooms in numbers (NCTM Instructional Affairs Committee, 1976), facilitating new ways for children to problem solve mathematical tasks (Drake, 1978; Shumway, 1976).

In the late 1970s, the price of micro – or personal – computers started to become affordable and more accessible to the education sector (Bell, 1981). By the late 1980s, computers of all kinds could be found in more than 95% of American schools (Sivin-Kachala & Bialo, 1994).

In the 1990s (and beyond), laptops began to be introduced into classrooms, offering opportunity for “deeper and more flexible uses of technology,” (Rockman et al, 2000, p. iv), including the ability to take the devices home and the affordance of ubiquitous learning. In 2000, Martin, Bigum, and Vallis (2000) cautioned against assuming laptops would deliver educational outcomes and highlighted the need to use the technology to help “find better ways to teach the things we have always done” (p. 39).

2.3.2 Historical beliefs and attitudes regarding technologies in classrooms

In the 1970s, the humble hand-held calculator began appearing in classrooms, and the device was thought to afford opportunity to “revolutionize the educational world” (Bell, 1981, p. 8). Perhaps it did, although not without divisive opinion. Proponents for calculators in classrooms saw opportunity to engage and motivate learners with exciting technology and time-saving instantaneous feedback, whilst opponents were concerned they would override basic learning (Drake, 1978; Shumway, 1976). Public opinion about the use of technology in education has been cause for debate for many years (Wang & Reeves, 2003), but its place is presently cemented, appearing in Australian curriculums from the first year of formal schooling (NSW Education Standards Authority, 2019; Victorian Curriculum and Assessment Authority, 2019) and

even in early childhood education frameworks (Department of Education and Training (Victoria), 2016).

Historically, research shows it was the intrinsic beliefs and attitudes of the classroom teacher, not public opinion, that influenced uptake of technology in the classroom (Churchill & Chiu, 2016; Vannatta & Nancy, 2004). These teacher-level beliefs, along with other school-level beliefs and policies (Becta, 2004) have been “key barriers that inhibit successful technology integration efforts” for many decades now (Lowther et al., 2008, p. 197).

When the ‘microcomputer’ (later known as a desktop computer) was introduced to classrooms in the mid-1970s as an educational tool, it was designed to revolutionise education but, as reported by Bell (1981), whilst a revolution in learning about computers was taking place in parts of the wider community, it was yet to occur in schools by the change of the decade. Bell noted that historically, until new technological devices (calculators, televisions and cassette recorders included) became commonplace in the every-day home, they were unlikely to be introduced into classrooms.

With the advent of the availability of technology in classrooms in the early 1990s, Cuban (1993) questioned why it was that despite “all the talk of school reform... computers are used far less on a daily basis in classrooms than in other organisations” (p. 185). He also noted that use of available technologies in classrooms was very much an exception rather than a rule in typical American classrooms. This is despite him

noting that there were three main factors to argue the place of electronic technologies in schools:

1. To ensure students are skilled in a manner that will enable them to participate in the workplace;
2. The opportunity for technologies to allow self-directed learning, in line with constructivist pedagogies; and
3. Productivity – “teaching more in less time for less cost” (Cuban, 1993, p. 190).

Cuban’s arguments align with Oliver’s (1994) observations that around this time, curriculum in Australian schools was beginning to move from seeing ICT (Information Communications Technology) as a stand-alone subject, to a skill that more widely reflected the requirements of a future workforce, by applying ICT across curricula.

In the early 2000s, there was an increase of government investment in computer hardware for Australian schools (Newhouse, 2001), despite almost all research demonstrating that, in the 30 years prior, the introduction of information technologies to classrooms had had “little impact on mainstream schooling” (p. 6). In the case of laptops though, unlike their desktop predecessors, students were afforded the ability to connect wirelessly to networks. Around this time, Rockman et al (2000) conducted a three-year study on the impact of laptops in schools versus non-laptop schools and suggested that laptops were providing a conduit for change. They identified that teachers in laptop schools had “changed their instructional strategies dramatically over the past few years, moving towards constructivist ideals and pedagogy” (Rockman et al, p. 65). As noted earlier, one particular reason for this, Rockman et al (2000)

speculated, was the affordance of laptops to provide “ubiquitous computing” (p. 65). This also included the amplified opportunity to access the Internet anywhere, anytime, compared to schools using non-laptop computers.

2.3.3 Historical practicalities (including barriers) to the implementation and use of technologies in classrooms

Whilst better affordability of technology may be an enabler for schools to allocate spending on such, merely having technological resources does not necessarily mean teachers utilise them in their classrooms (Hew & Brush, 2007). Certainly, technological innovation is often not replicated in schools the way it is in companies and organisations, writes Cuban (1993). One of the reasons for this, he states, is because of “cultural beliefs about what teaching is, how learning occurs, what knowledge is proper in schools, and the teacher-student (not student-machine) relationship” (Cuban, 1993, p. 186).

Ertmer (1999) says these cultural beliefs, along with other reasons, are an obstacle to technological innovation in schools. To further explore this, she applies the concept of first and second order barriers to change (Fullan & Stiegelbauer, 1991) to the implementation and use of technologies in schools (see Table 1). Ertmer links first-order barriers with circumstances that are extrinsic to teachers, whilst barriers that are intrinsic to teachers are factors in the second order. They have also been described as school-level and teacher-level barriers (Becta, 2004).

Table 1

First- and Second-Order Barriers to Technology Integration in Schools

First Order Barriers: Extrinsic to Teachers	Second Order Barriers: Intrinsic to Teachers
Lack of access to hardware	Beliefs about teaching
Lack of access to software	Beliefs about computers
Lack of available planning time	Established classroom practices
Lack of technical support	Resistance to change
Lack of administrative support	

Note. Adapted from Ertmer, P. A. (1999). Addressing First- and Second-Order Barriers to Change: Strategies for Technology Integration. *Educational Technology Research and Development*, 47(4), 47-61. Copyright 1999 by Educational Technology Research and Development

First-order barriers are readily measurable and can be addressed with improved resourcing (Ertmer, 1999), but challenging and changing ingrained teacher beliefs in order to break down second-order barriers can be difficult. A review of literature by Hew and Brush (2007) confirms this, stating “other researchers have found teacher beliefs about technology to be a major barrier to technology integration” (p. 229).

Whilst Hew and Brush’s review makes references to the work of Ertmer, and identifies similar barriers to technology integration in schools, they categorise them in a different manner, finding six distinct factors:

Table 2

Summary of Barriers to Technology Integration in Schools

Barrier	Elaboration
Resources	Availability of technology Access to technology Time Technical support
Institution	Leadership Time-tabling structure School plan
Subject Culture	General set of institutionalised practices and expectations which has grown up around a particular school subject
Attitudes and Beliefs	Teacher's beliefs about the educational purpose of using technology in the teaching and learning process
Knowledge and Skills	Technology skills Technology-supported-pedagogy skills Technology-related-classroom management skills
Assessment	Measuring student learning, typically through high-stakes examinations

Note. Partial reproduction from Hew, K., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Educational Technology Research & Development*, 55(3), 223-252.

Copyright 2006 by Association for Educational Communications and Technology.

Recent research finds the barriers identified and categorised by Ertmer (1999) and Hew & Brush (2007) still relevant in the classroom today (Hur, Shannon, & Wolf, 2016; Liao,

Sadik, & Ertmer, 2018) although some studies indicate a shift towards first-order/extrinsic barriers as dominant over teacher beliefs (Carver, 2016; Francom, 2016), including when it comes to the integration of iPads (Vu, McIntyre, & Cepero, 2014; Young, 2016).

2.4 iPad debut and introduction to classrooms

On its debut, the potential for the iPad to be used as a learning tool in the classroom was noted by numbers of educational institutions, with universities and schools around the world ordering devices for their students, banking on the idea that “the iPad will herald a revolution in the classroom” (Mathis, 2010, para. 4).

Shortly after the local release of the first generation iPad, then-Premier of Victoria, John Brumby, announced a trial of the devices in eight schools, so as to “ensure our students remain one step ahead when it comes to emerging technology” (Office of the Premier of Victoria, 2010, para. 3). Among the reasons he cited for the trial were the mobility of the devices, along with their possible capacity to engage students in learning and assist in achieving outcomes.

It was an opinion not shared by everyone. In the same month as the Victorian Premier’s announcement, the NSW Department of Education and Training (a beneficiary of the \$2.4 billion Digital Education Revolution that included supply of laptops to all public school students in years nine to twelve) issued a statement that

they would not be considering funding for iPads in schools. Specifically, then-Chief Information Officer Stephen Wilson stated:

An iPad is a wonderful consumption and entertainment device with a little bit of creative ability. It is one-way mostly. What we are trying to get students to do is to create and collaborate and to use the tools they will ultimately use in the workforce. (Kennedy & Foo, 2010, para. 4)

Regardless of the reservations of some, by the second half of 2012, sales of the iPad and other digital tablets had begun to replace sales of personal computers in the education sector in America and abroad, including Australia (Hughes, 2012; Sussex, 2012). By the second half of 2018, American news corporation CNBC reported that Apple had sold more than 400 million iPad devices, and claimed that the tablet was outselling all the major brands of laptop computers put together (Novet, 2018).

2.4.1 Current availability of iPads in Australian classrooms

A complete dataset on computer use by type in all Australian schools is difficult to find. However, the Victorian state government's Department of Education and Training takes an annual census of computers in schools. In February of 2011, the year following the debut of the iPad, there were just over 2000 tablet devices reported to be in use in Victorian schools, representing less than 1% of all computer types schools were using (Victorian Department of Education and Training, 2019). By February of 2019, this figure has steadily increased to 37%, with well over 200,000 tablet devices being used by students recorded in the 2019 census (Victorian Department of Education and Training).

2.5 Perceived role of the iPad in the classroom

The role of tablet technology in the classroom is twofold, it can be a computer device for student learning to support and facilitate the learning program, and can also be employed as a teacher tool for administrative and classroom management purposes.

2.5.1 The iPad as a learning tool

It is important to note that the iPad is recognised as a learning tool, not intended to replace the teacher. Masek, Murcia, and Morrison (2013) acknowledge the potential of mobile tablet technologies to form part of a holistic multi-modal pedagogy:

In an ICT enriched social constructivist classroom where it is assumed knowledge and understanding are actively constructed through social interactions and not passively received from the teacher or environment, teachers would match the use of technology to learning objectives goals and outcomes (p. 35).

Thus, as a learning tool, a key functionality of the iPad may be its offering of applications (apps) and the ability of those apps to meet and enhance learning outcomes. Applications can provide students with opportunity for immediate feedback and stimulate engagement with responsive adjustment in challenge levels based on the students' inputs (Ciampa, 2014). Tanaka (2013) suggests there are three categories of applications on the iPad:

- Instant Apps: those that are “pre-made for specific activities such as games, quizzes and grammar lessons” - structured with little training required.

- Interactive Apps: allow teachers and learners to “engage in virtual interactions” through applications such as Skype.
- Creative Apps: these are apps whereby learners (and teachers) are content-creators of written and audio-visual texts.

Walsh and Farren (2018) highlight the availability of the Internet on iPads as a learning tool, citing the wide amount of information that was accessible for children. Ally, Grimus, and Ebner (2014) write of the opportunity this provides:

This is the first time in history that citizens around the world, in all age groups, hold information and communication technologies in their own hands. They are using the mobile technologies to complete everyday tasks and to learn informally by accessing information as they need it from the world’s largest library, the Internet. (p. 44)

The Internet capability of iPads further allow them to be used as eReaders by downloading digital ebooks and eAudiobooks (Nay, 2012).

2.5.2 The iPad as a teacher tool

Teachers report using iPads to record and document learning and to facilitate assessment using the camera and audio capabilities (Beauchamp, Burden, & Abbinett, 2015; Blackwell, 2013; Maher & Twining, 2017). Other teachers highlight using the iPad in conjunction with a mirrored screen to facilitate lessons and have students report back on their own work (Burden, Hopkins, Male, Martin, & Trala, 2012). Further, iPads can be used for note taking at meetings and email communication with colleagues and parents (Nay, 2012).

2.6 Features and benefits of tablet technologies

Burnett and Merchant (2017) suggest why mobile tablet technologies, the Apple iPad in particular, have made their way into many contemporary classrooms:

They [iPads] have succeeded in capturing the interest of educators where many digital technologies have failed. Relatively cheap and light and without the encumbrance of wires, plugs and modems that have rooted technology so firmly to the spot in schools for so long, they are attractive to educators and educational policy-makers. They rest comfortably on classroom tables and their 'intuitive' interface means that less time is wasted with technological glitches and from lapses in teacher confidence (p. 2).

For young learners, the intuitive pinch-pull nature of operation of iPads provides an appealing advantage over desktop and laptop computers, which are often reliant having motor skills developed enough to control a mouse or sufficiently developed literacy skills to operate a keyboard (Blackwell, 2013). These redeeming features of tablet computers that allow even very young children to operate them, are not by accident but by design, suggest Stephen and Edwards (2018). Fifty years before the debut of the iPad, computer scientist Alan Kay, well-versed in learning theories, envisaged a book-sized mobile computer suitable for children to use for problem solving, researching and programming (Stephen & Edwards, 2018). Kay says in the late 1960s he thought computers for children should follow the Montessori principle: be mobile, encourage play-based learning, and allow children to create their own content

on the devices – a dynamic notebook, hence the naming of his concept as the ‘DynaBook’ (Kay, 2000).

For young learners in today’s classroom, many arrive with pre-acquired skills and knowledge in the use of tablet technologies, having already had access to an iPad at home (Burden et al., 2012; Facchinetti, 2013). Teachers are reported to perceive the devices as an opportunity to present learning tasks in a multi-sensory, fun way (Beauchamp et al., 2015; Burden et al.; Ciampa, 2014; Masek et al., 2013), with a Year One teacher observing that the iPad “became a highly motivational learning tool for some [students] who demonstrated undesirable behaviour elsewhere” (Getting & Swainey, 2012, p. 25). Overall, teachers have cited a high level of engagement, particularly amongst early learners, when using iPads, including in an increase in focused time on task (Burden et al., 2012; Getting & Swainey, 2012; Maher, Phelps, Urane, & Mal, 2012; Nay, 2012).

2.7 Barriers and enablers specific tablet technology

Prior to examining the barriers and enablers to the integration of iPads in classrooms, the sociocultural-historical context of technologies in classroom has been considered in this chapter. Barriers to technology integration in classrooms as identified by Ertmer (1999) and Hew and Brush (2007) were considered. These barriers remain, with Vu et al. (2014) noting that hurdles and enablers to iPad integration in classrooms are “virtually in line with factors that affect effective use of technology in classrooms identified by Hew and Brush (2007)” (p. 71).

2.7.1 Availability of and access to resources

A lack of sufficient hardware and software resourcing presents a recognised first-order barrier for classroom teachers to integrate technology into their lessons (Ertmer, 1999; Hew & Brush, 2007). This includes availability of devices, access to software (including Internet) and access to time (for learning, researching and planning).

2.7.1.1 Device availability

It is noted that when there are not sufficient devices for the whole school community there can be both a reticence for teachers to be obstructing other classes from access (Facchinetti, 2013) or frustration when they are not available (Walsh & Farren, 2018). Burden et al. (2012) found iPads needed to be kept in the classroom as an enabler, describing it as “a ‘just in time’ model of technology use rather than ‘just in case’ where technology is made available but in a remote location from the learning itself (p. 50),” a finding supported by Vu (2015).

Findings show that an increase in the number of devices kept in classrooms correlates with an increase in use (Vu et al., 2014). Keeping them permanently in the classroom can be problematic though, primarily when students (and teachers) forget to charge the iPads between use, and also when updates are required and teachers are either unsure how to manage those updates, or lack time to update each device individually (Blackwell, 2013; Engin & Donanci, 2015).

2.7.1.2 Access to software and the Internet

Apps on iPads require downloading from the Apple store. Some apps are free, whilst others require purchasing. Teachers may have permission to download software, but technical issues (such as downloading and syncing) can be a stumbling block, particularly when assistance is not available on the spot (Getting & Swainey, 2012).

Whilst the interface of iPads and other tablet technologies are reported as technically easy for the end-user, frustrations can ensue when there are connectivity issues, often around poor Wi-Fi in schools (Blackwell, 2013; Walsh & Farren, 2018).

2.7.1.3 Access to time

An intangible resource, time (or lack thereof), is recognised as an aspect that can hinder iPad implementation in the classroom. Teachers report they are hampered by a lack of available time apportioned in the timetable (Walsh & Farren, 2018) allowing time to Prepare, time to research and time to try things out (Khalid, Jurisic, Kristensen, & Ørngreen, 2014; Young, 2016). Furthermore, the ever-increasing number of apps being developed also means there is little time to sort through the sheer volume of what is available to identify software relevant to the educational needs of students (Blackwell, 2013; Mouza & Barrett-Greenly, 2015; Walsh & Farren, 2018).

2.7.2 Teacher beliefs

Intrinsic beliefs held by teachers regarding the role of technology in education form the basis of second order, or teacher-level barriers (Becta, 2004; Ertmer, 1999; Ertmer, Paul, Molly, Eva, & Denise, 1999). These beliefs may relate to:

- the role of iPads in the classroom, as a tool to facilitate learning, to meet specific ICT curriculum outcomes and/or as part of a holistic program integrating technology across disciplines (Blackwell, 2013),
- the ability of iPads to enhance or transform learning, including engagement, personalisation of learning and meeting curriculum outcomes (Saudelli & Ciampa, 2014), and
- the possibility for the devices to assist in areas of teaching practice such as lesson delivery, recording and assessment opportunities

In addition, teacher beliefs concerning the place of the iPads in the classroom have been linked with the teacher's ability to effectively monitor device use (task-focused use or safe use) by individual students when there are numbers in use at the same time (Saudelli & Ciampa).

2.7.3 Principal beliefs

School leadership, in particular principals, influence school level policy. When principals demonstrate limited understanding of technology-based pedagogy, this is reflected in school direction (Otto & Albion, 2002). Conversely, when principals demonstrate confidence in technologies and there is a clear expectation from within school leadership that iPads should be incorporated into teaching and learning, classroom teachers were more likely to be using them (Otto & Albion; Vu et al., 2014). Furthermore, as principal beliefs are tied in with a school's vision for ICT, their beliefs are shared with and can influence wider stakeholders in the community, such as parents (Maher & Twining, 2017).

2.7.4 Skills and knowledge

A lack of skills and knowledge has been found to be one of the most prevalent obstacles to the integration of iPads in school classrooms (Young, 2016), a hurdle that can be removed with appropriate training and development (Ertmer, 1999).

Professional development in the use of mobile technologies for education has been recommended both for practicing teachers and for inclusion in pre-service education programs (Ally et al., 2014). However, there appears to be a shift away from traditional methods of formally delivered training, moving instead towards a reliance on a familiarisation process to explore and learn how to use the technology (Burden et al., 2012; Walsh & Farren, 2018). Beauchamp et al. (2015) found teachers prefer to move through this process at a pace and setting of their own choosing:

In learning to use a new technology like the iPad, primary teachers adopt a diverse range of experiential, informal and playful strategies contrasting sharply with traditional models underpinning professional development which emphasise formal courses and events led by 'experts' conducted in formal settings such as the school. (p. 161)

Providing teachers with a device – and time – of their own has been reported to have more positive impact on knowledge and skill development when the exploration of the technology occurs ahead of classroom rollout (Blackwell, 2013; Burden et al.; Mouza & Barrett-Greenly, 2015). Once implemented in the classroom, there is evidence that students themselves are an additional source of expertise, and informally mentor their teachers in the use of technologies on the go (Beauchamp et al., 2015; Gronn, 2008).

In addition to learning the technical skills required to use iPads effectively in the classroom, there is a suggestion that teachers benefit from support and training to efficiently locate and assess suitable apps for classroom use (Mouza & Barrett-Greenly, 2015). Many teachers report being comfortable using an iPad as an entertainment device, but lacking in understanding of ways in which to integrate iPads as educational tools within a classroom setting (Blackwell, 2013). Mishra and Koehler (2006) highlight the need for teachers to have specific Technological Pedagogical Content Knowledge (TPaCK) “in order to appropriately incorporate technology into their teaching” (p. 1018). For iPads, suggest Saudelli and Ciampa (2014), the delivery of professional development specifically demonstrating educational use is particularly beneficial when it occurs within school settings because app use tends to be “context-specific” (p. 239).

Ad-hoc professional development can occur from within the school environment, in the form of casual collegial conversations or tuition from a dedicated ICT Coordinator (Kucirkova et al., 2017). Whilst teachers have been shown to demonstrate enthusiasm in the provision peer-to-peer professional learning support (Facchinetti, 2013; Vu, 2015), when formal professional development is absent, there can be a feeling of needing to rely on colleagues for assistance (Vu et al., 2014). However, utilising colleagues as resources is commonly affected by a lack of time, either time allocated for staff training or for timetabled instruction from the ICT Coordinator to students during lesson (Walsh & Farren, 2018). When a lack of knowledge and skills are combined with a lack of time, the two together make up a significant barrier to iPad integration (Young, 2016).

2.8 The research question

Earlier in the chapter, it was highlighted that often with the advent of new technologies, there are both those who hail an education revolution and a cohort of commentators with an opposing opinion, who do not see technology as either necessary and/or ground-breaking in the classroom. Public opinion on the matter comes from several areas:

Since the early 1980s, a loosely tied national coalition of public officials, corporate executives, vendors, policymakers, and parents have included in their reform agendas the common goal of creating more access to new technologies in schools (Cuban, 2003, p. 12)

In modern classrooms, it would seem the place of technology in schools is no longer in question, with many countries around the world having invested in technology for education, given a perceived value of beneficial outcomes (Lawrence & Tar, 2018). In Australia, curriculum frameworks state students should be engaged with digital technologies, including even our youngest learners attending early childhood education centres (Fox & Diezmann, 2017). It is expected that students become life-long learners, who, as future adult citizens that will encounter technology in almost every aspect of their lives, are able to integrate technology with their learning across all discipline facets (Ally et al., 2014; Hyndman, 2018). Lim (2002) acknowledges that there has been considerable research demonstrating links between technologies in schools and the development of skills for life-long learning. However, he goes on to say that investigation into what actually occurs in school environments within their broader

sociocultural contexts is lacking, stating “ICT does not exist in isolation; it is interwoven with the rest of the tools and participants in the learning environment” (Lim, 2002, p. 411).

Lim and Hang (2003) observe that there are multiple, interdependent systems within educational contexts, from a single classroom, to a school, right through to government educational departments, and note that each “is dependent on the larger ecological system within which it is embedded (p. 54).” Whilst Lim and Hang highlight the need to understand the interconnectedness of each activity system, and state that one cannot be completely isolated in examination from the others, a limitation to do so exists within the scale of this research project. As such the project seeks to investigate an activity system larger than a single classroom but less than an entire school. This leads me to ask the following question to research:

“What is the nature of the activity system experienced by primary teachers using tablet technology in junior primary classrooms?”

2.9 Chapter conclusion

In this chapter, the evolution of digital technologies in classrooms was described, followed by a review of known barriers to technology integration in educational settings. Contemporary literature on the recent addition of tablet computers to the technology market and their place in classrooms was presented, along with current understandings of tablet technology integration in classrooms. The chapter concludes with a statement of the research question.

CHAPTER THREE:

CULTURAL-HISTORICAL ACTIVITY THEORY

3.1 Chapter introduction

In this chapter, the theoretical framework guiding the research is presented. The chapter begins with a preamble on the application of cultural-historical activity theory to educational research. Next, perspectives on human learning are presented, starting with an examination of the beginnings of cultural-historical activity theory, leading to contemporary understandings of the perspective. The significance of Vygotsky's work on the use of tools and signs to mediate human behaviour is detailed. Alternative theoretical models that could have been applied to the project are briefly considered. Finally, current understandings of activity theory and how the perspective fits within this research is discussed.

3.2 Cultural-historical activity theory and educational research

In educational research there has been a move away from investigation of singular variables to “focus on the whole configuration of events, activities, contents, and interpersonal processes taking place in the context that ICT is used” (Lim & Hang, 2003, p. 50). This research project uses cultural-historical activity theory (CHAT) as a framework for design, providing a lens through which participants were interviewed and responses analysed. This is because CHAT provides the scaffold from which to study human behaviour within its native context. It examines the use of tools (*artefacts*), motivation for behaviour (*objects*) and roles the *community* and *rules* have

on people (*subjects*) in the environment in which they are operating, including how work is divided up between people (*division of labour*) to achieve a goal (Roth & Lee, 2007). It is a model that “makes it possible to include both historical continuity and local, situated contingency in the analysis” (Engeström & Miettinen, 1999, p. 9).

Activity theory is increasingly being used as a unit of analysis from which to study information communication technology (ICT) integration in schools as “it provides a conceptual map to the major loci among which human cognition is distributed in the learning environment, with ICT as one of the mediating tools” (Lim & Hang, 2003, p. 51). The model allows for the examination of collective practice in education and can assist with identifying specific relationships with the activity system, including opportunities to interpret conflicting processes and make recommendations for change (Karasavvidis, 2009).

3.3 The beginnings of cultural historical activity theory: theoretical perspectives on human learning

Cultural-historical activity theory has its beginnings in the Russian school of psychology, namely the school of thought brought to the fore in the Soviet Union during the 1920s and 30s when prominent scholars Lev S. Vygotsky, Alexei N. Leontyev and Alexander R. Luria were applying a cultural-historical approach to theory and practice in their disciplines of interest (Daniels, 2005; Engeström & Miettinen, 1999). Traditional schools of thought saw the human psyche as largely individual, whereby “human relationships are artificial by-products of otherwise autonomously functioning

individuals; the social is secondary to and derivative of the personal” (Gergen, 2001, p. 36). The Russian group of psychologists disagreed with this perspective:

Vygotsky argued that the higher voluntary forms of human behaviour have their roots in social interaction, in the individual’s participation in social behaviours that are mediated by speech. (Daniels, 2017, p. 39)

Thus, in the school of thought that observes the social construct of human behaviour, the use of signs, including speech, on the motivation for human behaviour and higher thinking processes, is acknowledged.

3.3.1 Social constructivist theory

Patrons of a social constructivist theory see human knowledge as constructed through a developmental continuum, whereby the learner explores the environment and builds on prior knowledge, particularly through the use of language as a scaffold, provided by a more knowledgeable peer or teacher (Edwards, 2005; Pritchard, 2005). Where Piaget saw the continuum as individually constructed, social constructivists emphasise the influence of social interactions on the individual’s cognitive development understanding of the world in which they participate (Gergen & Davis, 1985; Sivan, 1986).

3.3.2 Sociocultural theory

Sociocultural perspectives on learning theorise that learning is socially constructed, with particular focus placed on human traits and characteristics that are displayed during interactions with one’s community (the cultural context) to describe the

manner in which humans acquire new knowledge (Edwards, 2005; Packer & Goicoechea, 2000). Sociocultural theory is attributed to Vygotsky, who considered human behaviour and development more complex than a manifestation of individual maturation along a continuum (Marginson & Dang, 2017). He sought to explain the human psychological process within “the societal context in which the behaviour developed” (Cole & Scribner, 1978, p. 6). Vygotsky viewed the development of the child through social networks, highlighting what the child could do on their own versus what the child could do with social interaction with peers and adults (the “*zone of proximal development*” (Vygotsky, 1978, p. 84), mediated by physical and psychological artefacts (Marginson & Dang).

3.4 Cultural-historical theory

Cultural-historical theory refers to the theoretical ideas that underpin a view of learning whereby the underlying role of history on the development of cultural tools (objects and language) is acknowledged (Edwards, 2010). Two major tenets of the theory are that cognitive development occurs with the internalisation of the mental processes and that these mental processes have been culturally mediated (Bodrova & Leong, 2003).

3.4.1 Early recordings of terminology ‘cultural-historical theory’

Cultural-historical theory is generally attributed to Vygotsky’s methodology, given that almost all of his research from 1927 onwards came from a context of examining the historical development of the human mind (Tiutchev, 1999). Proprietorship of the phrase ‘cultural-historical psychology’ does not rest with Vygotsky, as it is not

specifically found in any of the writings authored by the researcher himself (Yasnitsky & van der Veer, 2014). Letters between Vygotsky and Leontyev from 1929 to 1932 do show that Vygotsky was using “*cultural psychology*” as a descriptor of their research, along with “*I[nstrumental] P[sychology]*” (I.P.) (Keiler, 2012).

The truncated terminology ‘*cultural-historical*’ appears in the transcript of a presentation in 1931 by fellow Soviet psychologist Aleksandr Aleksandrovich Talankin. Talankin was critical of the work of Vygotsky and Luria, viewing the reduction of Soviet culture to tools, objects and signs and the narrative around the development of labour in their work as a departure from purist Marxism (Keiler, 2012). He was further concerned that the work of Vygotsky and Luria was without critique, a position upheld by another (unknown) author of the time. The unidentified writer reviewed Vygotsky and Luria’s ‘*Essays on the history of behaviour*’ and described it as “bourgeois” and “idealistic” in conjunction with the phrase ‘*cultural-historical psychology*’ (Tiutchev, 1999; Vygodskaya & Lifanova, 1999). The phrase was intended as negative critique, and was further embraced by other detractors, particularly P.I. Razmyslov, who, in 1934, attacked the work of Vygotsky and Luria in the journal *Book and Proletarian Revolution*, using the phrase multiple times in order to publicly denounce their methodologies (Keiler, 2012).

3.4.2 Contemporary understandings of cultural-historical theory

Vygotsky’s passing at the age of thirty-seven meant that he forewent opportunity to re-examine and refine his philosophies, and as such, his activities around understanding the human consciousness are considered unfinished. Some have referenced Vygotsky’s

work as an incomplete thesis, a legacy that has become the bedrock from which cultural-historical psychology has developed (Miller, 2014; Toulmin, 1978; Yasnitsky & van der Veer, 2014). This untimely early death and resulting legacy has led to references to Vygotsky as “the Mozart of Psychology” (Toulmin, 1978, n.p.), going on to influence Luria’s body of work and more contemporary scholar, Yrjö Engeström (Blunden, 2015c; Miller, 2014). At the core of this legacy is the requirement to understand the historical and cultural context and its influence on human development:

It is a belief in the possibility of a holistic human science of mind, body and consciousness in their inseparable unity and in cultural and historical development that has driven the scholars who cumulatively contributed to the establishment of the “cultural-historical psychology” as we know it now (Yasnitsky & van der Veer, 2014, p. 3).

3.4.3 The significance of the sign and the tool in cultural-historical psychology

Central to cultural-historical theory is the tenet of human consciousness as mediated by signs (psychological tools, specifically: words) and tools (material tools or artefacts, stemming from a cultural need or basis) (Miller, 2011, 2014; Wertsch & Tulviste, 2005). Many researchers of Vygotsky’s time, Piaget included, studied human use of signs and tools as “parallel phenomena,” something Vygotsky seemed to find paradoxical (Vygotsky, 1978, p. 24). Instead, Vygotsky saw the tool and sign as forming a “dialectical unity” in human behaviour (Vygotsky, 1978, p. 24).

Vygotsky (1997) appears to admonish his peers and predecessors who, in their research, focused solely on stimulus-response aspects of behaviour and failed to note the significance of verbal instruction as part of their experiments: “The basic failure to differentiate the role of speech and the role of other sensory stimuli in the psychological experiment is the direct and inevitable consequence of the undivided dominance of the basic stimulus-response pattern” (p. 38). He postulated that behind the linear model of $S \rightarrow R$ is “positive content”, including the significance of speech in higher mental processes, without which, there is a failure to acknowledge “the cultural development of behaviour” (Vygotsky, 1997, p. 37).

Vygotsky (1997) refers to ‘created stimuli’ which are, by his definition, any human-made stimulus. When those stimuli are ones that provide the impetus for ‘mastering behaviour’ – of oneself or another being – he defines them as *signs*, with speech being a prime example of human created artificial signalisation (Vygotsky, 1997).

He wrote that this use of human-created supplementary signs - signs that have the specific purpose of regulating activity - is the evidence of higher-order thinking capabilities that differentiate humans from animals:

Creating and using artificial stimuli as auxiliary devices for controlling one’s own reactions also serves as a basis for the new form of determinacy of behaviour that distinguishes higher behaviour from elementary. The presence of created stimuli together with the given stimuli seems to... be the distinguishing characteristic of human psychology (1997, p. 54).

The use of these signs, Vygotsky identified, transforms thinking from simple stimulus-response type recall of facts to higher level processing and self-regulation (Gredler, 2009).

It is important here to note that Vygotsky's earlier references to signs refer to written words and symbols (including those which preceded alphabetised systems of recording) rather than speech, as it is the development of the use of written symbols which he saw as the epoch of human evolution from primitive to civilised, and it was the production of tools to mediate a solution to a task that, anthropologically, Vygotsky saw as key to evolution from animal to human (Blunden, 2015c).

Although thought to have developed alongside tool production, speech itself is not the catalyst for human mediated behaviour, it is only once speech is represented in a written form – a sign – that it becomes a psychological tool specific to mediated human action, one that is not seen anywhere else in the animal kingdom (Blunden, 2015c; Vygotsky, 1929). Vygotsky (1997) gives the example of a man who, needing to run an errand but is concerned he will forget, ties a knot in a handkerchief to serve as a reminder to complete the task when he sees the knot later in the day – a task which is “unthinkable and impossible for animals” (p. 39). He writes:

The use of notched sticks and knots, the beginnings of writing and simple memory aids all demonstrate that even at early stages of historical development humans went beyond the limits of the psychological functions given to them by nature and proceeded to a new culturally-elaborated organization of their behaviour. Comparative analysis shows that such activity is absent in even the

highest species of animals; we believe that these sign operations are the product of specific conditions of social development. (Vygotsky, 1978, p. 39)

Vygotsky (1997) saw language as the signalisation humans use to master behaviour and mediate activity for the purposes of problem solving physiological needs and wants. Furthermore, the tools that work in “dialectical harmony” with signs also mediate activity, in the form of vocational devices that enable work and aid humans in “mastering the processes of nature” (Vygotsky, 1997, p. 61). Figure 1 demonstrates the way in which he saw the sign and the tool working in conjunction to mediate activity:

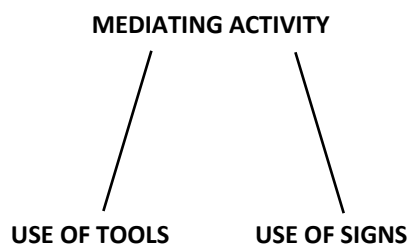


Figure 1. Vygotsky’s diagram depicting Tool and Sign as Mediators of Human Behaviour

Reprinted from “Research Method (M. J. Hall, Trans.)” by L. S. Vygotsky in R. W. Rieber (Ed.), *The Collected Works of L. S. Vygotsky The History of the Development of Higher Mental Functions*, (p. 62), 1997, Boston, MA: Springer US. Copyright 1997 by Springer US.

3.4.4 Mediation of human behaviour

Vygotsky used triangular schemata on a number of occasions to explain this unique use of signs in human behaviour. Initially, he demonstrated the importance of the use of signs as memory aids, such as the knot in the handkerchief, represented below in Figure 2. The base of the triangle represents the function of memory as “given... by nature” (Vygotsky, 1929, p. 418), with A and B showing “conditional-reflexive” (Vygotsky, 1929, p. 419) action and X depicting human incorporation of signs for the facilitation of “mnemotechnical memorization” (Vygotsky, 1929, p. 419), or devices to assist memory:

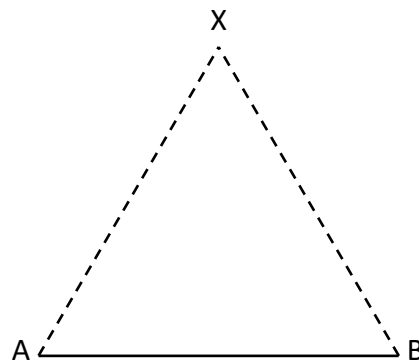


Figure 2. Vygotsky’s schematic triangle depicting Mnemotechnical Memorization
Reprinted from “II. The Problem of the Cultural Development of the Child” by L. S. Vygotsky, 1929, *The Pedagogical Seminary and Journal of Genetic Psychology*, 36(3), p. 420. Copyright 2012 by Taylor & Francis.

The use of the triangle is specific, as it shows the relationship between AB still exists when X is incorporated, just as there are connections between the sign (X) and each of A and B. For example, if a group of objects (A) and a total count of said objects (B) is a figure beyond which is in the natural capabilities of memory, one may employ the use of fingers (X) to assist in the retention of data, leading to relationships AX and BX

(Vygotsky, 1929, 1997). Thus, the relationship between A, X and B is not linear. If A represents the man and B represents the errand he needs to perform, then X is the knot, or an “artificially created stimuli-device,” from which “the man himself [uses to] determine his behaviour” (Vygotsky, 1997, p. 52).

Using the triangular schemata, Vygotsky demonstrates this mediated activity by showing that once the use of a sign (X), is incorporated into the stimulus-response principle, behaviour ceases to be merely reactionary to stimuli and becomes a “complex, mediated act”, one that is specifically controlled by a “higher psychological process” (Vygotsky, 1978, p. 40), as per Figure 3:

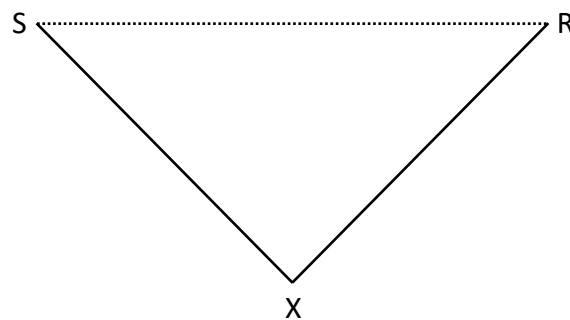


Figure 3. Vygotsky's Triadic Representation of Mediation

Reprinted from *Mind in Society: Development of Higher Psychological Processes*

(p.40) by L. S. Vygotsky, 1978, Cambridge: Harvard University Press. Copyright 1978

Harvard University Press.

3.4.5 Activity and action – the individual and the collective

Underlying the very concept of mediated activity is the reason: the motivation for said activity. Leontyev (1978) identifies a common purpose of all activity as follows: “the basic, constituent feature of activity is that it has an object. In fact, the very concept of activity (doing, *Tätigkeit*) implies the concept of the object of activity. The expression ‘*objectless activity*’ has no meaning at all” (p. 4). Furthermore, Leontyev states that “the object of activity is its *motive*” (p. 6) and describes it as an assembly of actions executed to attain a goal. In this way, Leontyev links activity with motive and actions with goals, whilst acknowledging that the motive and the goal in a process of activity by a collection of individuals may be different, they can form part of the same object. This, he says, stems from societies upon which traditionally there was a reliance on collective labour, such as to satisfy a need to find food for individuals forming a community (Leontyev, 1977).

Engeström (1999) succinctly differentiates between activeness and action, with activeness able to be used as a descriptor of both human and animal behaviour, whereby activity is “an object-oriented and cultural formation” (p. 21). In terms of the attachment of the word ‘activity’ itself to this unique human behaviour, some discussion has centered around precision of translation, notably pointed out by German professor Schurig in the late 1980s. Schurig notes that the German word ‘*tätigkeit*’ (and its Russian counterpart ‘*dejatel'nost'*”), featured in much of the writings stemming from Marxist psychology, specifically refers to the conscious goal-oriented behaviour that is exclusive to humans in the animal kingdom (whereas activity is not) and does not have an exact translation in English (Schurig, 1998).

Engeström (1999) refutes this idea, noting that the concept of activity with regard to object-oriented behaviour embodies cultural and societal aspects, and that there are numbers of examples of “conceptual blurring” (p. 21) of philosophical terms that cannot necessarily be prevented. Additionally, he specifically states that “we may well speak of the activity *of the individual*, but never of *individual activity*; only actions are individual” (Engeström, 2015, p. 54) therefore, in the discussion of activity in English the terms ‘activity’ and ‘action’ hold different meaning.

3.4.6 Rules, community and the division of labour

The collective aspect of object-oriented behaviour must be viewed from the societal standpoint from which the individual is operating (Leontyev, 2009). Acknowledging the individual as part of a society that has been culturally and historically shaped brings inherent particulars that can have different determinations on behaviour – rules, community and the manner in which the labour (or individual actions) is divided:

Human activity is not only individual production. It is simultaneously and inseparably also social exchange and societal distribution. In other words, human activity always takes place within a community governed by a certain division of labour and by certain rules (Engeström, 2015, p. 146).

3.4.6.1 Definition of rules

Activity of the individual and the collective is bound by rules from the society in which one exists. In contemporary society, the rules may come from multiple sources, such as

those determined legally by regulatory bodies (including governments and law enforcement agencies), to religious groups, or, at a more micro level, places of employment (Engeström, 2015).

3.4.6.2 Definition of community

Community refers to the social and civic networks in which the individual operates and may include workplaces, schools, families and sporting organisations (Engeström, 2015). Rogoff (2003) states that human development “can be understood only in light of the cultural practice and circumstances of their communities” (p. 3-4). This requires examination of the similarities and differences – and changes – of processes within communities, and an understanding of how the individual makes sense of the world from within their cultural unit (Rogoff, 2003).

3.4.6.3 Definition of division of labour

Based on Marx’s work on economic theory, Leontyev developed ideas around the division of labour in activity, which he succinctly described using the example of how individual actions form collective activity to entrap an animal for the purposes of satisfying a group (Engeström & Miettinen, 1999; Leontyev, 2009). He addresses any potential conflict between the object of activity and the motive for behaviour, citing the “separation of the object and motive of individual activity” (Leontyev, 2009, p. 187) coming together when there is a requirement for different individual actions to meet the needs of a collective group.

3.5 Cultural-historical activity theory

Engeström (1999) nominates Vygotsky's triadic representation and associated work around mediated action of the individual as the first generation of activity theory, formally interpreting the ideas graphically as in Figure 4, showing the *Subject* as the individual, the *Mediating Artefacts* are the cultural tool or sign, and the *Object* is the activity undertaken by the individual as enabled by the mediating artefacts, which leads to an *Outcome* (1987):

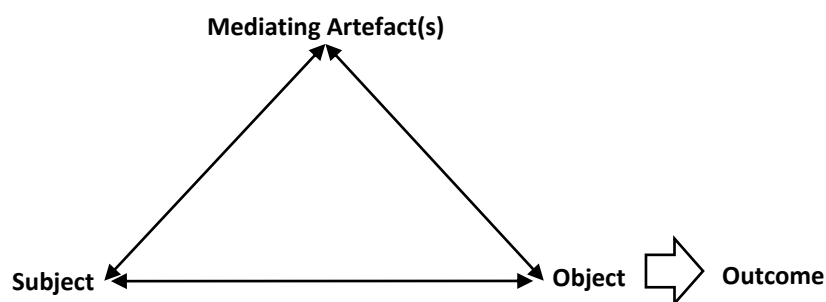


Figure 4. The First Generation of Activity Theory

Reprinted from “Activity Theory and Transformation” by Yrjö Engeström (1999) in Y. Engeström, R. Miettinen & R. Punamäki-Gitai (Eds.), *Perspectives on activity theory* (pp. 19-38). Cambridge: Cambridge University Press. Copyright 1999 by Cambridge University Press.

Engeström (2015) points out that Vygotsky's use of the triangular schemata to depict mediated activity does not allow for recognition of collective activity, and, that despite extensive work in around the significance of activity beyond the individual unit, Leyontev did not attempt to elaborate on Vygotsky's model to provide the inclusion of such. To demonstrate the place of community, along with the relationship activity has within natural societal bounds that tend toward the collaborative nature activity

generally takes on, Engeström (1987) expanded the triangular schemata to include the influencing elements of Rules, Community and the Division of Labour, as per Figure 5.

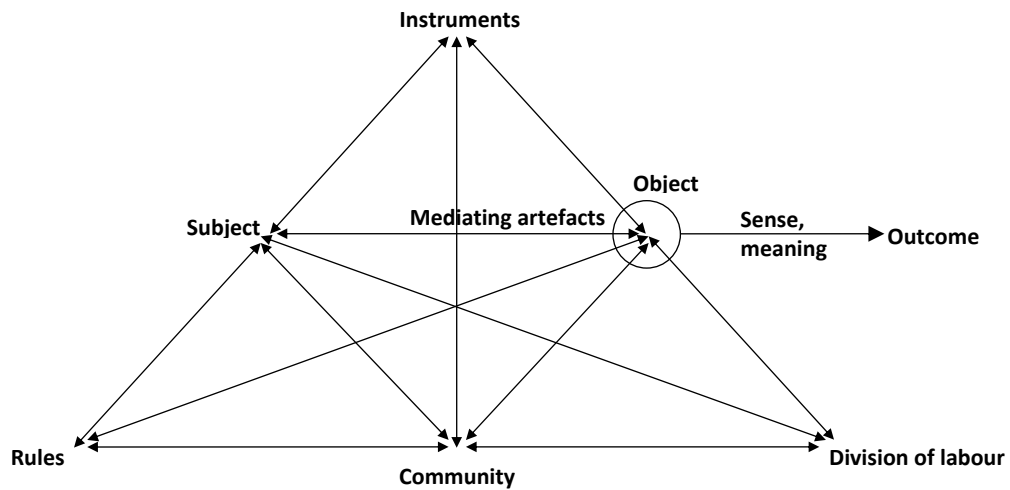


Figure 5. The Structure of a Human Activity System

Reprinted from *Learning by expanding: an activity-theoretical approach to developmental research* (p. 78) by Y. Engeström, 1987, New York, USA: Cambridge University Press. Copyright 1987 by Cambridge University Press.

This model, the Second Generation of Activity Theory, argues Engeström (2015), is the one that most completely covers the key drivers of mediated human behaviour, presented in a simple manner, whilst making allowances for “activity [to] be analyzed in its inner dynamic relations” (p. 65).

Additionally, Engeström (2015) notes that in this version of activity theory, the specifics of the outcome have changed. In the first generation model, the outcome is specific to the individual, whereas in the second generation the outcome has implication and meaning at the societal level.

3.5.1 The position of object in cultural-historical activity theory

Blunden (2015a) notes that whilst Leontyev, Vygostky, Engeström and other activity theorists hold in common the premise that “activity is defined by its object” (n.p.), the three major theorists hold different views on the specific definition of the object in activity theory. He determines that for Leontyev, what the object does is meet a social need, which motives the activity, essentially, the object “summons the activity” (Blunden, 2015b, n.p.). As such, Leontyev sees the two as inextricably linked, stating that “objectless activity” (Leontyev, 1978, p. 4) does not exist and that initially, if there is no apparent connection between an activity and an intended object, that is simply because the object is, as yet, unknown.

For Engeström, the object is the “problem space” (Blunden, 2015b, n.p.) from where the activity is motivated, which, upon completion, leads to an outcome – one that may not have been the original intended object. This differs from Leontyev’s theorising, where the object is the outcome. For Vygotsky, the object is more conceptual, a manner in which a problem is solved (Blunden).

3.6 Cultural-historical activity theory and the research project

Cultural-Historical Activity Theory (CHAT) is a theoretical perspective that provides for an “object-oriented, artefact-mediated collective activity system” unit of analysis (Engeström & Miettinen, 1999). The current project seeks to examine the decision making (collective activity) of teachers (subjects) on the use of tablet devices

(mediating-artefacts) in early primary classroom settings (micro communities forming part of a macro environment bound by rules and subject to constraints due to division of labour). Engeström's (1999) second generation of Activity Theory has been adapted for the project, as per Figure 6.

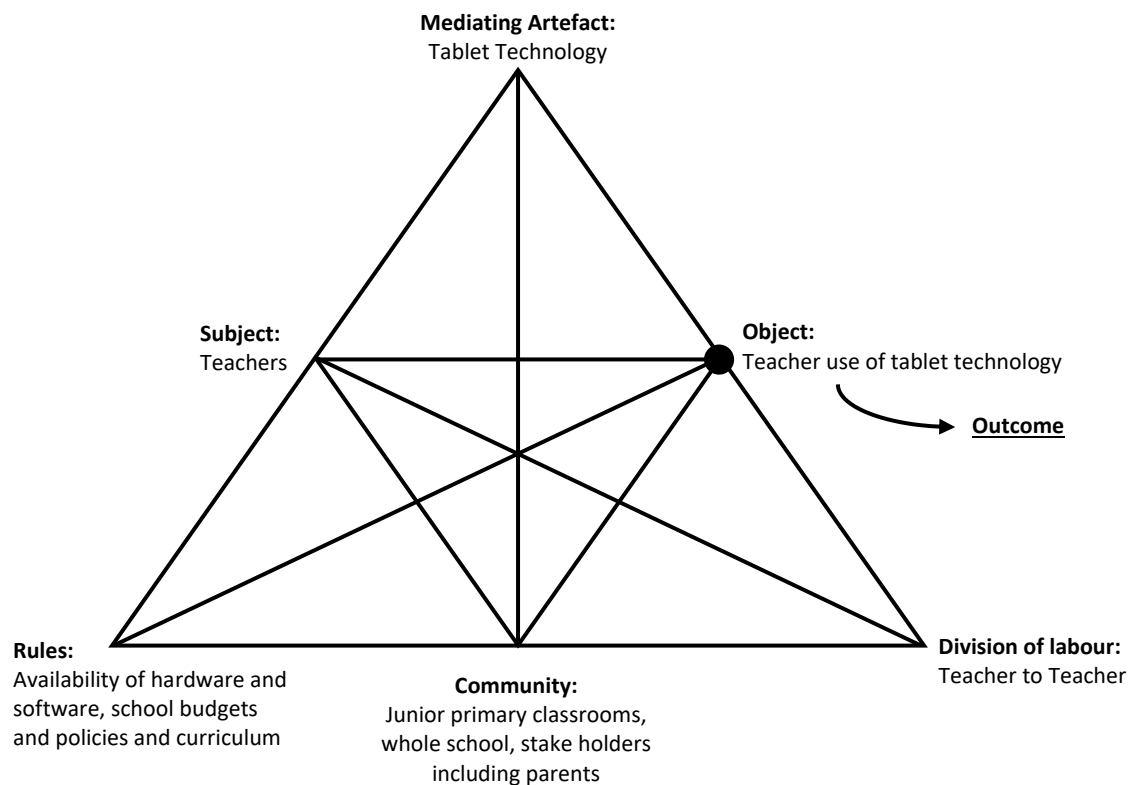


Figure 6. The Teacher Activity System

Adapted from Activity theory and individual and social transformation by Yrjö Engeström (1999) in Y. Engeström, R. Miettinen & R. Punamäki-Gitai (Eds.), *Perspectives on activity theory* (pp. 19-38). Cambridge: Cambridge University Press. Copyright 1999 by Cambridge University Press.

This project is aligned with Engeström's views on object and outcome, as the object is use of the devices and ensuing activity, with the outcome forming part of the findings.

CHAT, beyond being a psychological theory, provides a platform from which questions can be asked in social sciences (Engeström & Miettinen, 1999), an intention of this project.

3.6.1 Alternative theoretical models that could have been applied to the research project

Given the project examines an activity system that sits with bigger, broader activity systems (for example, the school-wide activity system, the Catholic Education sector, the Department of Education in Victoria), an alternative theoretical model that could potentially have been applied to the proposed research is the Ecological Systems Model (Bronfenbrenner, 1992). A study examining behaviour of a small group of participants linked to an immediate environment (in this case, classrooms from the first three years of a single school) could be seen as a “micro-research study” (Onwuegbuzie, Collins, & Frels, 2013, p. 5).

Given this project seeks to examine “systems by which he/ she/they/it might be influenced but of which he/she/they/it does not play an active role” (Onwuegbuzie et al., 2013, p. 5), such as the influence of leadership (rules) and community on the behaviour of the participants, the project would also potentially be an “exo-research study” (Onwuegbuzie et al., 2013, p. 5). However, Onwuegbuzie et al. (2013) suggest that research projects following this theoretical model would generally only examine multiple systems when conducting research employing mixed-methods (quantitative and qualitative).

Another alternative model that perhaps could have been applied to the project is Communities of Practice (Wenger, 1998), whereby a community of practice is “the simplest social unit that has the characteristics of a social learning system” (Wenger, 2010, p. 1). It is a model that recognises “four interdependent components—community, practice, meaning, and identity” (Cuddapah & Clayton, 2011, p. 64) whereby knowledge is seen as constructed “through participation in communities of practice where individual and group meanings are made” (Cuddapah & Clayton, 2011, p. 64).

Bannister (2018) suggests the community of practice model in an educational school setting might be teachers “mutually engaged in an activity (e.g., co-planning instruction, developing classroom tasks), held together by a joint enterprise (e.g., tackling a low student performance problem together), and have a shared repertoire of customs for practice (e.g., meeting routines, shared language)” (p. 131). In the case of this project, participant teachers did not quite fit this definition. Whilst there was collaboration at times, the data clearly shows that each teacher was planning for their own classes independently of other teachers, and had developed their understandings of the use of digital tablet technologies as a tool to support education along distinct continuums.

3.7 Chapter conclusion

This chapter began by highlighting the use of cultural-historical activity theory in use in contemporary educational research. The origins of cultural-historical activity theory were detailed, starting with perspectives on human learning. Vygotsky’s work on

significance of the sign and tool and their place in cultural-historical activity theory is discussed. Modern adaptations of this research into second generation activity theory was detailed, and a model of a teacher activity system was presented.

CHAPTER FOUR: RESEARCH METHODOLOGY & METHODS

4.1 Chapter introduction

In this chapter, the methodology and methods employed in the study are detailed. The chapter begins with an explanation of the research paradigms and qualitative approach adopted in the research, and a justification for its selection. Then the case study method is described, and the methods of data generation and analysis detailed. The conduct of the research is presented, including the selection of the case study site and participants, the generation of the data and the analysis of this data. Finally, the ethical considerations of the study are discussed.

4.2 The research approach

The aim of this qualitative study was to explore teachers' use of tablet technology in lower primary classrooms. The question guiding the research was: *What is the nature of the activity system experienced by primary teachers using tablet technology in junior primary classrooms?*

Guba and Lincoln (1994) suggest that it is research paradigms, which they define as “the basic belief system or worldview that guides the investigator” (p. 105), that will influence and direct the approach a researcher will take. They state that these paradigms, including the “range of possible relationships to that world and its parts” (Guba & Lincoln, 1994, p. 107) define the individual's sense of self within the world. As such, underpinning the architecture of inquiry are research paradigms of *ontology*, *epistemology*, *axiology* and *methodology* (Guba & Lincoln, 1994; Lincoln & Guba, 2013).

4.2.1 The interpretivist paradigm

For this project, the research paradigms fit under an interpretive umbrella paradigm, an approach that views knowledge as socially constructed (O'Donoghue, 2019). In the interpretivist paradigm, the individual and society are inextricably linked and as such, “interpretivists examine the meanings that phenomena have for people in their everyday settings” (O'Donoghue, p. 20).

4.2.2 Ontology

Ontology refers to the “nature of being,” writes Walter (2015, p. 14), and is concerned with the ways in which individuals perceive reality and what can be understood about this perception (Guba & Lincoln, 1994, p. 108). Conventional views support only a single reality, “independent of any observer’s interest in it” (Geelan, 2004, p. 13), whilst a constructivist sees realities as having been constructed “in the minds of the persons contemplating them” (Lincoln & Guba, 2013, p. 40).

The research question for my project sought an insight into the teacher activity system as experienced by teachers and how the system might influence their decision making in using tablet technology in their classrooms. This required an examination of the thought processes of participants, seeking to understand the teacher activity system. Thus, for the purposes of this project, my ontological stance is aligned with the theory that reality is socially constructed.

4.2.3 Epistemology

Epistemology is the “theory of knowledge concerned with understanding how knowledge is defined, valued, and prioritised” (Walter, 2015, p. 12). It is perhaps more succinctly defined by Lewis-Beck, Bryman, and Liao (2004) as “how we know what we know” (p. 309). A conventional epistemological view in an inquiry is that the researcher remains at a observable distance from that which is being studied, whereas a constructivist stance sees the two as inextricably linked; interactively working together to produce the findings of an inquiry (Geelan, 2004; Guba & Lincoln, 1994).

The design of my project is such that the research question was best answered through direct interaction with participants, as this yielded broader data than observations alone could have – a constructivist epistemological stance.

4.2.4 Axiology

Inherent in all human research is a social context. Traditional views held that research ought to be value-free, that researchers should be able to make inquiry based on observable facts without influence from their own values (Walter, 2015, p. 13).

Lincoln and Guba (2013) reject this “as a possibility when inquirer and research participants act together to co-create knowledge and create a new, shared reality” (p. 41). Given my ontological and epistemological stances, and the use of a socio-constructivist theory as a framework, it stands to reason that in this project my own axiological position – the value judgements that I make – may have bearing on how I have interpreted the results.

4.3 Methodology

To make meaning out of the social world, writes Usher (1996), it is necessary to not limit research to that which is observable. The epistemology of qualitative research, write Creswell and Noth (2018), requires researchers to be “close” to participants, to be in the field to best understand their subjective, lived experience. Bryman (1984) phrases this ‘close’ requirement as the researcher attempting “to see through the eyes of one’s subjects” (p. 78). Conversely, a quantitative approach would have the researcher “view events from the outside” (Bryman, 1984, p. 78) with an emphasis on measurable data.

In this project, direct interaction with participants was the best way to try and understand their lived experience. Pring (2004) writes that such attempts to make “meaning through which personal and social reality is understood... simply cannot be quantified” (p. 45). Thus, my ontological and epistemological stances indicated a qualitative approach to direct the conduct of the research.

4.3.1 A qualitative approach

The value of qualitative data, write Johnson and Waterfield (2004) is that it is particularly detailed and “unique to a particular context” (p. 122-123) coming from the viewpoint of participants whose individual cultural constructs will differ, offering data that is to be “interpreted rather than measured” (p. 123). This study required exploration of each participant’s individual experience of the teacher activity system at the site in which it is specifically associated, with the hope of finding commonalities that will attempt to answer the research question and contribute to an understanding

of their shared experience. Creswell (2013) provides the following definition of qualitative research that aligns with the approach taken for this project:

Qualitative research begins with assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem. To study this problem, qualitative researchers use an emerging qualitative approach to inquiry, the collection of data in a natural setting sensitive to the people and places under study, and data analysis that is both inductive and deductive and established patterns or themes. The final written report includes the voices of participants, the reflexivity of the researcher, a complex description and interpretation of the problem, and its contribution to the literature or a call for change. (Creswell, 2013, p. 44)

The phrasing of ‘what is the nature’ in the research question implies an examining of behaviour and characteristics. In this case, the specifics of thinking and actions around the elements of the teacher activity system. Whilst it might have been possible to gain an understanding of this specific activity system with a more conventional ontological approach through the use of survey and quantitative analysis, it would not have allowed for the deeper insights that were gleaned through the use of on the spot probing questions interspersed into conversations with the participants. This instrument of data collection is discussed further later in this chapter.

4.3.2 The case study method

Case study is a method that seeks to hone in on a specific phenomenon in order to “gain theoretical and professional insights from a full documentation of that instance”

(Freebody, 2003). Examination of the work of three influential methodologists in case study in an effort to define case study method highlights some differences in approach (Yazan, 2015):

- 1 Stake (1995) writes that "case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances" (p. xi). Stake (2005) writes that a case can be defined by "boundedness, contexts, and experience" (p. 3) but that it is epistemological reasoning helps define what the understanding of a case is. He says that from a qualitative perspective the researcher examines the activity in context, which will influence how the activity is interpreted, describing case study as "both a process of inquiry about the case and the product of that inquiry" (Stake, 2003, p. 136).
- 2 Yin (2014) additionally discusses context in defining case study. He says that the 'case' in 'case study' refers to a contemporary phenomenon, to be studied in its real-world context. For Yin, the manner in which the case study is designed and the data is collected, including triangulation, are also defining features (2014).
- 3 Merriam (1998) includes the work of Stake (1978) in her definition. She says his acknowledgment of Louis Smith's ideas around the "bounded system" (Smith, 1978, p. 342; Stake, 1978, p. 7) define what case study research is. Merriam says that a case must be able to be defined by boundaries, that is, the object of study can be hemmed in and that the amount of data that can be collected has an upper limit.

Case studies are often associated with one certain entity or situation, such as a classroom or program within a school, and can even be restricted to one particular behaviour or characteristic (Lichtman, 2013). It would be expected that the teacher activity system would differ from school to school depending on the varying inputs into the system. As such, for this project, it was best to limit the study to a single context of a teacher activity system. Yin (2014) states that case studies are appropriate when investigating how or why phenomena are occurring, when those insights could not be gleaned from alternative research methods such as surveys or analysis of archival documents. This makes the use of a case study in the design an appropriate epistemological choice, as it provides the opportunity for the “careful delineation of the phenomena for which evidence is being collected” (VanWynsberghe & Khan, 2007).

In this project the boundaries for the case study were narrower than just the single site; the study was restricted to interviewing teachers specifically in year levels Prep (now called Foundation), One and Two. This was because planning objectives differ between academic cohorts, with a delineation often being junior classes (Foundation to Year Two), middle classes (Years Three and Four) and senior primary classes (Years Five and Six). Naturally, the manner in which the use of tablet technology is planned for and implemented with older, more capable students would be very different than in junior primary years.

There is some literature that questions the ability of single case studies to generalise findings, but this is refuted by Yin (2014), who says that they are “generalisable to theoretical positions and not to populations” (p. 21). In order to address concerns,

Hamilton and Corbett-Whittier (2013) highlight a requirement for the inclusion of two or more forms of data collection or two or more perspectives, in order to “triangulate the data” and provide needed validation for the reported conclusions. In this project, triangulation of the data was enabled as the views of four separate participants were recorded.

4.3.2.1 Researcher bias in the case study approach

A further criticism of the use of case study for research includes the possibility of researcher bias due to design or the allowance of particular data to have some influence on the findings. Yin (1994) states that doing so in itself would not be allowed as part of an ethical research process. Yin further states that there is of course potential for bias in other approaches, so this is not an issue solely for case study research. I note that whilst I have personal interest in the use of tablet technology in the classroom, the research was designed to solicit participants thought processes regarding tablet technologies in *their* own classrooms. As will be discussed shortly, questions to participants were phrased in a manner that did not reflect my own beliefs.

4.3.3 Selection of site and participants

The school that was approached for participation in the study was a Catholic Primary School in the eastern suburbs of Melbourne. The school was chosen for two reasons, the first being that I had an existing professional relationship with both the Principal and the school’s Information Communication Technology (ICT) Coordinator, having formerly worked with them as an employee at a different school. More importantly, the school was also chosen as they had been using tablet technology in their junior

classrooms for more than six months. Specifically, each classroom in the school shared five iPads with one other classroom, with the shared sets of iPads referred to as 'kits'. A copy of the letter that was sent to the Principal and the ICT Coordinator outlining the project and asking for permission to conduct the research at the school is provided at Appendix 8.1, and a copy of the Principal consent form is provided at Appendix 8.2.

At the time of data collection, the school had six full time teachers working in year levels Prep through to Two. All six teachers were invited to participate in the study and four agreed. The invitees were given a Participant Information Letter (see Appendix 8.3) explaining the project and a consent form (Appendix 8.4). The letter provided participants with assurances that participation was voluntary, that their names would not be included in the project, that pseudonyms would be used and that only group findings would be reported. All participants, the ICT Coordinator and the Principal were provided with the contact details of the project supervisors and the University Human Research Ethics Committee (HREC) should they have wanted to contact someone regarding the research other than myself. The pseudonyms chosen for each participant are listed in Table 3.

Table 3

Pseudonyms Allocated to Participants

PARTICIPANT NO.	GENDER	PSEUDONYM GIVEN	YEAR LEVEL TAUGHT
1	Female	Lauren	1/2
2	Female	Brooke	Prep (Foundation)
3	Female	Leah	1/2
4	Male	Stephen	1/2

4.3.4 Data generation

Data for the project was generated by conducting semi-structured interviews with participants.

4.3.4.1 Method of data generation: semi-structured interviews

The data for qualitative research studies is often generated from the subjective experience of individuals (Auerbach & Silverstein, 2003; Creswell, 2012). In order to put together the information required to try and answer the research question, I decided on semi-structured one-on-one interviews as the principle method of data generation. This type of interview was chosen as it is best used in situations when participant responses are not easily predictable and the interviewer needs to improvise much of the follow up to the responses to Prepared questions (Wengraf, 2001). Creswell (2012) suggests being ready with a set of “probes” (p. 221) that can be used for the purposes of clarifying or seeking further detail. Whilst the list of guiding questions aids an interviewer in Preparation, Seidman (2005) says that in-depth interviewing is not about simply recording answers to questions, ultimately the goal is to “ask participants to reconstruct their experience and to explore their meaning” (p. 92). Seidman goes on

to note that it is the exploratory questions that follow up from participant responses to the guiding questions that can yield the most data.

Seidman suggests that semi-structured interviews require the researcher to be an “active” listener and to “assess whether what they are hearing is as detailed and complete as they would like it to be” (p. 78). He highlights the importance of finding a balance between sharing enough of one’s own background whilst keeping the focus on the participant to develop rapport during interview sessions. Further to being comfortable personally, Wengraf (2001) highlights the importance of an interview setting that is conducive to uninterrupted discussion, that is, away from potential interruptions and with enough time allowed that both the interviewer and the participants do not feel hurried.

4.3.4.2 Developing the interview schedule

Prior to conducting face-to-face interviews with participants, an interview schedule was developed. Hoepfl (2000) says there are three key reasons for developing an interview schedule, they are to:

1. ensure good use of limited interview time
2. make interviewing multiple subjects more systematic and comprehensive
3. help to keep interactions focused (Hoepfl, p. 57)

My interview schedule consisted of three planned stages: a brief personal introduction followed by opening statements about the study, the main body of the interviews (based around guiding questions to generate data) and an interview closure.

For the opening, I Prepared an overview that I paraphrased during interviews. The purpose of the overview was to demonstrate how the participants were oriented in the theoretical framework:

*“I am using a framework called Cultural Historical Activity Theory to help me understand your experience around the use of tablet technology in your classrooms. It is a theoretical perspective that aids in the examination of how a range of factors work together to influence an activity. I would like to look at different variables that influence **your** decision making when deciding to use tablet technology in your classroom by asking you some questions in these areas. You are the subject; the mediating artefact is the tablet technology itself. Rules; as in your school rules, budgets, etc. Community is other people that might influence your decision making; leadership group or parents or whatever that might be. Division of labour; how you’re supported by the other staff, how you feel the workload is shared.”*

The main body of the interviews was informed by the theoretical model. With consultation and feedback from my research supervisors, I prepared guiding questions pertaining to “predetermined inquiry areas” (Hoepfl, 2000, p. 52); the elements of the teacher activity system. The questions ranged from those with a broad focus: ‘*What are your thoughts about tablet technology in general?*’ to questions with a narrower focus: ‘*Please discuss the adequacy (or not) on software spending for devices?*’ A full copy of the guiding questions can be found at Appendix 8.5. I chose not to prepare a formal list of probes to follow up the guiding questions, as Wengraf (2001) suggests probing

questions form part of an “active follow-up strategy” (p. 159) and are formulated on the spot during interviews.

For the final part of the interview schedule, I planned pleasantries thanking participants for their time and contribution to the project.

4.3.4.3 Generating the data

Interviews began with a brief personal introduction led by me. I wanted to set a relaxed tone to the start of interviews by letting participants know that I was a fellow teacher, conducting interviews as I was interested in hearing their experiences when deciding to use tablet technology in their classrooms. Participants were advised that interviews would not take more than 45 minutes and that any data collected would be held securely and password protected. (Mentions of the school’s Information Technology Coordinator by first name during interviews were replaced with “ICT Coordinator” during transcribing).

I am very grateful to the Principal of the school where I conducted my interviews, who provided me with a quiet meeting room and arranged for participants to be released from classroom teaching time so they did not need to give up personal or planning time.

Following introductions were the opening statements about the study. To explain the theoretical framework to participants in a straightforward way, I shared a copy of the

teacher activity system on an iPad at the start of each interview. To avoid pre-empting answers, the headings of each component of the activity system were briefly outlined using the pre-Prepared overview as a guide.

All four participants indicated with a verbal cue that they were comfortable with the teacher activity system as shown, and none had any follow up questions regarding the teacher activity system itself.

Following the opening of the interviews, I had discussions with each participant ranging between twenty minutes and half an hour. The Prepared guiding questions (Appendix 8.5) were printed and made available to participants during the interviews. Participant responses during interviews will be examined in detail in the next chapter.

At the conclusion of the main body of the interviews, participants were offered an opportunity to add any additional comments or ask questions. Finally, the interviews were closed by thanking participants for their time and indicating their responses were valued by me for the project.

4.3.4.4 Recording the data

Audio of interviews were recorded on an iPhone, using the 'Voice Memos' application. Each interview was recorded in a separate file and titled with the participant pseudonym. The next step was to transcribe the spoken data, verbatim, into a written format. Nutall (2014) suggests the best way to present the processed transcriptions is in

a landscape format, with each line numbered. I did this using Microsoft Excel and considered each 'line' to be a length of discourse by one person, either myself as the interviewer or the participant, until the next person spoke.

Transcribing the data verbatim, pressing pause, typing, going back, checking for accuracy, was a lengthy process. Gibbs (2002) acknowledges that the process for many researchers transcribing their own data can be tedious, but that an advantage of having to carefully listen to the data is that it allows the researcher to "become very familiar with their content" (para. 6). Transcribing the data myself rather than outsourcing the transcription, whilst time-consuming, enabled me to assess the data from a different perspective (to that of the questioner) and to understand the data more deeply than at the time of interviewing. It also allowed me to notice similarities and differences between participant responses in particular areas of the teacher activity system.

4.3.5 Methods of data analysis

Analysis of qualitative data is the process by which the researcher attempts to understand the data collected and make interpretations in order to answer the research question (Creswell, 2012). When data for qualitative research studies is derived from the employment of semi-structured interviews, the transcripts are a "voluminous" set of data which then needs to be translated into a more refined and manageable form (Auerbach & Silverstein, 2003; Barlow, 1974). The process of moving from a large set of raw data to usable segments involves coding, a process of organising text contained in the transcripts through the use of labels which are used to identify

sections of text with similar segments, so as to identify patterns and determine themes (Auerbach & Silverstein, 2003; Creswell, 2012).

Morse and Mitcham (2002) note that a researcher may scrutinise their data from a deductive perspective, with a preconceived set of ideas that facilitate the consideration of relationships between the data and the initial research concept. Alternatively, the researcher may examine the data through an inductive lens, whereby data is carefully considered and compared until concepts are revealed and codes are determined and assigned (Bradley, Curry, & Devers, 2007).

4.3.5.1 Coding

Given this project was undertaken with a theoretical framework built in to the research question, it made sense to begin the undertaking of analysis with a pre-determined, although not concrete, set of codes pertaining to each element of the teacher activity system. Crabtree and Miller (1992) support this idea, stating that the theoretical perspective or the research question may form the base for a priori codes; a template of codes that are pre-determined either 'a priori' (before) the initial reading of the text or upon a preliminary scan of the text. Following on from the transcribing of the data, I developed an initial set of codes with around half a dozen codes for each element of the teacher activity system.

Primary-cycle coding is an initial reading of the data, a time to note particular observations, attach comments and possibly begin assigning preliminary codes for further examination (Crabtree & Miller, 1992; Tracy, 2012). As the data is revisited, the

codes should become more specific, perhaps “in vivo” (Glaser, 1978) stemming from words contained in the data set that were articulated by participants.

I transferred my data transcripts from Excel into NVivo software in order to begin analysis with a list of deductive codes pertaining to each element of the teacher activity system. The codes were developed using language from the guiding questions and anticipated possible answers as shown in Table 4. A copy of the teacher activity system is provided again at Figure 7 to demonstrate the components of the teacher activity system from which I drew upon to decide on the codes.

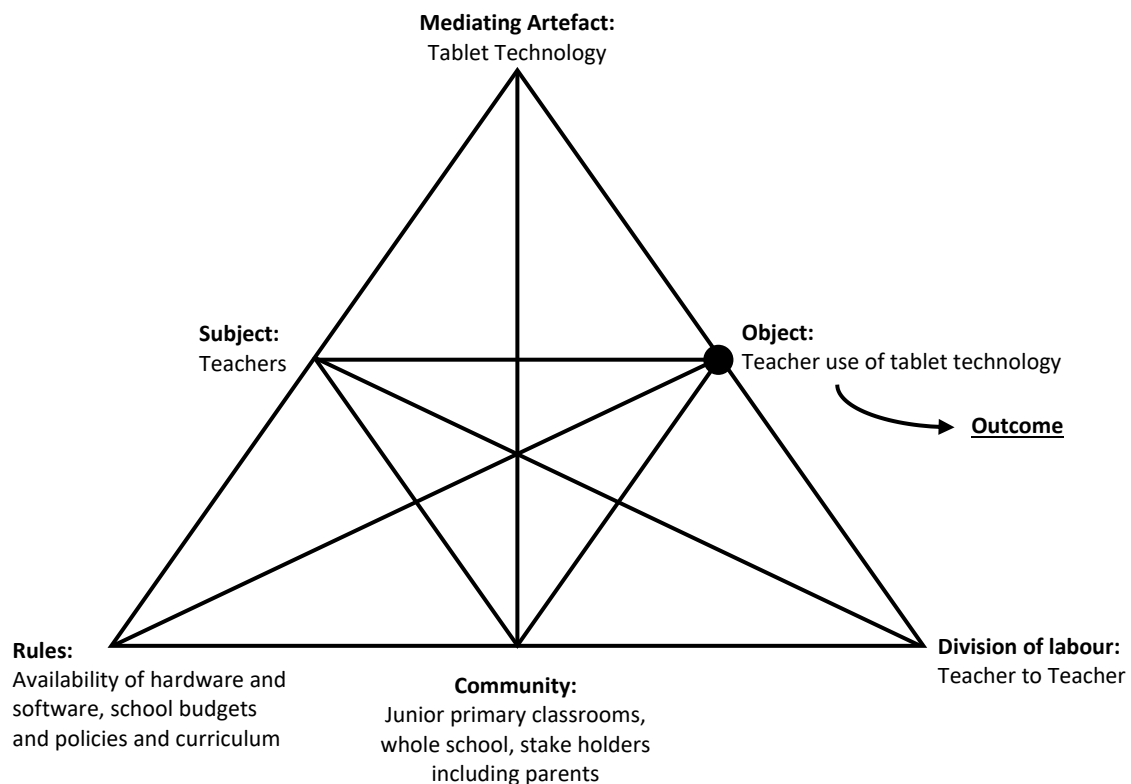


Figure 7. The Teacher Activity System

Adapted from Activity theory and individual and social transformation by Yrjö Engeström (1999) in Y. Engeström, R. Miettinen & R. Punamäki-Gitai (Eds.), *Perspectives on activity theory* (pp. 19-38). Cambridge: Cambridge University Press. Copyright 1999 by Cambridge University Press.

Table 4

A Priori Codes Assigned to Components of the Teacher Activity System

<u>Teacher Activity System Component</u>					
	<i>Mediating Artefact</i>	<i>Subject</i>	<i>Rules</i>	<i>Community</i>	<i>Division of Labour</i>
<i>A priori codes</i>	tool	teacher	budget	expect	labour
	purpose	general	available	students	help
	reason	device	spend	school	questions
	role	feel	number	parents	professional-
	use	confidence	enough		development
	factor	decide	leader		
	"don't use"	program	Coordinator		
		activity	curriculum		

Once I began assigning codes, I noted that many of the *a priori* codes I had decided upon were not specific enough and that I instinctively began to move into assigning more *in vivo* codes. After that, I had a long list of codes that required organisation.

Lichtman (2013) writes that there is formulaic procedure for analysing data, and that the key ideas are “the three Cs... coding, categorising, and concepts.” NVivo uses a specific set of terminology that aligns with Lichtman’s ideas:

- *Node*: A node is a digital storage container within the program that connects data from different sets of data within a project, putting them into categories. In other texts and programs these can also be known as codes, themes, categories, topics and concepts.
- *Parent node and child node*: Nvivo allows aggregate grouping of nodes into themes, with categories of nodes (child nodes) bundled together under overarching concepts, or parent nodes.

- *Case*: A case refers to a research participant (not to be confused with case study design) (QSR International, 2018).

To begin organising my nodes, they were manually cross referenced in an Excel table against each component of theoretical framework to highlight areas of the theory that are most dominant in the data. A definition for each node was added for clarity, which prompted me to re-name some nodes so they would be more readily arranged into categories.

Table 5

“In vivo” Nodes Cross Referenced with Components of the Teacher Activity System

NODE	Mediating Artefact	Subject	Rules	Community	Division of Labour	Object	DEFINITION OF NODE
Access		✓	✓		✓	✓	Availability of iPad for use in P-2 classroom
Barrier to access		✓	✓		✓	✓	Issues preventing access to iPad
Successful access		✓	✓		✓	✓	Factors providing for access to iPad
Barrier to use	✓	✓	✓	✓	✓	✓	Issue preventing employment of iPad in P-2 classroom
Classroom activity or subject	✓	✓	✓			✓	Activities or subject in which the tool is employed
Community	✓	✓	✓	✓	✓	✓	Influence of students, wider-school community incl. parents on use of iPad in P-2 classroom
Comparison with alternative tools	✓	✓	✓			✓	Instances in data where iPad is compared to alternative technologies such as laptops
Device to student ratio	✓	✓	✓	✓	✓	✓	Data regarding device to student ratio
Educational outcomes	✓	✓	✓			✓	Potential of iPad to assist in the achievement of educational outcomes
Factor affecting non-use	✓	✓	✓	✓	✓	✓	Reasons given preventing use of iPad in P-2 room
Factor affecting use	✓	✓	✓	✓	✓	✓	Reasons given why iPad is used in P-2 classroom
Perceived benefit	✓	✓	✓	✓		✓	Benefits of use of devices
Perceived downfall	✓	✓	✓	✓		✓	Cons of using device
Professional development - informal		✓	✓	✓	✓	✓	Collegial conversations
Professional development		✓	✓		✓	✓	More formal PD such as scheduled time with ICT Co-ord. or staff meetings
Purpose	✓		✓			✓	Purpose of using devices in P-2 room
Role	✓		✓	✓	✓	✓	Role that iPad can fulfil in the classroom
Rules	✓	✓	✓	✓	✓	✓	Any reference to rules
Rules - access decision makers		✓	✓	✓	✓	✓	Data around decision makers on availability of devices, timetabling etc.

NODE	Mediating Artefact	Subject	Rules	Community	Division of Labour	Object	DEFINITION OF NODE
Rules - budgets		✓	✓	✓	✓	✓	<i>Data concerning budget for purchasing of hardware and software</i>
Rules - policy	✓	✓	✓	✓	✓	✓	<i>School policies guiding use of iPad in classroom, curriculum influence on use in classroom</i>
Rules - purchasing		✓	✓	✓	✓	✓	<i>Decision makers regarding the quantity of devices to purchase and the allowance of \$ for software</i>
Software and apps	✓	✓	✓		✓	✓	<i>Instances in data mentioning specific applications</i>
Specific use	✓	✓	✓		✓	✓	<i>Examples of how devices are used in P-2 rooms</i>
Teacher device	✓	✓			✓	✓	<i>Instances mentioning use of devices specifically designated for teacher use</i>
Tool	✓	✓			✓	✓	<i>Specific mention of "tool"</i>
TOTALS	18	24	24	14	20	26	

Finally, the data in NVivo was carefully re-read and nodes re-arranged (and assigned/unassigned where necessary) in a more meaningful, hierarchical way to reflect elements of the teacher activity system. Parent-nodes representing each element of the teacher activity system and child-nodes represent sub-components of each element. To know the breakdown of the data according to each element of the activity system, after coding was completed, the qualitative data were aggregated in a quantifiable manner. This was to give insight into which elements were more influential on the activity system. Table 5 shows the final parent and child nodes, along with the number of times they occurred in the data:

Table 6

Final Parent and Child Nodes Showing Aggregate and Singular Occurrences

Parent Node	Child node	Aggregate occurrences at parent node	Singular occurrences at child node
Division of Labour		112	
	<i>Class teacher to class teacher</i>		48
	<i>Class teacher to ICT Coordinator</i>		64
Rules		97	
	<i>Device to student ratio</i>		26
	<i>Access - barriers</i>		24
	<i>Budgets and purchasing</i>		18
	<i>Access - general</i>		9
	<i>Time allocation for PD</i>		9
	<i>Access - enablers</i>		8
	<i>Curriculum</i>		3
Mediating Artefact		93	
	<i>How devices are used</i>		32
	<i>Educational outcomes</i>		21
	<i>Perceived benefit</i>		19
	<i>Comparison with alternative tools</i>		13
	<i>As a teacher tool</i>		6
	<i>Perceived downfall</i>		2
Rules		97	
	<i>Device to student ratio</i>		26
	<i>Access - barriers</i>		24
	<i>Budgets and purchasing</i>		18
	<i>Access - general</i>		9
	<i>Time allocation for PD</i>		9
	<i>Access - enablers</i>		8
	<i>Curriculum</i>		3
Subject		83	
	<i>Personal beliefs</i>		35
	<i>Professional development - formal</i>		18
	<i>TPaCK</i>		17
	<i>Professional development - informal</i>		13
Community		21	
	<i>Parents</i>		8
	<i>Leadership</i>		7
	<i>Students</i>		3
	<i>External</i>		2
	<i>Colleagues</i>		1
TOTALS		503	503

The data from the comparison table and explanation of the nodes are discussed in the findings chapter.

4.3.6 Ethical considerations

Any research that involves the use of human subjects requires adherence to ethical practices from both a professional and legal standpoint (Hopf, 2004). Data collected from the study is non-identifiable, personal introductions between the participants and me, where we exchanged names, was not recorded. Pseudonyms were given to teachers during analysis of the data. Only aggregate findings from the data are reported in the thesis. Long-term, the raw data is being stored on a USB (with the participants' given pseudonyms) in a locked cupboard at Australian Catholic University, to be destroyed in five years' time from the date of publication of the thesis.

Prior to the beginning of the study formal Ethical Approval was sought from the Human Research Ethics Committee (HREC) (Appendix 8.6) at the University and the local Catholic Education Office (CEOM) (Appendix 8.7). The project was deemed to be low risk by the assessing HREC officer, which, according to the National Statement on Ethical Conduct in Human Research (Australian Research Council, Australian Vice-Chancellors Committee, & National Health Medical Research Council, 2007) means that there is no foreseeable risk to participants beyond general discomfort. In this project, it was possible that discomfort could have come from personal questions, as such I needed to have an awareness of the body language put out by participants and ensure interviews stayed on track to addressing the research question.

4.3.6.1 Further ethical considerations

Creswell and Noth (2018) point out the need to minimise disruption at the study site when conducting the research, an important ethical consideration in the case of this project as teachers needed to take time from either the classroom or allocated planning time to participate. Menter, Elliot, Hulme, Lewin, and Lowden (2011) advise researchers to consider demands participants already have on their time and to be “clear, explicit and open.” To do this, I initially planned the interviews at a time that was suitable for the teachers involved. I also explained the project to participants in a succinct manner, kept copies of both the activity system and interview questions at hand to keep interviews on track and limited the required time for individual participants to be involved to 45 minutes.

Another important consideration was my ability to retain the guarantee I had made to participants to protect their identity. I needed to consider what I might do should a participant share information in an interview that I believe ought to have been reported to the Principal that would then lead to their identification, for example something that might contravene school policy with regard to spending from budgets. Lichtman (2013) suggests the best way to do this is to avoid interviews “moving in a personal direction” and be Prepared to stop interviews if necessary. This strategy was also to be employed to address any discomfort on the part of the participants, should I have detected it.

4.3.7 Researcher reflexivity

The qualitative researcher brings knowledge of their own to research projects, formed through social-constructs (Finlay & Gough, 2008) as, for various reasons (personal, academic or career for example), the researcher has an interest in the subject matter they investigate (Creswell & Noth, 2018). To maintain rigor, the researcher should demonstrate reflexivity by being cognizant and evaluating the potential influence of personal interest in the subject matter (Guillemin & Gillam, 2004; Lichtman, 2013).

Guillemin and Gillam (2004) describe researcher reflexivity as an awareness of “what sorts of factors influence the researcher’s construction of knowledge and how these influences are revealed in the planning, conduct, and writing up of the research” (p.275).

In the introduction, I described my personal experiences with technology in the classroom, observations of my own child using an iPad at home and my thoughts on the potential affordances of iPads as a pedagogical tool. In my professional practice as a primary school teacher, I have enjoyed (and still do enjoy) complementing and augmenting my lessons with available digital technologies.

Creswell and Noth (2018) state qualitative researchers must “position themselves” (p. 44) in their study. Having conveyed my stance on the place of technology in education, I wish to highlight that I could remain reflexive both in my data collection and writing up of the project, as I had not had first-hand experience in using iPads in classrooms at the time of interviews. This enabled me to focus on the research question guiding the

project when conducting interviews, seeking to understand the nature of the teacher activity system experienced by teachers using iPads in junior primary classrooms.

Earlier in the chapter, I stated that the school approached for participation in this study was one that I had existing professional relationships with. It is pertinent to note that in addition to having an existing professional relationship with the school's Principal and ICT Coordinator, I had also previously worked with one of the participants in the study some years earlier at another school. The three other participants I met for the first time on the interview day. In my introductions with the participants, I was cognisant of advising them that the purpose of the interview was purely to assist me in collecting data to fulfil the requirements of a Masters research project, and that no identifiable information would be provided to the Principal or ICT Coordinator, other than aggregate findings as would be reported in the final thesis. When interviewing the participant I already knew, I was able to maintain reflexivity as that person had been a colleague some years prior to the advent of tablet technologies, and I therefore had no preconceptions about how they might be using the technology in an educational capacity.

4.4 Chapter conclusion

This chapter has revisited the research question "What is the nature of the activity system experienced by primary teachers using tablet technology in junior primary classrooms?" and outlined steps taken to gather data to address the question. It has discussed why the choice of a qualitative approach is the most appropriate for the study and outlined why a case study was undertaken. The chapter has addressed the

use of semi-structured interviews for data collection and validity of the case study to triangulate the data to address the research question. Ethical considerations when dealing with human participants have been addressed along with attempts by the researcher to minimise risk during interviews. The manner in which data was obtained, recorded without identifying participants, and securely stored for the duration of the project was then described. An overview of the steps taken to analyse the data was given, the findings of which will be discussed in the next chapter. Finally, for the purposes of identifying reflexivity, my position as a teacher with an interest in the use of digital technologies in the classroom was stated.

CHAPTER FIVE: FINDINGS

5.1 Chapter introduction

In this chapter, the findings from the study are presented. The research question was *How does the activity system mediate primary teachers' use of tablet technologies in junior primary classrooms?* The findings suggest that the nature of the teacher activity system is primarily characterised by an emphasis on *division of labour*, *rules* and the iPads as a *mediating artefact*, followed by teachers as *subjects* and to a lesser extent, *community*. The chapter begins with an overview of the findings from the teacher activity system as a whole, illustrated by a figure demonstrating the more significant elements of the system. A detailed discussion of the findings from each element of the activity system will then be presented, in order of significance.

5.2 How the activity system mediates primary teachers' use of tablet technologies in junior primary classrooms

Interview questions for participants were arranged around elements of the teacher activity system of mediating artefact, subject, rules, community and division of labour. Analysis of the data showed that all elements of the activity system were evident. This is a function of the theoretical framework guiding the questions asked of participants. However, what the findings indicate is that some elements of the activity system generated more data than others. As per the data analysis section in the methodology, frequency counts were conducted of data as coded to each element, to reveal which elements held prominence of volume in the data set, as per Figure 8.

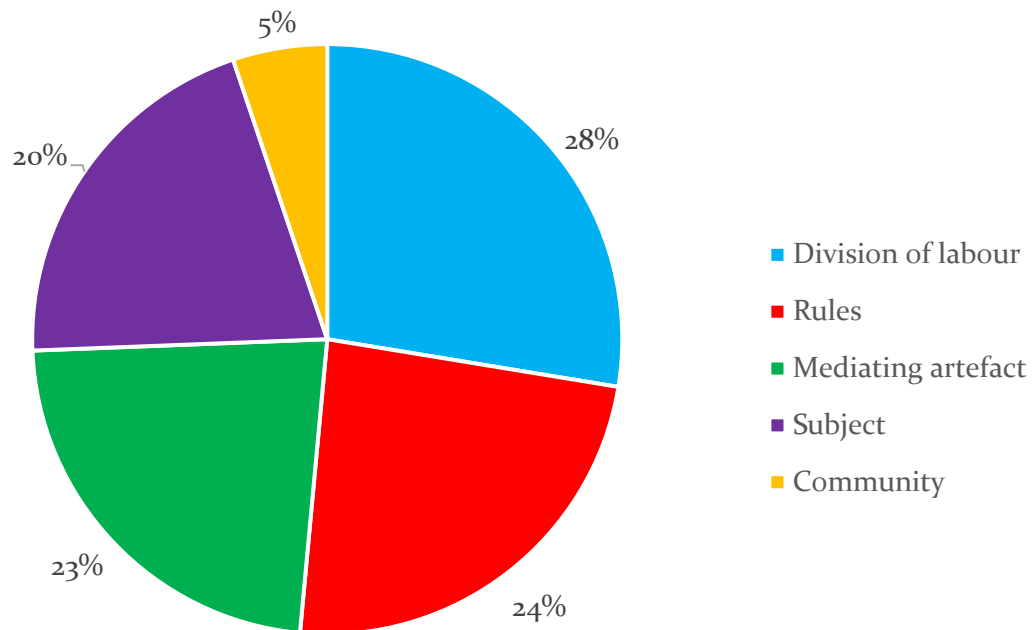


Figure 8. Spread of Elements from the Teacher Activity System in the Data Set

The findings show that the division of labour within the teacher activity system was discussed in 28% of participant responses. Furthermore, responses generated from participants show rules, mediating artefact and subject each represent between 20 and 24% of the qualitative data. The findings show that responses pertaining to the internal and external community attributed to only 5% of the data. Findings for elements of the activity system will now be examined in detail in order of most prevalent to least prevalent in the data.

5.3 Division of labour

There were two components to division of labour. Each component describes a different relationship pertaining to the way in which labour had been divided in the

school to facilitate iPads as a tool for use in junior primary classrooms. The two relationships are:

- Division of labour: class teacher to ICT [Information Communication Technologies] Coordinator. This relationship concerns how non-teaching tasks relating to iPads are allocated between classroom teachers and the school's ICT Coordinator, and
- Division of labour: class teacher to class teacher. This relationship describes the way in which work is shared between the classroom teachers themselves.

5.3.1 Division of labour: class teacher to ICT Coordinator

The findings show a strong correlation between use of iPads in junior primary classrooms and the manner in which labour relating to the purchasing and loading of software for iPads is divided between classroom teachers and the school ICT Coordinator. The activity system shows subjects had to go through the ICT Coordinator in order to have applications loaded on the class iPad kits.

Data generated by Lauren included discussion of the turnaround time to have apps added. She stated at times this prevented her from using her timetabled planning time to consider the incorporation of new apps into her work program for the following week:

[It] can be a bit of a process. ...you know, when—when they've (ICT Coordinator) got the chance, so if you think oh okay, it's Wednesday and I've got, you know—I've got my planning on Thursday, I mean for Monday, the

chance of there being a new app, the app that you want on there by Monday is nil.

Scott elaborated on the process, indicating that a few weeks' notice was usually required to have new software installed on the devices. The data shows that he was incorporating this timeline into his planning:

We can't, to my knowledge, can't put apps on the group iPads by ourselves, we need to put in a request. It's not the quickest turnaround. It's not the slowest, to be fair. If I put something in, yeah, I'd have to say 'in a few weeks' time' I want to use this app.

The findings show that due to this process, Brooke was using existing apps on the class iPads but was not spending time exploring new apps. She indicated that she was frustrated by the rules that she could not independently install software on the class iPads, stating 'All of the iPad apps are pushed out from a central point. So, on the sets of iPads that we use, we can't add one, we have to go through ICT'. Some dissatisfaction with the rule preventing classroom teachers from downloading new software on the class sets of iPads was shared by Leah too, with her saying that permission to do so was only granted to the ICT Coordinator. She would prefer to have been able to have some control over the process: 'If I could do it myself, that would be ideal, but... the administrator needs to put them on in our school. So yeah, that's been a little bit frustrating in terms of being able to use them (the iPads)'.

The findings show that the frustrations that existed in the activity system around the process for installing software were not attributed to the ICT Coordinator personally, in fact, all teachers acknowledged the support on offer from the ICT Coordinator. As Brooke noted: 'She'll even work with groups, or help you run a class on something or that sort of thing, I haven't done that yet with her, but I am looking at doing it this term'.

In summary, the findings show that the division of labour between the classroom teachers and the ICT Coordinator with regard to the downloading of software was a barrier to the integration of tablet technologies into their classrooms. As Leah stated, 'We have to get [ICT Coordinator] to download the app, so that's probably, of everything, that is probably the thing that is preventing me most from using them, because we can't do it ourselves.'

5.3.2 Division of labour: class teacher to class teacher

The findings show that the role of division of labour on iPad use in junior primary classrooms at the site extended to the relationships the classroom teachers had with each other. Each cluster of year levels at the school had nominated a go-to person who would attend ICT training and be available for assistance for those year level teachers. In the case of the junior primary teachers at this school, it was Scott. Leah referred to Scott as their 'ICT rep.' Lauren says of their nomination:

It was sort of put out, someone from each level can you please go to this, so you can be like the go-to person in your level. It was supposed to be the person, the most confident person [in technology].

Whilst Scott said he was happy to provide support to his colleagues, his own data suggests the issues that arose were not of a high-level technical nature and related to things such as forgotten passwords. Scott stated that he would prefer to provide technological pedagogical support to the other classroom teachers. The data suggests this could have been by way of specific hands-on technical support, or, as he stated, simply collegial discussion regarding pedagogical uses of iPads in the classroom:

I would love it if someone asked about an app I've been using or 'have you got any ideas about how to use this in reading', because look, I've tried things. I don't know if they're any good, I thought they worked okay in my class, and that's the extent of my experience with them, but I'd be happy to share that.

The data shows that discussion Scott was interested in having around the pedagogical possibilities of iPads in the classroom was limited. This was additionally observed by Brooke, who spoke of a lack of knowledge sharing between herself and the teacher she shared a kit with:

In terms of iPad sort of resources, there's not a huge amount of sharing... but we, I can't even think of when we've discussed an app. Well, maybe one app I said to her, and she said 'yeah, yeah, that's a good one'. That's probably the extent of our discussion about iPad use... obviously we could be talking about it a lot more.

The data suggests that perhaps not all teachers had considered the sharing of workload between teachers in terms of ICT. When prompted on the idea of collegial discussion

regarding software for the iPads, Leah immediately moved away from a teacher to teacher division of labour, referring back to the ICT Coordinator by suggesting that it would be 'beneficial' if the Coordinator could attend teacher planning sessions to discuss apps for iPads.

Overall, the findings show that the division of labour between class teachers is informally constructed in terms of integrating iPads in junior primary classrooms. The school had a process of support set up, but requests for assistance from Scott, as the nominated ICT representative, were ad-hoc and more about basic technical requirements rather than pedagogical in nature. Conversations between teachers that would increase their Technological Pedagogical Content Knowledge (TPaCK) was reported as limited.

5.4 Rules

Data generated associated with Rules in the Teacher Activity System show three aspects of note:

- *Rules: access to devices.* Much of the data was associated with rules in the school pertaining to teachers obtaining physical access to the devices. This includes participant mentions of barriers or enablers to iPad use in the classroom and general commentary they made regarding physical access.
- *Rules: device to student ratio.* The number of devices available per student was a secondary point of discussion.
- *Rules: budgets and purchasing.* Data generated from interviews included discussion of the rules around purchasing of hardware and software.

Participants were also asked about rules regarding curriculum and the use of iPads and school policies regarding time for professional development, however a significant amount of data was not generated. This section will focus only on discussion of the more significant findings – the rules regarding access, device to student ratio and budgets and purchasing.

5.4.1 Rules: access to devices

The school in this case study had purchased iPads in bulk, which were divided into sets of five, called kits, with each kit being shared between two classrooms. The kits were physically stored externally to the classrooms, in rooms such as level offices. There was an agreed rule that each class would have access to a kit every alternate week. Scott noted that ‘there has been some access issues that we have to get around for when they are able to be used’, making it clear that these two rules around access to the iPads (physical location and allocation every second week) set up barriers for teachers in the junior primary classrooms to plan for and implement iPads into the classroom programs.

Lauren directly indicated that sharing rules presented an obstacle for her to consider the use of iPads in her work program. She reported that without forward knowledge of when she would have access to iPads, she was prevented from incorporating them as a resource in her planning:

We do our maths planning at the beginning of the term, so you don't know when you're going to have the iPads, so therefore... to actually do all your planning before you know if you're going to have the iPads or not, to do maths

things on there, you need to pre-plan for that and because the planning is already done... [I] don't really use them in maths.

Scott and Leah had devised a way to overcome this obstacle. They found that by using an 'odd and even week' system, even though they didn't strictly adhere to it, they would know when iPads would be available for them to use. Leah stated: 'we set up timetables where week-to-week, you're the odd weeks, I'm the even weeks and switch between classes'. This means that the rule regarding alternating use of a kit each week with another classroom was an informal school policy.

Given the alternating rule was not policy, not all teachers adhered to it with Brooke reporting, 'we do alternate, like I do reading groups first and then I do writing and she (the other teacher) swaps it over'. By switching the reading and writing timetable instead of running lessons concurrently, Brooke and the teacher she shared a kit with could plan together and use the iPads as tools in the same lessons, delivered at different times.

Brooke also said that she preferred not to keep the iPads in the designated storage area. This was so they would be available immediately in the classroom when she did need them for incidental opportunities. This storage location was supported by the teacher Brooke shared a kit with. Whenever the other teacher wanted them, she would have children collect the kits from Brooke's classroom:

She uses them a lot less than I do, so from my point of view, I pretty much have access to them whenever I want, and I take responsibility for making sure

they're charged, so they're in my room, under my desk, I charge them, she sends kids in and I send them though whenever she wants them.

Leah said that she and Scott were doing the same, stating that they were both 'pretty flexible in that respect', and were happy to make the kits of iPads available for the other teacher to use if they weren't using them themselves.

Whilst going and collecting the kits was not reported as an issue for the teachers, Lauren did mention that not having them in the room at times lead them to forget they had access to them that particular week: 'Sometimes we haven't even got them out... they're still sitting in the planning office. So, we forget our week'. Further, Leah said that not having the iPads permanently in the classroom prevented opportunities for incidental use of tablet technology as a supporting tool in the classroom:

Sometimes, if you plan for it, you can organise it, but if, you know there's occasions where you are teaching and you might, just decide 'oh we could really use [the iPads] for this activity.' It would be good for us to have an allocation of iPads, that would be ideal.

In summary, the findings demonstrate that a clear barrier to the use of iPads for both incidental and planned learning opportunities was not having permanent physical access to iPads in the classroom.

5.4.2 Rules: device to student ratio

The findings show that when teachers did have access to iPads, at times they found the numbers of devices in the kits to be inadequate for whole class activities. Teachers said their average class sizes were 25, which meant that 50 students (two classes) were sharing one kit of five iPads. All participants said this meant that the iPads were either being used in small group situations or in conjunction with other technologies.

Brooke reported that she was happy using them with small groups. In her class children often worked in small groups of between four and six students. She had a provision for one extra iPad in her classroom for special needs, which she was able to add to the kit. Brooke said that she felt the number of iPads was adequate for small group work and that when more students needed access to technology, the Internet in particular, they incorporated computers into their lessons along with the iPads.

Scott stated said that he also incorporated other technologies, having been able to source ten laptops for his room, but reported that the iPads better met the class's technical ability:

A lot of the class struggled to effectively [mimics typing on a keyboard] but then the same process on an iPad, the ability to be able to touch-type, the frequency of the output of words and information available to record and retain was far greater than it was on a laptop.

Whilst Scott indicated that the idea of a 1:1 student to device ratio sounded good, at the time of interview he indicated he would be happy to just have double the current

number iPads available for use in the classroom. He thought ten iPads would provide enough opportunity for all students to be able to use one when they wanted.

Leah said initially the kits of iPads had only contained three devices, but after teachers put in a request the number was increased to five. She indicated that she would still like to see that number increased, saying that if she were able to have a larger set of iPads it would change the way she incorporated tablet technology into her lessons. This was due to the appeal of the devices for the children in her class, including the intuitive nature of use along with immediacy of response:

The kids just find it so engaging, just even, just manipulating things on there and most of the programs are tailored to kids, they're really bright and colourful and give immediate feedback and things like that, so yeah... it would be good to have that at our disposal just to use them with the whole class.

Overall, the data generated demonstrates that teachers were satisfied using iPads in small group work. Due to the number of devices available for use, none of the teachers had been able to use tablet technology in a whole class setting without the incorporation of alternative technologies. Comments from the teachers indicate they could see potential for whole class activities should more iPads be available.

5.4.3 Rules: budgets and purchasing

The findings show that class teachers had access to a software budget for the purposes of purchasing and installing apps on their teacher iPads. Brooke said this was so they could trial apps before requesting them be placed onto class sets.

In terms of student iPads, as previously indicated, classroom teachers had little control over the physical installation of software. As such, they indicated they were unaware of rules regarding budgets for purchasing software for student devices. Whilst all teacher participants did talk about the process of having software installed, it was Brooke who identified the 'why' regarding the rule requiring the ICT Coordinator to handle the installations, which she was able to link with purchasing:

I think part of it's to do with licensing, so if they're paid apps, if we want one of those, we've got a certain number of licenses, so I think part of it comes down to the legality ... there are issues with, like legal issues in relation to that so it just makes sure that we're not breaching [licensing rules].

This idea was also touched on by Scott, who knew if he requested a free app there was a great chance of having the software installed in a shorter timeframe: 'we put in a request regardless of if it's paid or free, I think it's more likely to get on there if it's free - pretty quick'.

Laura and Leah expressed opinions that rules regarding the purchasing of hardware and software came from 'leadership' and accepted rules regarding spending on both hardware and software as 'top-down' decisions. In summary, the teachers indicated

they had minimal knowledge of rules regarding hardware purchasing. However, Brooke and Scott both linked some ideas regarding software purchasing rules with the division of labour between themselves and the ICT Coordinator due to either cost or licensing.

5.5 Mediating artefact

Data generated concerning the mediating artefact, the iPad device itself, shows participants used the devices in a number of ways. This data has been grouped and is discussed in Section 5.5.1 *Mediating artefact: how devices are used*. Further components of Mediating Artefact on the activity system that will be discussed in this section include *educational outcomes* and *perceived benefit*.

5.5.1 Mediating artefact: how devices are used

The findings show variances in the ways in which teachers were using both the class set of iPads, and the device allocated to them personally. Lauren differentiated the use of her teacher iPad with that of student use. She was not using educational or administrative apps, other than for visual recording of anecdotal observations, indicating she used her teacher iPad only for taking photos: ‘I use it for photos. That’s my camera, that’s my classroom camera, my iPad. And the sole reason I probably use my iPad’.

Conversely, Lauren said she used the kits of iPads with her students in other ways. The children in her class were using iPads in small group activities during literacy and

numeracy lessons, and as a research tool by utilising the web search capabilities of the devices.

The use of iPads in small group learning during literacy sessions was common among all participants: Brooke was using educational applications to support specific learning goals she had for children working in small groups. She was also using the integrated camera function of the iPads, with the children as the operators:

We use them during literacy groups... most of the activities they do on them during reading groups are related to sounds or basic words, those sorts of things, depending on their reading level. Then we use them as well, mainly during writing, to take photos of things around the room. So, words things like that that they can then bring back to their table to use.

Leah also mentioned that she was using educational iPad apps with small groups during reading lessons, and as a research tool to access the Internet during other subjects. She did say that she would like to make more use of the devices:

I don't really use [them] as much as I'd like to unfortunately. Reading's probably the only time, and undertaking their personal inquiries were the times when I have really used them. I'd like to use them more in maths, as well as you know, an early finishers kind of task.

Leah indicated that she had a list of apps she'd like installed on her class set, but hadn't had time to narrow down the list and was planning to use her holidays to do so.

Scott was using iPads in a number of explicit ways with his students during their literacy sessions. His response demonstrates that iPads were being used as an integrated tool in his classroom, with apps being used specifically for the purposes of assisting with the completion of tasks and for consolidation of prior learning:

It's used in a variety of manners, it's used in guided reading focus groups, it's used as an aid to write notes and to record things. I've used them in rotations to consolidate learning, it's never really been centred around teaching new topics, it's often been spelling applications or it might be reading and text response, quick consolidation of something where they may have done the day before of the week before, just to sort of practice and give them that experience.

Of all the participants, Scott went into the most detail about how he was using tablet technologies in his classroom. In addition to using the iPads for small learning groups in literacy and as an Internet searching tool, Scott was also working with his students to use the devices as researching, recording and presenting tools. His junior primary students were using iPads to keep written and verbal notes to help them with projects they were orally presenting to the class:

They've actually used the iPads [for] note taking and recording as well. It also helped [to have] the ability to record their voices, so they were able to have a question and they all were able to verbally and orally record notes, play them back in a different environment or situation. [Students] might have gone into an annotated picture, so they might have set us a line about the, the whatever the tail on a lizard, and when they're drawn their picture of a lizard for their

presentation they were able to then listen to that, and record and transcribe that.

Further, Scott was the only teacher in the study who detailed ways in which he used his teacher device as a tool beyond the camera capabilities. He stated that he used it for anecdotal note taking and recording observations in class, and as a recording tool during meetings and professional development sessions.

In summary, all teachers were using iPads in small group learning situations and for Internet access. Whilst all teachers reported a lack of time to explore additional potential for iPads as a tool in their room, one teacher stated he used the school's ICT Coordinator as a resource, and always followed up with her to learn more when 'things took his eye'. The findings would suggest that in doing so, this teacher had been able to implement the use of both teacher and student devices more broadly into his work program.

5.5.2 Mediating artefact: educational outcomes

Teachers in the case study were asked about their beliefs regarding the potential of iPads to help their students achieve educational outcomes. Leah made links between the use of iPads and technology specific outcomes in the curriculum. Brooke highlighted the need for her students to be able to navigate technology as it was reflective of the real world. Scott identified that iPads were used as a tool in his classroom to achieve educational outcomes, in the much the same way he'd use 'a pencil or a library book'. Scott said he believed iPads offered plenty of potential to

assist students in achieving educational outcomes, but that the understanding of how to do so was not in place in the school:

I think it has a great potential to be a driving force in achieving learning outcomes. I don't think they're used that way - here anyway. It'd be nice if there was an avenue for that but I don't even know how you'd go about that, so there's knowledge gaps.

This is further evidenced with Lauren stating that she was sure there were ways iPads could help her and her students achieve educational outcomes. She said that she and her colleagues had had many conversations around doing so but that she still 'wouldn't know how'.

In summary, the data shows that whilst teachers believed in the potential of tablet technology to help them achieve educational outcomes, none of the participants in the study had specific pedagogical understandings of using iPads as a tool for doing so.

5.5.3 Mediating artefact: perceived benefit

The data shows that teachers in the study perceived tablet technologies as a beneficial tool to have in their classrooms. All teachers reported high levels of engagement from children when using iPads. They identify the devices as 'easy to manipulate' by children, being 'bright and colourful' and 'responsive'. Leah said engagement was in part because the devices 'give immediate feedback'.

The portable nature of the devices in conjunction with Internet connectivity was considered by teachers as a specific benefit, particularly in comparison with the use of laptops as an alternative. Brooke summed up these ideas as follows:

I think with an iPad or a tablet the fact that you can take it so easily around, you've got access to the Internet on it, you know, you can take photos, you can manipulate them, there are so many different apps you can use on there. I think probably that transport part of it, the fact that they are so easily accessible, you know you don't need to log on, you just open them up: so much more time efficient.

Overall, the findings show that teachers perceived the iPads as positive additions to their classrooms. Only one negative mention was made, and that was the ease of which a student might be able to use/switch to a different app on the iPad than the one intended for use/allocated by the teacher.

5.6 Subject

The concept of subject centres on the participants themselves – the teachers. During interviews, they all made mention of *professional development* with regard to the implementation of iPads in their classrooms. A large proportion of data was also collected concerning teachers' *personal beliefs*.

5.6.1 Subject: professional development

The data generated around professional development can be divided into three sub-categories. They are professional development, conducted both (1.) formally or (2.) informally, and (3.), specific references in the data to the development of teachers' Technological Pedagogical Content Knowledge, or TPaCK (Mishra & Koehler, 2006).

The OECD describes professional development for teachers as “activities that develop an individual’s skills, knowledge, expertise and other characteristics as a teacher” (Organisation for Economic Co-operation and Development, 2009). For the purposes of this case study, references in the data to structured training were categorised as formal professional development, whilst informal professional development refers to mentions of informal dialogue or ad hoc sessions that sought to improve teacher education and skills with regard to the use of iPads. TPaCK refers to having both the technological and pedagogical understanding to not only know how to use technology itself, in this case iPads, but also how to integrate that technology in a meaningful way to achieve pedagogical outcomes.

Teachers in the study note that opportunities were available for them to attend informal professional development training sessions in the use of tablet technologies at the school. However, the classroom teachers say they are often too time-poor to make use of them, as suggested by Lauren:

And I know [ICT Coordinator] really does try, she really does... she'll put lots of things in place but I think it's a case of too much at one time. And a lot of the

times, we don't have time, like it might be a lunchtime thing, or you know, we just don't have time to go to them.

This was echoed by Leah, who said 'She's very forthcoming with support, but the only problem is that it has to be done during recess and lunch time, there's no allocated time for that'. Scott stated that whilst he had had opportunity to attend ICT professional development, other staff had been asking for formal training, stating there had been a 'big cry' for professional development in the pedagogical use of iPads.

In lieu of not being able to send whole staff on professional development, Scott suggested that there was room to dedicate five to ten minutes during meetings such as P.L.T.s (Professional Learning Team meetings) to try out iPad applications and discuss what other staff had been doing in the classroom. Brooke expressed a similar desire. She specifically mentioned that she would like not only to know what apps other teachers might be using, but how they were using them, which would then increase her TPaCK:

For me at the moment it's about exposure to the apps, and, and opportunities to explore them, so even if people who do have that knowledge were just to highlight the way they use them or the way they could be used, something like that... for me it's that balance between the time and the knowledge of them, so that, that opportunity to explore and for people to highlight 'this is what you can do with them'.

In summary, all teachers agreed that a lack of time was the major obstacle to the development of their TPaCK. Teachers indicated allowance for such was given during their formal meeting times and that having to attend sessions during their lunchtime was an obstacle to attendance.

5.6.2 Subject: personal beliefs

Teachers in the study acknowledged their personal beliefs influenced their decision making when deciding to implement tablet technology into their junior primary classrooms.

For one teacher, Lauren, it was her personal confidence with ICT in general that she believed was a stumbling block to broader use of iPads: 'I'm not very technical... it takes a lot of planning for me'. This was despite her statement that iPads are 'easy and the kids love them'.

Both Brooke and Scott indicated in their interviews that they had a higher level of self-belief in terms of using iPads in their classroom than that of Lauren. Both teachers did however, make note that they believed iPads were tools, with Scott stating that they should not 'replace teaching' nor be used for 'keeping people busy'. Brooke stated her position on the use of iPads in her classroom as follows:

I think they're a really good tool, but I think it's important that we're open to other tools as well. So, they're one tool that we can use, and they can be used in lots of different ways and because of the nature of them for lots of different

curriculum areas and all of that sort of thing, but it's also important to recognise other things we've got at our disposal and that kids also need to be in touch with.

In particular, Brooke stated that she wanted her students 'to think for themselves rather than going straight to a tablet'. This was part of her stance that the iPad was to be a tool to support learning, rather than to deliver learning.

Overall, each of the teachers in the study believed iPads were a useful tool to have in their classroom, with each attributing engagement of their students as a key contributor to this belief.

5.7 Community

The research question asks about the nature of the activity system in this particular school. Part of the activity system includes the influence of community on the activity system as experienced by these teachers. As such, participants were asked about the specific input students, leadership and the wider community, including parents and media might have.

Teachers had conflicting opinions on the influence of leadership in the school on the use of iPads in the classroom, particularly around the expectation to be use the equipment. Lauren thought that as the money had been spent on the devices, there was 'pressure' to be using them, whilst Leah specifically stated that she saw iPads as an 'available tool', with 'no expectation put on us that we have to use them'.

Teachers in the study acknowledged that there was potential for broader influence from the community, such as parents and media, but the findings do not show this data to be of significant influence on the teacher activity system.

5.8 Chapter conclusion

In this chapter, findings to the research question *What is the nature of the activity system experienced by primary teachers using tablet technology in junior primary classrooms?* have been presented. The findings showed that the *division of labour* and the *rules* were mediating the activity system. This comprised of the manner in which labour was divided between classroom teachers and their ICT Coordinator and additionally between the classroom teachers themselves. The next element presented *rules*. Components of rules included rules governing access to tablet technology, the number of devices available per child in classes, and, in particular, rules concerning budgets and purchasing of software. Following this was the *mediating artefact* itself, where discussion on the findings of the ways in which devices were used was detailed, along with findings regarding junior primary teachers' responses on the educational outcomes and perceived benefits of the devices. Findings were presented on the *subject*, showing the element to be comprised of professional development and personal beliefs of participants. A less influential element on mediation of the activity system was *community*.

CHAPTER SIX: DISCUSSION

6.1 Chapter introduction

In this chapter, the findings from the study are discussed. The research question was *How does the activity system mediate primary teachers' use of tablet technologies in junior primary classrooms?* The chapter begins with a description of how key ideas from the Literature Review (Chapter 2) fit with the teacher activity system described in the Findings (Chapter 5). A model integrating the literature and findings is presented. The findings from each element of the activity system within the integrated model are discussed. Finally, a second model is presented, incorporating the findings from this study into the model first presented, linking the literature, theory and findings.

6.2 The literature and the theory

The purpose of this study was to understand the mediation of the teacher activity system on the use of tablet technology in junior primary classrooms. In the Literature Review (Chapter 2), studies by Ertmer (1999) and of Hew and Brush (2007) were highlighted as prominent, oft-cited research into barriers and enablers of ICT in classrooms (Kim et al., 2013). Ertmer (1999) described barriers in terms of first and second order, where first order barriers are extrinsic to teachers' control, such as availability of hardware, and second order barriers as intrinsic to teachers, such as personal beliefs. Hew and Brush (2007) agree that there are factors both intrinsic and

extrinsic that create hurdles for teachers to integrate ICT in their classrooms, however they grouped barriers into six categories. They are Resources, Institution, Subject Culture, Attitudes and Beliefs, Knowledge and Skills and Assessment.

In the Theory Chapter, the teacher activity system was described. This was based on the activity system proposed by Engeström (1999) that acknowledges cultural historical effect on motivation for collective activity. The *subjects* in the activity system in this study were four junior primary teachers, whilst the cultural tools, or mediating artefacts were iPads. The *object* in this study is the use of the cultural tool (iPads) in junior primary classrooms. The activity system considers what the *object* of subjects' activity is; mediated not only by the cultural tool, but also by *rules*, *community*, the *division of labour* and the subjects themselves. The discussion of findings highlight the *outcome* of the collective behaviour mediated by elements of the activity system (subject, mediating artefact, rules, community and division of labour). That is, the object of activity is the use of iPads in junior primary classrooms, and, in the activity system, the outcome "is the end result of the activity" (Yamagata-Lynch, 2010, p. 2) - whether or not iPads are used, and why. This therefore addresses the research question: *How does the activity system mediate primary teachers' use of tablet technologies in junior primary classrooms?*

The literature demonstrated that integration of iPads for use in junior primary classrooms is thought to be dependent on barriers and enablers. The findings of this study also suggest that participants experienced barriers and, to some extent, enablers,

when considering using iPads, both as a teacher tool and as a learning tool. To interpret the findings and understand how elements of the activity system mediate teacher use of tablet technologies in junior primary classrooms, it is necessary to examine the relationship between established barriers and enablers and activity theory.

Whilst Hew and Brush (2007) categorise barriers to ICT integration into six areas, they state that “in reality the barriers are related to one another” (p. 231). For example, *teacher beliefs* about the potential of tablet technology to enhance educational outcomes are connected to technological pedagogical content *knowledge and skills* (TPaCK) (Saudelli & Ciampa, 2014). Teacher knowledge and skills can influence teacher attitudes and beliefs and lead to increased technology integration in classrooms, but that is not a guarantee (Kim et al., 2013). Ertmer (2005) says that “two teachers who know the same things about technology might believe different things about its use” (p. 4).

In an attempt to examine how established barriers (and enablers) to ICT integration in classrooms might fit into the teacher activity system of the current case study, I have integrated the graphical model of the activity system developed by Engeström (1999) with a Hew and Brush (2007) model depicting the relationship between barriers. Further, I have shown the barriers as extrinsic, first-order or intrinsic, second-order barriers to acknowledge the work of Ertmer (1999). This integrated version is shown at Figure 9.

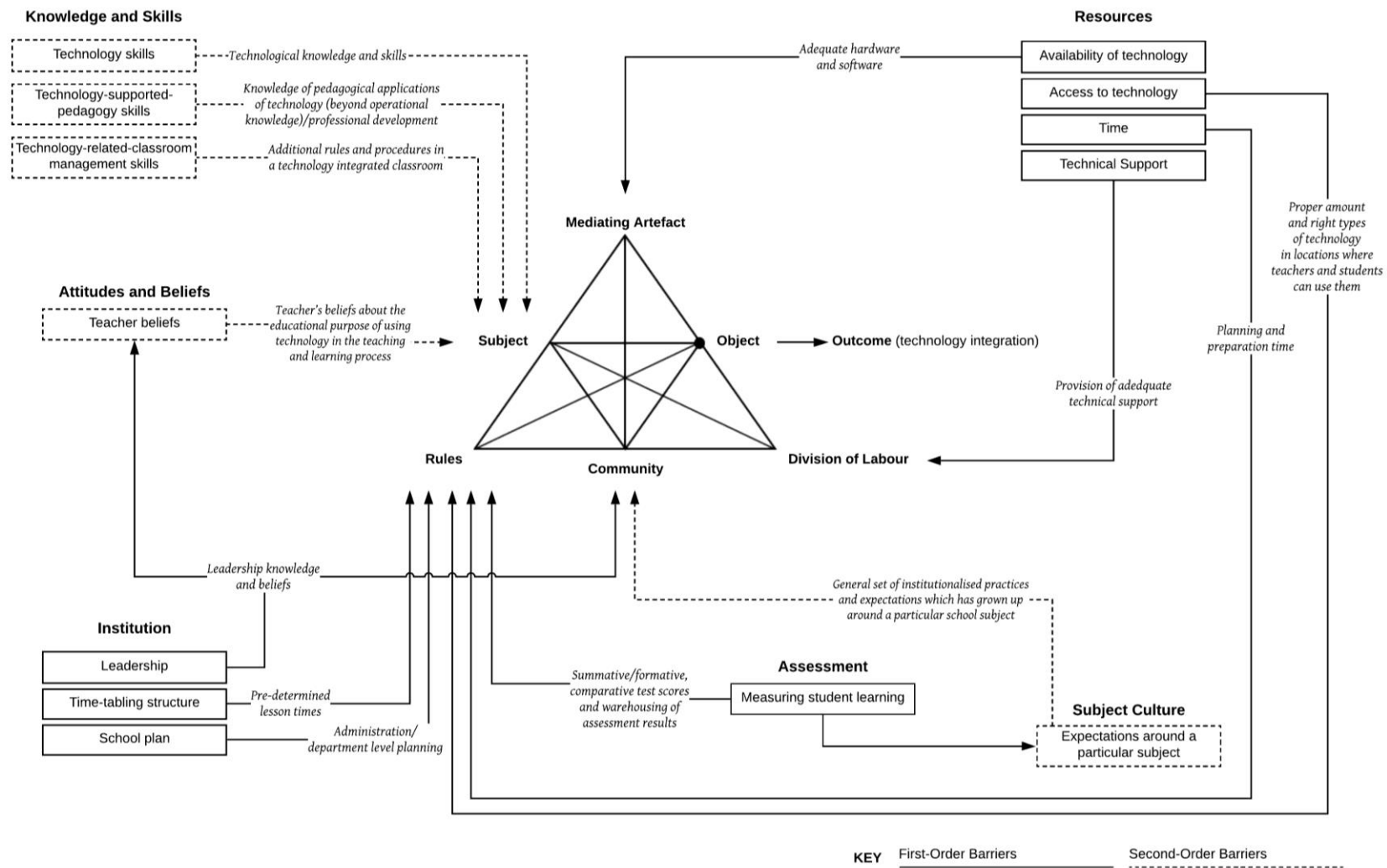


Figure 9. Barriers to Technology Integration in the Classroom overlaid to an Activity System

Note. Adapted from Engeström (1999); Ertmer (1999); Hew and Brush (2007).

The ideas from both Ertmer (1999) and Hew and Brush (2007) referred to in the integrated model pre-date the inception of tablet technologies for commercial sale (the iPad debuted in 2010). As discussed in the Literature Review (Chapter 2), recent studies suggest the barriers and enablers identified in both studies are still considered relevant and relatable to tablet technologies (Hur et al., 2016; Liao et al., 2018; Vu et al., 2014). In part, the findings of this study support this, and will be discussed in detail in the following sections of the chapter. When considering the findings from an activity theory stance, these established barriers are perhaps too specific to individuals.

The use of activity theory in this project enables the analysis of the collective activity system; the four participating teachers of junior primary classrooms. The “societal and collaborative nature” (Engeström, 1999, p. 30) of the subjects in the activity system is considered, in which the societal context is recognised as a “dynamic...internally contradictory formation” (Kuutti, 2007, p. 373).

Internal contradictions in the activity system can be seen as tensions (Yamagata-Lynch, 2010), but tensions do not equate to problems (Engeström, 2001). Rather, contradictions are precursors for the precipitation of change in activity:

As the contradictions of an activity system are aggravated, some individual participants begin to question and deviate from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort (Engeström, p. 137).

Essentially, it is the identification and exploration of these contradictions that provide the opportunity to facilitate change in practice to alter the outcome of the activity system (Ellis, 2008).

I propose that key findings of this study identify a contradiction between the *division of labour*, the *rules* and the *object* when considering the nature of the teacher activity system as experienced by junior primary teachers using iPads in Prep to Year Two classrooms. This contradiction will be discussed after examining the mediation of individual elements on the activity system.

6.3 Subject in the activity system

The integrated model proposes that *Knowledge and Skills* along with *Attitudes and Beliefs* influence the subjects' mediation of the activity system. As described earlier, the combined technical knowledge and skills of teachers, along with their personal beliefs, are established enablers or barriers of ICT in the classroom (Chen et al., 2009; Ertmer, 1999; Hew & Brush, 2007). It has been established that whilst knowledge and skills is a second-order barrier that can be overcome with appropriate professional development (Blackwell, Lauricella, Wartella, Robb, & Schomburg, 2013; Lowther et al., 2008; Makki, O'Neal, Cotten, & Rikard, 2018), first-order barriers stemming from teacher beliefs and attitudes about technology in the classroom are more difficult to overcome, even when second-order barriers are diminished or removed (Ertmer, 2005).

The findings of this study show that both the beliefs and the skills of the teachers influenced the activity system. The findings also demonstrate a clear delineation being drawn between technological skills and pedagogical technological knowledge. This echoes research presented in the Literature Review (Chapter 2), citing the work of Blackwell (2013), who noted that whilst teachers in her study were able to familiarise themselves with tablet technology for personal use, they “did not know how to integrate the device in more innovative ways appropriate for an educational environment” (p. 14).

The data suggests that participants were using iPads comfortably from a technical skill point of view to varying degrees. It is important to note that whilst the participants saw potential for the devices to help them meet academic outcomes, none of the teachers had clear ideas about how to implement the devices in a specifically pedagogical manner. Each teacher’s TPaCK, their Technological Pedagogical Content Knowledge (Mishra & Koehler, 2006), is also an established enabler or barrier to ICT integration in the classroom, with Burden et al. (2012) stating a clear need to assist “teachers to explore and better understand the complexities and subtleties of pedagogical affordances when applied to mobile technologies like the iPad” (p. 30).

The reported findings show that for participant Lauren, a lack of confidence in her TPaCK was a barrier to use. Whilst she stated she used iPads in small group literacy sessions, her own use of the teacher allocated device was generally limited to its camera function. Leah and Brooke had said that if they had more time to develop their

TPaCK, they would likely be able to better integrate tablet technology into their lessons, indicating their level of TPaCK at the time of data collection was also presenting a barrier to use.

In the findings chapter, Scott's technical knowledge was presented. The findings stated that he was using tablet technology in a variety of ways, including as a research, presentation, recording and assessment tool, in addition to iPads for skill practice and consolidation in small group learning situations. Whilst Scott specifically stated that he spent time following up on tips and advice from the ICT Coordinator (in order to develop his TPaCK), he still believed there were "knowledge gaps," particularly when it came to pedagogical understanding for the use of iPads to assist in achieving educational outcomes.

In terms of collective behaviour, these findings show that gaps in the TPaCK of the subjects creates a tension between the subjects and the intended outcome of the activity system – the use of iPads in junior primary classrooms.

Beliefs of the four participants in this case study showed that they believed in the potential for tablet technology to support and enhance their classroom programs. Blackwell et al. (2013) found that "if a teacher had strong agreement that technology can benefit children's learning, teachers used technology more often" (p. 317). Participants in this study were positive about the devices being both portable and connected to the Internet, and all stated that the devices were intuitive to use and

engaging for the students in their classes. Despite this, the findings demonstrate a lack of surety from participants on how to use those features in a pedagogically beneficial way, citing a lack of formal development and minimal iPad-specific professional dialogue between peers. As such, the findings from this study do not support the findings of Blackwell et al. (2013), and the tension between the subject and the object is reinforced.

6.4 Mediating artefact in the activity system

In activity theory, a key concept is the role of an artefact, or tool, “a material object that has been modified by human beings as a means of regulating their interactions with the world and each other” (Cole, 2007, p. 90). These tools have inherent cultural-historical context, in that they are iterations of previous tools used in, and understood by, persons in the cultural environment, or activity system (Cole, 2007). The findings show that the subjects in the system viewed tablet technology precisely as a newer version of a technological tool for use in their educational situations. The findings chapter reported that teachers in this case study specifically recognised iPads as a tool at their disposal to help them and their students for research, for recording and presenting learning, and for consolidating learning. This finding shows that the participants did not view tablet technology as an essential part of the teaching and learning programs, but as something that could be used, if it were available. Figure 10 highlights the use of the word ‘tool’ in the data, within a context of seven words:

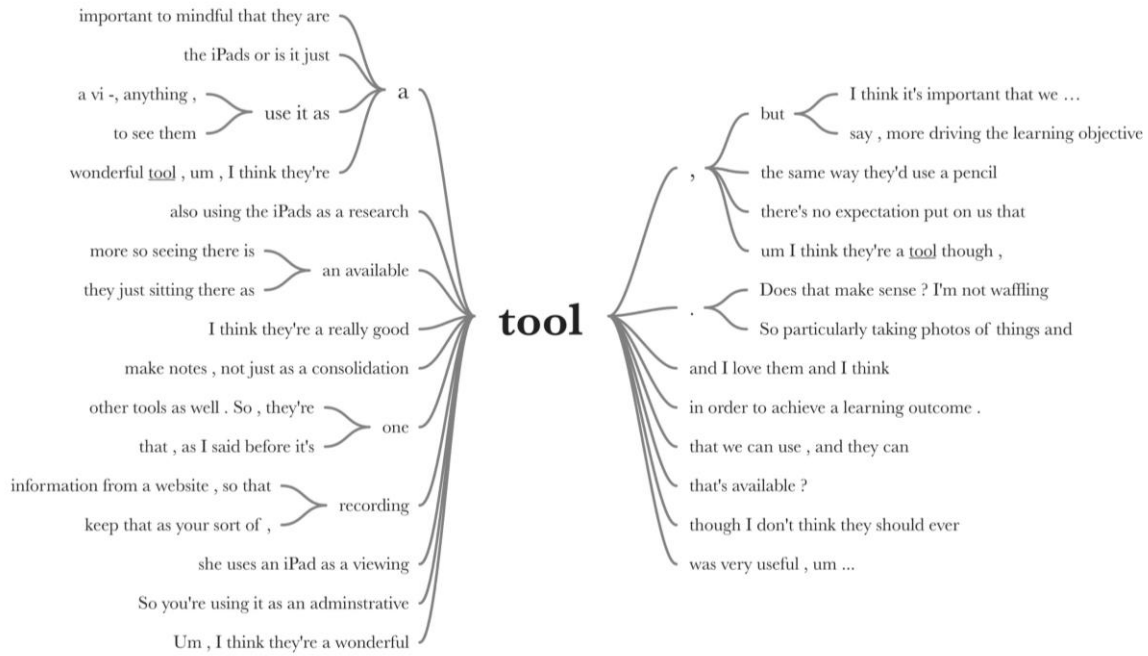


Figure 10. Participants' use of the word 'tool' (within context of seven words).

In addition to showing how participants were using iPads for teaching and learning, Figure 10 shows participant attitudes towards the technology. Overall, teachers found the devices appealing and reported their students did too. This was highlighted in the Literature Review (Chapter 2), where it was reported that the portable nature of iPads (especially in comparison to desktops and heavier laptops) combined with Internet connectivity, had been found to make the devices appealing to educators for use in the classroom (Brice, 2011; Mathis, 2010; Pitcher, 2010). The findings reported in this study support this, with teachers highlighting the ease of which Internet-enabled devices could be transported by their junior primary students.

Participants reported they found the colourful and responsive touch screens of the devices appealing for their young students. This suggests that the attributes of the

mediating artefact itself present as an enabler to their use in the junior primary classrooms in this study. In fact, all teachers stated that they would be likely to use the technology more often if devices were permanently allocated to their classrooms. The teachers in the study said this would help them not only to plan for use of iPads in their work program, but to also make more incidental use of the technology. This demonstrates that a lack of technology permanently available in the classroom is a hurdle to integration, both planned and spontaneous.

The integrated model at Figure 9 shows that availability of technology, specifically adequate hardware and software, is a known barrier (Hew & Brush, 2007), with Ertmer (1999) noting that technology integration in the classroom is dependent “on having sufficient access to hardware (p. 50)”. The findings of this study support this, with a tension between the tool and the rules influencing the activity system.

6.5 Rules in the activity system

The findings show that whilst the school had purchased a number of iPads, devices were not pooled into one large resource. Rules regarding allocation of devices to particular classrooms dictated that five iPads would be available between pairs of classrooms. When participants in the study required a greater amount of technology in the classroom, the findings show they incorporated a teacher device and desktop computers into lessons, or, in the case of Scott, sourced extra devices such as laptops. Participants in the study stated that they would make more use of tablet technology

were more devices available for use. In the activity system, this finding links with the tension between the artefact and the rules discussed in the previous section.

Further to the rules dictating that sets of iPads were to be shared between pairs of classrooms, there were rules about the storage of iPads in central, non-classroom locations that presented a barrier to use. Hew and Brush (2007) make an observation that whilst a school may have sufficient quantities of technology accessible for teachers and students, access also means “the proper amount and right types of technology in locations where teachers and students can use them (p. 226)”. The activity system in this case study shows that it is this specific access requirement that appears to be presenting a barrier to wider integration of tablet technology in junior primary classrooms. Whilst access to technology could potentially link to the mediating artefact at Figure 9, I have specifically linked to rules in the activity system, given that the number of devices available for teachers to use is governed by rules set by the leadership team.

Figure 9 shows a number of barriers to technology identified by Ertmer (1999) and Hew and Brush (2007) that could influence the ways in which rules mediate the activity system. The findings of this study show that access to technology is significant, that is, the “proper amount and right types of technology in locations where teachers and students can use them” (Hew & Brush, 2007, p. 231). Rules concerning time are of note in the data, but connect specifically to the provision of technical support, and will be discussed in conjunction with the division of labour.

Other factors identified in Figure 9 that could specifically influence how rules mediate the activity system are of lesser note in this study.

6.6 Community in the activity system

As reported in the findings chapter, the influence of community on the teacher activity system was minimal. In terms of leadership influence on the type and quantities of tablet technologies provided, participants responses to interview questions came with nonchalance. All stated, without discord, that purchasing decisions were top-down and that classroom teachers were not consulted on such decisions, although they believed there would be an avenue to provide an opinion should they wish to do so.

Interestingly, there were differences of opinion between participants when it came to expectations regarding use of iPads in their classrooms. One of the participants stated she felt obligation to use them in her lessons due to the money the school had outlaid on purchasing, whilst another saw them only as an available tool, to be used – or not – as needed. The Literature Review (Chapter 2) stated that principal beliefs held influence on ICT integration in schools (Maher & Twining, 2017; Otto & Albion, 2002; Vu et al., 2014). The data from this study is inconclusive as to the direct influence of the school Principal on the mediation of the activity system, due to a lack of expansive responses to questioning in this area during interviews.

6.7 Division of labour in the activity system

The findings show the division of labour to be of significance on the mediation of the teacher activity system. Notable is tension in how labour is divided between the classroom teachers and the school's ICT Coordinator. To have new software applications put onto student iPads, teachers are required to put a request in to the ICT Coordinator to purchase and install the apps. The teachers in the case study found this process to be a barrier to iPads integration in the classroom, with the data indicating that this was due to the timeframe required for the process to be completed. Time was mentioned in the data as influencing the activity system in two ways. One, because the time taken to have apps installed presented a barrier for teachers to conduct any short-term planning that would incorporate the use of new apps they wanted to use in their lessons; and two, the amount of time available to the ICT Coordinator to spend installing software on behalf of the classroom teachers.

A lack of time for technical support to meet demands is a known barrier for ICT integration in the classroom (Cuban, Kirkpatrick, & Peck, 2001; Ertmer, 1999; Hew & Brush, 2007). Whilst for the classroom teacher "the focus of integration is on pedagogy - effective practices for teaching and learning" (Earle, 2002, p. 10), research shows the "ICT Coordinator still functions dominantly in the role of technician" (Devolder, Vanderlinde, van Braak, & Tondeur, 2010, p. 1654).

The teachers in this study had indicated they believed they would be able to make more use of iPads in their junior primary classrooms if software were able to be

installed quickly. Although teachers were technically able to install the software themselves, rules pertaining to the division of labour precluded classroom teachers from having control of the software installation process, leaving them reliant on technical support to have apps downloaded onto student iPads.

6.8 Rules and division of labour in the activity system

The findings show that the classroom teachers felt supported by the school's ICT Coordinator but cited a lack of time in general as a key factor for the turnaround time for software installation. The school's ICT Coordinator was not a participant in this study, as the focus was on the activity system of junior primary classroom teachers. As such, the specific reasons rules regarding time influence the division of labour, between the classroom teachers and the ICT Coordinator, relies on the views of the participants.

As presented in the findings, two of the teachers reasoned these rules to be in place due to licensing requirements that restricted classroom teachers from being able to purchase software at a bulk level. Application stores, such as the Apple Education Store in Australia, require a select number of staff (often one) to represent and complete purchasing on behalf of an organisation (Apple Inc., 2014). In the case of the school in this study, only the ICT Coordinator and (non-teaching) technicians have access to the Apple Education Store for the purposes of volume purchasing.

The literature says that teachers need to be equipped with the knowledge and skills that enable them to integrate ICT into their classrooms. The reality of this case study shows that teachers do have many of the technological skills required to use tablet technologies in their classrooms. They are capable of installing software, as evidenced in the findings that show they have budgetary allowance and sufficient technological administrative privilege to add apps to a single, teacher-allocated device.

Therefore, whilst the teachers in this case study have the technological understanding required to install software to meet the learning goals of the individual students in their classrooms, they are not allowed to according to the rules. Essentially, the rule determining that this task is given to the ICT Coordinator according to the division of labour in the school, is a contradiction in the activity system. Engeström (2001) describes a potential reason for this contradiction:

When an activity system adopts a new element from the outside (for example, a new technology or a new object), it often leads to an aggravated secondary contradiction where some old element (for example, the rules or the division of labor) collides with the new one. Such contradictions generate disturbances and conflicts, but also innovative attempts to change the activity (p.137).

Thus, in the teacher activity system in this project, the introduction of iPads as a new technology has led to a contradiction with a previous rule stating ICT Coordinators installed software, with classroom teachers now seeking a change in that rule, preferring to divide the labour for software installation amongst themselves.

In addition to only the ICT Coordinator having the administrative privileges to install software on student devices, the findings show a related mediating factor on the activity system. This was the timeframe required for technical support from when classroom teachers request applications be placed on students' devices to the occurrence of actual installation. The teachers stated requiring a party other than themselves to install software rendered it difficult for them to plan and Prepare for lessons incorporating tablet technologies using new applications with any sense of immediacy.

In terms of time, teachers also stated they had little opportunity to research and build their knowledge bank of new apps for future use in their classrooms. A lack of time has been a known barrier to ICT integration for many years now, particularly in terms of available time for teachers to research and learn about options available to them (Cuban et al., 2001; Ertmer, 1999; Hew & Brush, 2007). This influences the teacher activity system in terms of the subjects themselves, that is, their knowledge and skills from the Hew and Brush (2007) model.

6.9 Outcome of the activity system

In this study, the ICT Coordinator is an intermediary between the mediating artefact and the subjects due to the rules regarding software purchasing and installation. I argue that due to this, the outcome of the activity system suggests the role of the ICT Coordinator as an additional barrier to the integration of tablet technology in junior

primary classrooms exists – with this incurred due to Apple Inc.’s expectations about bulk purchasing of apps. To demonstrate, I have adapted my earlier proposed integration of the models of Ertmer (1999), Hew and Brush (2007) and Engeström (1999) to include this new barrier. The updated integrated model depicting barriers to technology integration in the classroom overlaid to an activity system is shown at Figure 11, with additions highlighted in green.

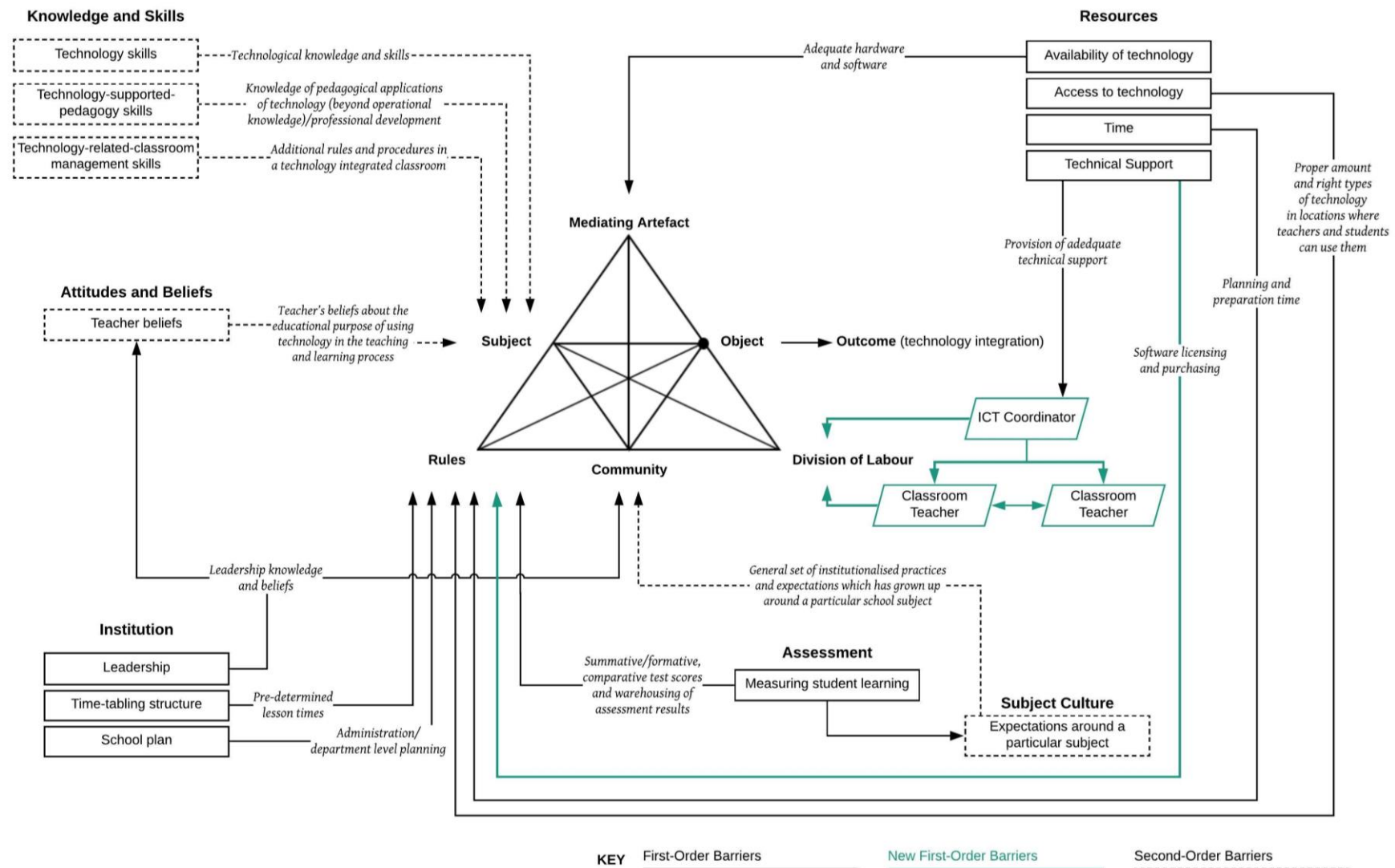


Figure 11. Barriers to Technology Integration in the Classroom overlaid to an Activity System II

Established barriers and enablers to ICT integration identified in the literature and presented in the integrated model (Figure 11) have been confirmed by this study. These include teacher knowledge and skills, teacher attitudes and beliefs, availability of and access to tablet technology. What the first proposed integrated model (Figure 9) did not show was the influence of the division of labour on the activity system. In the first model, technical support fed directly into the division of labour component of the activity system. In the updated version incorporating the findings of this study (Figure 11), technical support leads to the school ICT Coordinator and then demonstrates how the division of labour between the Coordinator and the classroom teachers mediates the activity system, while also referencing software licensing and purchasing as a rule. The updated model further shows how the first-order technical support barrier to ICT integration has been connected to the rules element of the activity system. This is because this study found that it was not a lack of technical capability that presents a barrier to ICT integration for classroom teachers, rather, it is the rules governing who installs software on student tablet devices.

Hew and Brush (2007) stated that “employing a limited number of technical support personnel in a school severely hinders teachers’ technology use” (p. 227). In the case of tablet technologies, I speculate that overcoming the obstacle to ICT integration in this school relies not in the employment or upskilling of extra staff for the purposes of technical support, but attempting to overcome the need for classroom teachers to rely on an administrative process for the downloading of software on tablet devices. In the words of participant Leah: “If I could do it myself, that would be ideal.”

Whilst using models presented by Ertmer (1999) and Hew and Brush (2007) would suggest a lack of time for technical support as a barrier to ICT integration experienced by individual teachers, the use of activity theory allows an examination of collective labour processes. This enables an identification of a contradiction in the activity system. In this case study, classroom teachers have the technical knowledge required to support themselves but are restricted by the *rules*. There is a contradiction in this activity system between the *division of labour*, the *rules* and the *object* – teachers use of iPads in junior primary classrooms. This contradiction in the activity system is shown at Figure 12.

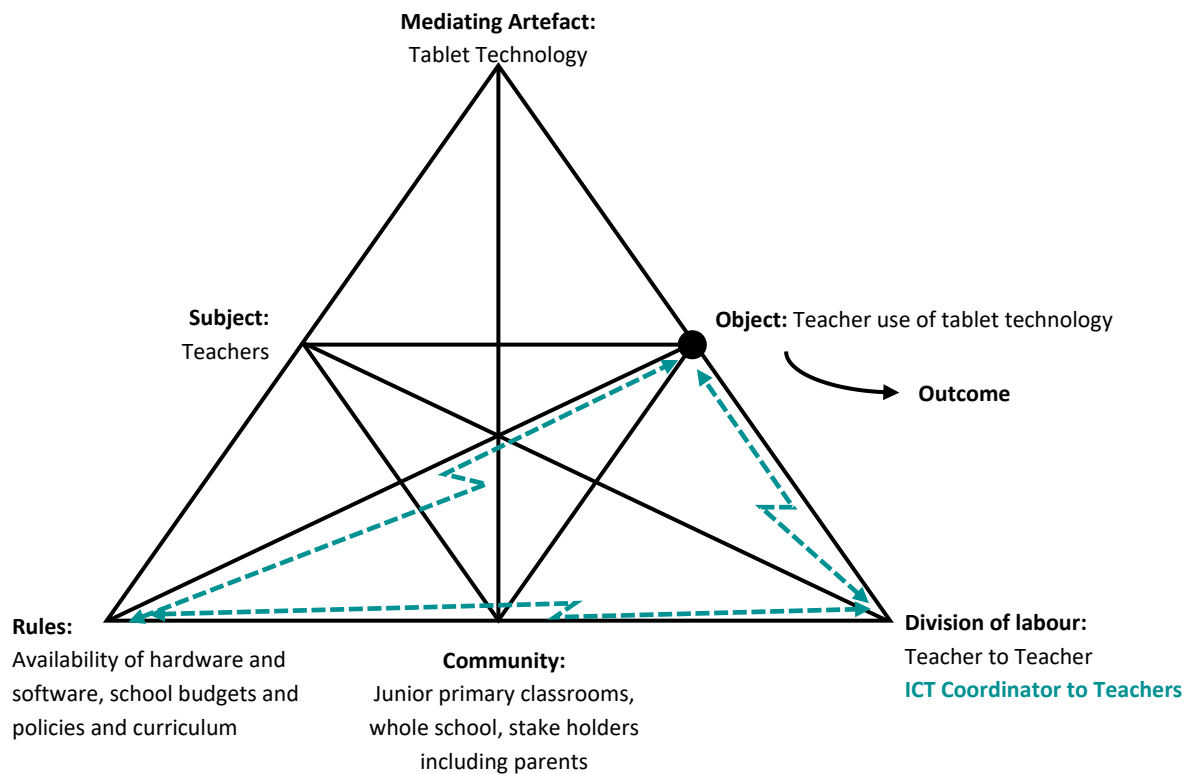


Figure 12. Contradictions in the Teacher Activity System

Adapted from Activity theory and individual and social transformation by Yrjö Engeström (1999) in Y. Engeström, R. Miettinen & R. Punamäki-Gitai (Eds.), *Perspectives on activity theory* (pp. 19-38). Cambridge: Cambridge University Press. Copyright 1999 by Cambridge University Press.

The activity system shown at Figure 12 highlights not only the contradictions identified in the activity system in this project, but updates the relationships in the division of labour to include the ICT Coordinator, as per Figure 11. Prior to participant interviews the relationship of the ICT Coordinator and classroom teachers, and the division of labour between the two, had not been given due consideration on its ability to mediate the activity system. This is because the research question asked about the nature of the

experience of the subjects in the activity system, the teachers of junior primary classrooms.

Whilst this project upheld many of the identified barriers to ICT integration in the literature, I argue it is the contradictions in the activity system between the division of labour, the rules and the object that is impactful on the *outcome*. Whilst the work of Ertmer (1999) and Hew and Brush (2007) identifies barriers experienced by individual teachers, the use of activity theory shows that the conflict in achieving the object of ICT integration lies not within individuals and their experiences of barriers, but within the system of activity. The significance of contradictions is that they can be “the driving force of change and development in activity systems” (Murphy & Rodriguez-Manzanares, 2008, p. 443).

The object of activity in this system is the use of iPads in junior primary classrooms. There is a rule in the activity system that states classroom teachers cannot install software on student iPads and distributes the task to an ICT specialist. This rule relates to an organisation external to the school, in that the software provider, Apple Inc., offers volume purchasing so multiple copies of software can be installed, but restricts the number of staff with access to the store. Thus, this dictates how labour is divided amongst the teachers and ICT Coordinator at the school, causing a contradiction that mediates activity and impacts achievement of the object.

With a contradiction in the system hindering the object, the mediational outcome of the activity system is that teachers are less likely to use iPads as the artefact effectively.

6.10 Chapter conclusion

In this chapter, ways in which key themes from the literature fit within the theoretical framework used in this study were described. The ideas were presented as a diagrammatical model integrating the established first-order and second-order barriers to ICT integration in classrooms with the model of an activity system. The findings of the study were considered in terms of the integrated model and their influence on mediation of the teacher activity system. The discussion of the findings leads to an argument for an additional barrier to be added to the integrated model. This addition is based on the influence of the rules regarding purchasing and installation of software for student tablet devices and how the labour for the provision of this is divided. An updated integrated model depicting the addition of newly argued influencing factors on the division of labour and rules in the mediation of the teacher activity system was presented. Finally, contradictions in the activity system were identified.

CHAPTER SEVEN:

CONCLUSION

7.1 Chapter introduction

This chapter begins with an overview of the research project. The relationship between the project and existing research that was presented in the Literature Review (Chapter 2) is identified. Next, new insights this study can contribute to the understandings of ICT integration in schools are offered, followed by the implications of these for teaching practice. Limitations of the project are outlined and then possible areas for further research in the field are suggested.

7.2 Overview of the research project

The aim of the study was to explore teachers' use of tablet technology in lower primary classrooms. The research question guiding the study was "*What is the nature of the activity system experienced by teachers using iPads in junior primary classrooms?*" The project was undertaken as a case study of a Catholic Primary School in Melbourne's eastern suburbs that had a bulk set of school-purchased iPads available for classroom use. Four teachers participated in the study, each having implemented tablet technology in their classrooms as a tool for both student and teacher purposes to varying degrees. Cultural historical activity theory and the use of a teacher activity system provided the lens through which the participants' implementation of iPads was examined.

The teacher activity system was adapted for use from the model of activity proposed by Engeström (1999). This theoretical perspective has its roots in the work of Soviet

school of psychology, in particular the work of Vygotsky (1978), who determined collective human behaviour to be mediated through the use of cultural tools, both linguistic and tangible.

In this study, the cultural tool was the Apple iPad branded tablet device. The subjects in the study were the participating junior primary classroom teachers. The interview questions were designed around elements of the activity system, being the *mediating artefact* of the iPad, the *subjects* themselves, and also the influence of *rules*, *community* and the *division of labour* had on mediation of the activity system. Data arising from participant interviews was coded around these elements of the activity system. Findings were reported based around the elements of the teacher activity system, and the interconnected roles the elements had on determining collective behaviour, in this case use (or non-use) of iPads in junior primary classrooms.

A discussion of the findings was presented, with an integrated model to demonstrate how the existing literature fits with the theoretical model of cultural-historical activity theory (Figure 9). After a discussion of the findings, a new version of the integrated model was presented (Figure 11), incorporating additional ideas regarding barriers to ICT integration that the study identified around rules and the division of labour between classroom teachers and the school's ICT Coordinator.

Next in the discussion, this additional barrier to ICT integration was considered from a collective behaviour perspective, in keeping with the theoretical model. The activity system shows that there are contradictions in the relationships between the division of labour, the rules and the outcome. The identification of this provides insight into the

nature of teachers' experiences of the teacher activity system and the manner in which the contradictions between the rules, the division of labour and the object mediate the activity system. The outcome is that iPads are potentially not being integrated in junior primary classrooms in this school as often as they might be were the contradictions resolved.

7.3 Relationship of this project to previous research

This project was undertaken with an objective to understand the nature of the teacher activity system experienced by junior primary teachers using iPads in junior primary classrooms. The Literature Review (Chapter 2) demonstrated that use of Information Communication Technologies (tablet and other technologies included) in classrooms is influenced by barriers and enablers, both extrinsic and intrinsic to the teacher. In discussing barriers to ICT integration in school classrooms, the work of Ertmer (1999) and Hew and Brush (2007) is widely acknowledged (Kim et al., 2013). Barriers influencing ICT integration were identified by Ertmer in 1999 and built upon by Hew and Brush in 2007. Apple branded tablet devices known as iPads were introduced to the Australian market in 2010, and, by 2016 were recognised as “the dominant mlearning tool in education” (Young, 2016). In the Literature Review (Chapter 2), it was acknowledged that whilst the research undertaken by Ertmer and Hew and Brush was conducted prior to the introduction of tablets, the barriers to ICT integration they identified are applicable to the use of iPads in classrooms (Hur et al., 2016; Liao et al., 2018).

In this study, some of the established barriers to ICT integration were determined to be influencing the activity system, with findings including:

- Without clear and permanent access to devices, opportunities for planned and incidental use of tablet technology was hindered
- The quantity of devices available for use limited whole class integration
- Insufficient time available for the provision of technical support to install software prevented integration of tablet technology
- More time for professional development of teacher technological and pedagogical content knowledge (TPaCK) with regard to iPads was desired

The identification of these barriers to ICT integration are consistent with established research that was presented in the Literature Review (Chapter 2).

7.4 New insights offered by this project

A new insight to barriers to ICT integration that this study can offer concerns classrooms teachers' technological capability to install software themselves. Analysis of the data found multiple references to this. Participants in the study stated that they would like to install software on student devices themselves, and the findings showed the participants believed they would use tablet technology more in their classrooms if this were the case. The technological capabilities of the teachers to do so was evident, as they could install software on devices allocated for teacher use.

According to rules in the activity system, only the ICT Coordinator could install software on student devices, in line with expectations from Apple. In the Discussion (Chapter 6), it was suggested that this was due the ICT Coordinator having access to a

volume purchasing program that the classroom teachers did not have. The teachers in the study indicated this impacted their decision making when planning to use iPads in their classrooms. This was because the requirement to have someone other than themselves install software meant there was a time delay between wanting to use a new app on student devices and having the installation process completed.

Existing research on barriers and enablers outlined in the Literature Review (Chapter 2) focuses on individual teachers, be they barriers considered internal to or external to the teacher. The use of activity theory in this project required examination of the teacher participants as a collective whole. This provided insights into contradictions in the activity system and led to the identification of the barrier presented by the contradictions between the division of labour, the rules and the object of the activity.

This study provides new insight into the complexities of use facing educators integrating iPads in junior classrooms beyond the identification of individualistically-attributable internal barriers (for example, attitudes) and other established external barriers, such as access.

The use of activity theory in the field of educational research is becoming more evident (Engeström, 2016). Engeström notes that the second-generation activity model of activity is “frequently applied as a graphic model and lens” (p. vii) through which data is mapped, as is the case in this project. He suggests that this is useful for the purposes of educational research seeking to gain an overview of the behaviour in context, but

that the application of third generation activity theory is desirable to better understand the connectedness of one activity with another (Engeström).

The results of this project suggest further research could be undertaken to examine the impact of contradictions in activity systems on the outcome of ICT integration, rather than focusing on the internal attributes of individual teachers, as the models presented by Ertmer (1999) and Hew and Brush (2007) do. Castro (2016) notes that the barriers to ICT integration identified by Hew and Brush number in excess of 100, and that focusing on the individual as the unit of study leaves the onus on the teacher to be “the frontier for applying technological innovations to the teaching and learning process” (p. 7232). Whether this onus is fair, or even pragmatically possible, to be addressed by teachers at the individual level is a worthy question. The use of activity theory instead allows examination of the subject within the cultural context, and, in this case, has allowed identification of contradictions in the wider social-cultural environment that the subjects experience. This means accountability for effective iPad use in the junior primary classroom may be more addressed systematically.

7.5 Limitations of the project

The way in which activity theory has been used with this study may be a limitation. Second generation activity theory was used in the project as a framework for mapping the data. While this is an appropriate use of activity theory, third generation activity theory could have been used for further analysis on the contradictions. The study of interacting activity systems is a characteristic of the third generation of activity theory, where at least two interacting systems are the focus of analysis (see Engeström, 1987).

Contradictions are 'historically accumulating structural tensions within and between activity systems' (Engeström, 2001, p. 137). However, this project has been undertaken to fulfil the requirements of a Master of Education, which in itself provides a limitation in word count; suggesting a fuller analysis of the activity system using third generation activity theory is likely beyond the scope of this project.

Further, the study is limited because it is not representative of an entire school system, it is a snapshot of an activity system, focussed on four participants teaching junior primary classes in a single case study.

7.6 Recommendations for further research

This study sought to understand the nature of the activity system experienced by teachers using iPads in junior primary classrooms. A finding was determined that a barrier is presented where control of volume purchasing of software applications resides with someone other than the classroom teacher. Further research could be directed towards understanding what occurs within the system when joint efforts are made to address the contradiction between division of labour and the rules in this instance. This would be important to establish relative to the outcome, whereby iPad use by junior primary classroom teachers was found to be limited by the contradiction in the system.

7.7 Implications for teaching practice

Identification of the contradiction in the activity system between the rules and the division of labour that prevents classroom teachers from being able to install apps

presents a challenge. The study has demonstrated that classroom teachers have the technological capability of doing this for themselves, and indeed have budgets for purchase and installation of apps on devices specifically allocated for teacher use. The implication of the findings is that to resolve tension in the activity system, alterations in the division of labour and the rules are required. That is, a resolution is needed that will satisfy both the rules governing access to software purchasing programs and the classrooms teachers' desires to change the division of labour so they can self-install software on student iPads, thereby improving iPad integration in junior primary classrooms in this school.

Engeström (2001) says that the identification of tensions and contradictions become the “driving force of change in activity” (p. 133). Suggestions for how to address contradictions in the activity system in this case study include working with the school leadership team to identify possible changes in the division of labour, teachers liaising directly with the ICT Coordinator to explain how the current division of labour mediates the use of iPads in their classrooms, and/or leadership team and teachers' better understandings of the expectations of Apple Inc. around volume purchasing of software. These interventions might lead to better outcomes for the integration of iPads in classrooms.

7.8 Chapter conclusion

This chapter provided a revision of the project, its use of second generation activity theory as a model for mapping the activity system of a small group of teachers in junior primary classrooms. The project examined the nature of their experiences integrating

iPads as teacher and student tools into their work practice. Links to literature reviewed earlier in the project were made, with barriers to iPad integration affirmed by the study. The chapter highlights new insights offered by the project, namely the identification of a contradiction between rules in the activity system and the division of labour. In summary, rules regarding the division of labour allocating the role of software installation to a designated Coordinator at times presented a barrier to subjects achieving the object of their activity – integration of iPads into their classroom teaching practice. Acknowledgements of limitations of the study were made, in particular, the choice to use second generation activity theory rather than third generation. A recommendation to broaden the scope of the study was made, along with a suggestion to make a comparison with a school with an alternative structure to the division of labour in place where rules allowed subjects in the activity system to purchase and install software on student devices. It is suggested that an implication of the study for teaching practice is the need to consider technological capabilities of the subject when determining rules and the division of labour. Finally, the chapter concludes by reminding readers that activity theory considers the social context of collective behaviour, and may be a better model for understanding the broader context of barriers to ICT integration in education than attributing internal and/or external barriers to individual teachers.

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- Young, K. (2016). Teachers' Attitudes to using iPads or Tablet Computers: Implications for Developing New Skills, Pedagogies and School-Provided Support. *TechTrends*, 60(2), 183-189. doi:10.1007/s11528-016-0024-9

Appendices

In order, are the following appendices:

- 8.1 Letter sent to Principal asking permission to conduct research in a school
- 8.2 Copy of Principal consent form
- 8.3 Copy of information letter sent to participants
- 8.4 Copy of participant consent form
- 8.5 Prepared guiding questions for participant interviews
- 8.6 Australian Catholic University Human Research Ethics Committee Approval Form
- 8.7 Catholic Education Office approval to conduct research in a Catholic school

8.1 Letter sent to Principal asking permission to conduct research in a school

[Addresses Redacted]

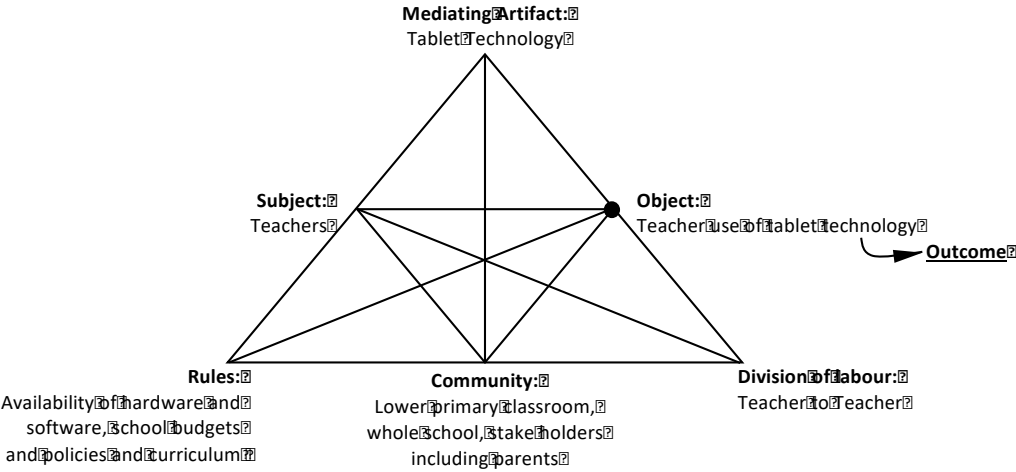
Dear [Principal],

My name is Nyree Clyne, I am a primary teacher at [school redacted] and am presently working towards obtaining a Master Degree in Education by Research. My research investigates Prep to Year 7 wo teachers' decision making concerning the use (or non use) of iPads/other tablets in their classrooms. Student participation is not required and no data pertaining to students will be collected. I am hoping you and your lower primary staff might be amicable to me conducting my research at [school redacted].

Your P-2 teachers would be invited to participate in two interviews, a one-on-one meeting and then a group session. Each interview should take less than an hour, therefore the maximum time commitment for most participants would be no more than two hours. The audio from the interviews will be recorded on an iPhone or iPad using dictation software.

Participation is voluntary and the teachers involved can withdraw at anytime. The teachers will be given pseudonyms for the purpose of storing the data so as to ensure that individuals will not be identified and findings will only be reported as a collective.

Specifically I am using a framework known as Activity theory to underpin my work which I have adapted for use as a 'teacher activity system'. Teachers will be introduced to the concepts behind the activity system by way of a diagram, and prompted to discuss particular influences on their motivation to use iPads in their classroom. The diagram is as follows:



This study has been granted approval from both the Australian Catholic University Human Research Ethics Committee and the Catholic Education Office of Melbourne, as per attached documents.

?

I have attached a copy of the Participant Information Letter, which outlines the study for the teachers. If they agree to participate I am hoping they can sign the Consent Forms and return the Researcher copy to [ICT Coordinator], which I will arrange to collect. I am flexible with interview times and will work with you and your staff to arrange meetings at your convenience.

?

Should you wish to discuss the project further with either myself or my supervisors, please do so. My supervisor contact details are as follows:

?

- ☐ Associate Professor Suzy Edwards (Principal Investigator) at Australian Catholic University, St Patrick's Campus Melbourne (contact details redacted)
- ☐ Dr Donna Gronn (Co-Supervisor) at Australian Catholic University, St Patrick's Campus Melbourne (contact details redacted)

?

I am happy to arrange a time should you like me to invite your staff to participate in person. If either you or [ICT Coordinator] are happy to do so on my behalf, could you please provide each of the Prep, One and Two teachers with the Participant Information Letter and Consent Forms. I have included the relevant number of copies. It is not necessary to discuss the Teacher Activity System I have outlined with them at this time, I will do this at the beginning of each interview. I will telephone in the next few days to follow up.

?

?

Thanking you for your time.

?

Yours Sincerely,

?

?

?

Nyree Clyne

?

8.2 Copy of Principal consent form



PRINCIPAL CONSENT FORM *Copy for Researcher to Keep*

TITLE OF PROJECT: Teachers and iPads in Prep to Two

SUPERVISOR: Associate Professor Suzy Edwards

STUDENT RESEARCHER: Mrs Nyree Clyne

I (the Principal) have read (or, where appropriate, have had read to me) and understood the information provided in the Letter to Participants. Any questions I have asked have been answered to my satisfaction and I agree for St Bede's of 2 Marwal Ave, Balwyn North, to participate in this project.

I realise that I can withdraw my consent at any time (without adverse consequences). I agree that research data collected for the study may be published or may be provided to other researchers in a form that does not identify individual participants in any way.

NAME OF PRINCIPAL:

SIGNATURE DATE

SIGNATURE OF SUPERVISOR: DATE: 19.05.2014.....

SIGNATURE OF STUDENT RESEARCHER: DATE:.....

8.3 Copy of information letter sent to participants



PARTICIPANT INFORMATION LETTER

PROJECT TITLE: Teachers and iPads in Prep to Two
PRINCIPAL INVESTIGATOR: A/Prof Suzy Edwards
STUDENT RESEARCHER: Nyree Clyne
STUDENT'S DEGREE: Master of Education (Research)

Dear Participant,

You are invited to participate in the research project described below.

What is the project about?

The research project investigates factors that may influence the use or non-use of iPads in lower primary classrooms. The study will provide insights into the thought processes of teachers concerning the use of iPads as part of pedagogical practice.

Who is undertaking the project?

This project is being conducted by Nyree Clyne and will form the basis for the degree of Master of Education at Australian Catholic University under the supervision of Associate Professor Suzy Edwards and Dr Donna Gronn.

Are there any risks associated with participating in this project?

There are no anticipated risks associated with your participation in this project. Your name will not be included with the data, a pseudonym will be used and only group findings will be reported. Findings attributable to any particular individual will not be included.

What will I be asked to do?

- The project involves a one on one audio recorded interview that will take less than an hour. Upon completion of all one on one interviews you will be invited to participate in a further audio recorded group interview with your colleagues of around an hour's duration.
- Some participants will be asked if the researcher may observe their use of iPads in the classroom prior to the commencement of individual interviews. The researcher will take notes at this time to help inform questions to be used at the interview stage. Data on your students will not be recorded. If you do not wish to be observed whilst teaching it is still possible to participate in this study.
- The interviews are intended to be an informal discussion on your use of iPads as part of your pedagogical practice. A diagram of suggested influences on the decision to use iPads in the classroom will be provided as an accompaniment to questions the researcher has prepared. The diagram will be explained to you and can be used as a prompt for discussion. You can choose not to answer any question you do not wish to.
- The study will take place at on site at your school.

How much time will the project take?

The total time for each participant in both interviews shall not exceed two hours. For participants whom the researcher observes in the classroom prior to the interviews the total time of involvement in the project shall not exceed three hours.

What are the benefits of the research project?

It is envisaged the outcomes of the study will provide insights into the decision making processes of teachers concerning the use of tablet technology as part of pedagogical practice and assist practitioners in understanding challenges faced by educators when employing mobile technologies. You may find the collegiate discussion that occurs during the interviews supports your professional development.

Can I withdraw from the study?

Participation in this study is completely voluntary. You are not under any obligation to participate. If you agree to participate, you can withdraw from the study at any time without adverse consequences

Will anyone else know the results of the project?

The study will be published in the researcher's thesis forming the Degree of Master of Education. Results of the study may be published in a professional journal and/or presented at education conferences. A copy of the thesis will be provided to the Catholic Education Office of Melbourne, the school at which the research is undertaken, and participants, upon request. Your identity will be protected and a pseudonym will be used to refer to individual responses stored in the data. The data will be stored digitally in a locked cupboard and destroyed five years after the completion of the thesis.

Will I be able to find out the results of the project?

You may request a copy of the thesis upon successful completion.

Who do I contact if I have questions about the project?

If you have any questions about the project, before or after, please contact one of the following:

- Associate Professor Suzy Edwards (Principal Investigator) at Australian Catholic University, St Patrick's Campus Melbourne on +613 9953 3531 or suzy.edwards@acu.edu.au
- Dr Donna Gronn (Co-Supervisor) at Australian Catholic University, St Patrick's Campus Melbourne on +613 9953 3284 or donna.gronn@acu.edu.au
- Mrs Nyree Clyne (student researcher) njdrum001@myacu.edu.au

What if I have a complaint or any concerns?

The study has been reviewed by the Human Research Ethics Committee at Australian Catholic University (review number 2014 140V). If you have any complaints or concerns about the conduct of the project, you may write to the Manager of the Human Research Ethics Committee care of the Office of the Deputy Vice Chancellor (Research).

Manager, Ethics
c/o Office of the Deputy Vice Chancellor (Research)
Australian Catholic University
North Sydney Campus
PO Box 968
NORTH SYDNEY, NSW 2059



Ph.: 02 9739 2519
Fax: 02 9739 2870
Email: res.ethics@acu.edu.au

Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

I want to participate! How do I sign up?

If you agree to participate, please sign the attached consent forms and return the *Copy for Researcher to Keep* to the ICT Coordinator at your school.

Yours sincerely,

NYREE CLYNE,
Student Researcher
Australian Catholic University,
St Patrick's Campus, Melbourne.

8.4 Copy of participant consent form



CONSENT FORM *Copy for Researcher to Keep*

TITLE OF PROJECT: Teachers and iPads in Prep to Two

SUPERVISOR: Associate Professor Suzy Edwards

STUDENT RESEARCHER: Mrs Nyree Clyne

I (the participant) have read (or, where appropriate, have had read to me) and understood the information provided in the Letter to Participants. Any questions I have asked have been answered to my satisfaction. I agree to participate in (please tick all that apply):

- ☐ a one hour observation session recorded as researcher notes
- ☐ an audio recorded individual interview of not more than one hour
- ☐ an audio recorded group interview of not more than one hour

I realise that I can withdraw my consent at any time (without adverse consequences). I agree that research data collected for the study may be published or may be provided to other researchers in a form that does not identify me in any way.

NAME OF PARTICIPANT:

SIGNATURE DATE

SIGNATURE OF SUPERVISOR:.....

SIGNATURE OF STUDENT RESEARCHER:.....

DATE: 19.05.2014.....

DATE: 19.5.14.....

8.5 Prepared guiding questions for participant interviews

Component	Possible questions
Mediating artefact: Tablet technology	<ul style="list-style-type: none"> • What role does tablet technology have in your classroom? • What do you see as the driving factors that influence your use (or non-use) of tablet technology in the classroom?
Subject: Teachers	<ul style="list-style-type: none"> • What are your thoughts about tablet technology in general? • How do you feel about tablet technology in your classroom? • Why did you decide to incorporate tablet technology into your work program (or not)?
Rules: availability, budgets, policies, curriculum	<ul style="list-style-type: none"> • How is spending on tablet hardware and software determined in your school? • Please talk about how many devices you have in terms of numbers of students? • Please discuss the adequacy (or not) on software spending for devices? • What influence (if any) do school leaders play in your decision to use tablet technology in your classroom? • Do you think tablet technology help you meet curriculum outcomes in your lessons? If so, which areas of curriculum?
Community: classroom, school and stakeholders	<ul style="list-style-type: none"> • Do students play a role in your decision making around the employment of tablet technology? • Does your school culture include the use of tablet technology in the classroom? • What influence do parents and the wider community have on your use of tablet technology in the classroom?
Division of labour: teacher to teacher	<ul style="list-style-type: none"> • How do you and your colleagues support each other to use tablet technology?

8.6 Australian Catholic University Human Research Ethics Committee Approval Form



Human Research Ethics Committee **Committee Approval Form**

Principal Investigator/Supervisor: Associate Professor Suzy Edwards

Co-Investigators:

Student Researcher: : Ms Nyree Clyne (HDR student)

Ethics approval has been granted for the following project:

Teachers and iPads in Prep to Two: Using a teacher activity system to explore the use of tablet technology.

for the period: 13/05/2014-28/11/2014

Human Research Ethics Committee (HREC) Register Number: 2014 140V

Special Condition/s of Approval

Prior to commencement of your research, the following permissions are required to be submitted to the ACU HREC:

Catholic Education Office, Melbourne and School Principal permissions

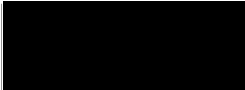
The following standard conditions as stipulated in the *National Statement on Ethical Conduct in Research Involving Humans* (2007) apply:

- (i) that Principal Investigators / Supervisors provide, on the form supplied by the Human Research Ethics Committee, annual reports on matters such as:
 - security of records
 - compliance with approved consent procedures and documentation
 - compliance with special conditions, and
- (ii) that researchers report to the HREC immediately any matter that might affect the ethical acceptability of the protocol, such as:
 - proposed changes to the protocol
 - unforeseen circumstances or events
 - adverse effects on participants

The HREC will conduct an audit each year of all projects deemed to be of more than low risk. There will also be random audits of a sample of projects considered to be of negligible risk and low risk on all campuses each year.

Within one month of the conclusion of the project, researchers are required to complete a *Final Report Form* and submit it to the local Research Services Officer.

If the project continues for more than one year, researchers are required to complete an *Annual Progress Report Form* and submit it to the local Research Services Officer within one month of the anniversary date of the ethics approval.

Signed:  Date: 13/05/2014.....
(Research Services Officer, McAuley Campus)

8.7 Catholic Education Office approval to conduct research in a Catholic school



Catholic Education Office

GE14/0009
14/5/2014

Project #2020 Clyne

Mrs Nyree Clyne
246 Canning Street
Carlton North VIC 3054

Dear Mrs Nyree Clyne

I am writing with regard to your research application received on 6/5/2014 concerning your forthcoming project titled *Teachers and ipads in Prep to Two: Using a teacher activity system to explore the use of tablet technology*. You have asked approval to involve a Catholic school in the Archdiocese of Melbourne, as you wish to involve students.

I am pleased to advise that your research proposal is approved in principle subject to the eight standard conditions outlined below.

1. The decision as to whether or not research can proceed in a school rests with the school's principal, so you will need to obtain approval directly from the principal of the school that you wish to involve. You should provide the principal with an outline of your research proposal and indicate what will be asked of the school. A copy of this letter of approval, and a copy of notification of approval from the organisation's/university's Ethics Committee, should also be provided.
2. A copy of the approval notification from your institution's Ethics Committee must be forwarded to this Office, together with any modifications to your research protocol requested by the Committee. You may not start any research in Catholic Schools until this step has been completed.
3. A *Working with Children* (WWC) check – or registration with the Victorian Institute of Teaching (VIT) – is necessary for all researchers visiting schools. Appropriate documentation must be shown to the principal before starting the research in the school.
4. No student is to participate in the research study unless s/he is willing to do so and informed consent is given in writing by a parent/guardian.

1 of 2

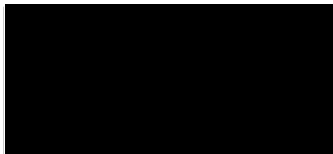
James Gould House, 228 Victoria Parade, East Melbourne VIC 3002 Tel: (+61 3) 9267 0228 Fax: (+61 3) 9415 9325
Correspondence: PO Box 3, East Melbourne VIC 8002 Email: director@ceomelb.catholic.edu.au www.ceomelb.catholic.edu.au
ABN 85 176 448 204

5. Any substantial modifications to the research proposal, or additional research involving use of the data collected, will require a further research approval submission to this Office.
6. Data relating to individuals or the school are to remain confidential.
7. Since participating schools have an interest in research findings, you should consider ways in which the results of the study could be made available for the benefit of the school community.
8. At the conclusion of the study, a copy or summary of the research findings should be forwarded to the Catholic Education Office Melbourne. It would be appreciated if you could submit your report in an **electronic format** using the email address provided below.

I wish you well with your research study. If you have any queries concerning this matter, please contact Ms Shani Prendergast of this Office.

The email address is apr@ceomelb.catholic.edu.au.

Yours sincerely



Anna Rados
MANAGER ANALYSIS, POLICY & RESEARCH