Exploring technology integration in teachers’
classrooms in NSW public schools

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Dedication

This PhD is dedicated to Noel, Patrice, Claire and Will.
Acknowledgements

Doing this research has been stimulating, hard work; such is the road of the PhD traveller. Thank you, to the University of Western Sydney and the Research Committee in The School of Education for giving me the opportunity to conduct the study. The supervision I received from Associate Professors Geoff Munns and Bronwyn Cole in the College of Arts was extraordinary; these two people are great teachers and their humility and insight made each PhD meeting a learning experience, which I will miss. The excellent support from administrative staff, like Ms Markie Lugton in the research office was very much appreciated.

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I take responsibility for the contents of the thesis, including its flaws and I trust that the four teachers who let me into their classrooms feel I have honoured their practice. I will always treasure the data collection and cross-case phases of the study. Thank you also to the students in each of the classrooms, the four school principals and the NSW DEC for approving the study in the first place.
The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

Signed

Jane Louise Hunter
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Abstract

This thesis took the TPACK framework (Mishra & Koehler, 2006) as its theoretical starting point and posed the question: how do a group of exemplary teachers conceptualise their knowledge of technology integration in education contexts? The research was a series of purposeful, intensive case studies of four teachers in Stages 1-5 classrooms (approximate ages 6-16 years) in different school sites. The study found that the teachers’ knowledge of technology integration is constructed on theory (T), creativity (C), public learning (P), life preparation (L) and contextual accommodations (C). These five main conceptions are underpinned by particular pedagogical themes. In the first conception, T, is underpinned by construction of learning, purposeful teaching, focused planning, enriched subject matter, promotion of reflective learning, shifts in conversations and thinking and authentic student engagement. The second conception, C, is underpinned by boosting creative learning, creating opportunities for production, unleashing playful moments, supporting values and differentiating learning. The third conception, P, is underpinned by scaffolding performance by making learning public and enhancing outcomes. Life preparation, or L, is underpinned by operationalising the real world, giving voice, ownership and responsibility, and the revelation of effectiveness in terms of self-regulation and self-efficacy. The final conception, contextual accommodations, C, is underpinned by the personal and professional, changes to time, nurturing community and defining the game. Each initial of the conceptions come together to form a fresh equation, T+C+P+L+C = high possibility classrooms (HPC). The study findings add to what is known about the TPACK framework by deriving five new conceptions out of exemplary teachers’ knowledge of technology integration. Recent moves in some futures literature (Chen, 2010; Craft, 2011, Gardner, 2012; Mishra & Koehler, 2012a; Pink, 2009; Robinson, 2012; Zhao, 2012) reflect the study findings about where education must go if young people are to be involved in high possibility classrooms where they are given opportunities to learn well, be creative, productive and thinking citizens who
can help solve some of the world’s most significant problems. New knowledge generated by this study forms a useful and practical conduit to ensuring all children have an experience of learning that is important and relevant. The study findings are both theoretical and practical in their approach to graduate and experienced teachers’ knowledge of technology integration and will be of critical significance to leaders in teacher professional learning in education jurisdictions.
Chapter 1: Australia, NSW and technology integration: towards a fresh approach.

The issue of technology integration in learning is a formidable challenge for many teachers in schools. From wikis to blogs, from YouTube videos to Wii devices for increasing physical activity, technology is changing how we interact with information and with each other. As the pace of ongoing conversations about technology hastens and its role in education is prioritised, we are also conscious of how technology can become obsolete as quickly as it arrives. Some teachers effect its use with relative ease in the classroom, while others retreat from challenging or advancing their knowledge of technology integration and the classroom remains a parallel universe to life outside.

This thesis is a study of how a particular group of teachers implemented knowledge of technology integration in their classrooms and what was fresh in their approach. The term fresh is used to describe the ‘emergent knowledge’ or a ‘new way’ of understanding how teachers integrate technology in classrooms. The study was based on understandings of four ‘exemplary’ teachers who taught students in Stages 1-5 in New South Wales (NSW) public schools. The first chapter of the thesis presents the background of the study, the research problem and its significance, as well as an overview of the methodology used and the structure of the report.

In the thesis, the term technology will be used in preference to information and communication technology (ICT). I regard the broader term technology used by Mishra and Koehler (2006) as highly useful, as it refers to “tools created by human knowledge of how to combine resources to produce desired products, to solve problems, fulfil needs or satisfy wants”. Within this definition, the term is also used to describe “individual tools or

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1 Wikis are content management systems, where web pages are stored separately and the pages are assembled on the fly as people access them. Blogs are interactive web pages most often used as a way to publish writing on a variety of issues with a variety of goals. YouTube is a video-sharing website. Wii is a home video game console.
techniques, and all tools and techniques and knowledge” (p.5). The scope of this definition includes tools such as interactive whiteboards, digital cameras, iPads, iPhones, computer hardware and software, blogs and digital resources (including films, games and curriculum learning objects). The act of technology integration is including technology in teaching (Mishra & Koehler, 2006) and it will be conceived in this way in the research at hand.

The term ‘exemplary’ is used to describe the four teachers in the study. The teachers were recruited on the basis they are an ‘excellent fit’ against six criteria established for the purposive sample, detailed in Chapter 3.

1.1 The current technology context in classrooms in Australian schools

Education scholars argue that one of the central goals of public education is the transmission of knowledge (Dewey, 1938; Gudmundsdottir, 1990; Hirsch, 1996; Shulman, 1987). Within this mandate, primary and secondary schools in Australia are charged with responsibility for facilitating access to technology for learning, promoting technology awareness, improving students’ technology skills and understanding, as well as fostering safe and sensible use of online environments for learning at home and at school (Deschamp, 1998; Garrett, 2012; NSW DET, 2009; Rudd, Smith & Conroy, 2007; Small, 2008). The Ministerial Council on Employment, Education, Training and Youth Affairs ICT in Schools Taskforce (MCEETYA, 2005, 2006, 2008b) published the first major reports on teaching and learning using technology in Australian schools.

These sources quoted the National Goals of Schooling in the 21st Century as a key reason for schools to give priority to student learning with technology: “when students leave school they will be confident, creative and productive users of new technologies” (p. 8). It was the Melbourne Declaration on the Educational Goals for Young Australians (MCEETYA, 2008a) that first recognized the need and furthermore “practical knowledge and skills
development in areas such as ICT and design and technology are central to Australia’s skilled economy and will provide crucial pathways to post-school success” (p. 12).

Building technology capacity in Australian schools has continued to gather momentum, particularly over the past eight years whereby the current Federal Government is:

Investing over $2.4 billion to support the effective integration of information and communication technology (ICT) in Australian schools in line with broader education initiatives, including the new Australian National Curriculum. (ACARA, 2012, p. 45).

Technology competence has also emerged as an important focus in documentation for the new Australian National Curriculum and includes an overarching concern for the development of technology capabilities in students. Many of the draft papers target:

Learning effective use of ICT and knowing how to appropriately access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas at school and in their lives beyond school.

(ACARA, 2012, p. 46).

While it is clear from recent Federal Government initiatives that Australian students must be equipped with technology skills, and technology is having a positive impact on education in schools, it has not yet resulted in the educational transformation worldwide some educators envisaged (Bauer & Kenton, 2005; Ertmer, 2005, Goldman & Lucas, 2012; Keengwe, Onchwari & Wachira, 2008; Russell, O’Dwyer, Bebell & Tao, 2007; Schrum, 2011).

In NSW, where this study was conducted, the Department of Education and Communities (NSW DEC, formerly NSW DET) has implemented various strategic plans for technology integration in schools. These plans included technology projects, professional learning for teachers and the first rollout of computers into schools. Intertwined with significant technology hardware investment, in 2006 the NSW Board of Studies authorised a computer
skills test for all students in Year 10 (Stage 4). Furthermore, the 2007 NSW election commitment for *Connected Classrooms*\(^2\) was the largest budget allocation – $158 million – for an education program in Australian education history (Hunter, 2011). The program increased available bandwidth to schools, installed 2400 interactive classrooms (classrooms with interactive whiteboard and video conference facilities) and teachers and students accessed new learning tools and Web 2.0 applications.

The Digital Education Revolution (DER)\(^3\) and the National Secondary Schools Computer Fund distributed 200,000 laptops to students in Years 9-12 at 500 secondary school sites (DEEWR, 2008). The project, valued at $446 million, concluded in December 2012 and no further funding will be provided (Wright, 2013). Historically, the technology focus for public schools was on hardware implementation, complimented by large-scale curriculum resource production and some technology skills-based teacher professional learning (Howard, Thurtell & Gigliotti, 2012; Hunter, 2011; Lee & Gaffney, 2008). The role of pedagogy and content in student learning combined with the teacher’s technology ability has gradually become more important in NSW classrooms.

### 1.2 Pedagogy, content and technology

In my role as a senior officer in the NSW DEC from 2002-9, I had opportunity to work alongside hundreds of teachers engaged in technology projects in primary and secondary schools (Hunter, 2007a, 2007b; Hunter, 2011; Mitchell, Hunter & Mockler, 2010).

Observations showed that many teachers did not concentrate on technology integration from a pedagogical point of view. The problem was not that teachers did not want to or could not integrate technology, their perceptions stemmed from views that technology was an ‘add-on’

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\(^{2}\) The NSW State government installed a ‘connected classroom’ in every public school across a three-year period, it includes an IWB, laptop, LCD screen, digital camera and microphones for multipoint video conferencing.

\(^{3}\) DER refers to the Federal Government initiative to equip every Australian child in the last four years of secondary school with their own portable technology device, a laptop. At the time of data collection the program was in its third year.
in the classroom and their task in the learning processes of students was to focus on content. One teacher stated “technology tools are used for word processing literacy tasks, or for dropping data into excel spreadsheets” (Hunter, 2011, p 68). Technology professional learning for teachers at the time was often in the form of one-off workshops, information newsletters or skills-based Intel courses, which have been described as “one size fits all” approaches (NSW DET, 2005). These work on the assumption that all teachers are at the same level of technology skill:

Many teachers didn’t find the ‘hardware’ easy to use with the emphasis primarily on implementation and curriculum resource production. They did not seem well-equipped to embrace the technology tools appearing in schools.


At the time, such observations of the field aligned with the work of Mishra and Koehler (2006) and their multifaceted, seven component framework of Technological Pedagogical and Content Knowledge or “TPACK”, as seen in Figure 1 below.

![Figure 1: The TPACK framework and its knowledge components.](image)

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Note: each TPACK component is explained in the literature review in the next Chapter.

It became increasingly obvious from what I observed in classrooms that TPACK had great heuristic value in technology research and might foster new directions for understanding how teachers conceptualised these knowledge systems. The framework built upon well-known curriculum and pedagogy work of Shulman (1986, 1987) and was a highly useful lens through which to develop understanding of how teachers could conceive their knowledge of technology integration. Equally important in the framework were the interactions between these bodies of knowledge. Mishra and Koehler (2006) used the “knowledge as design” work of Perkins (1986) to further support the idea of knowledge as a tool that is adapted to a purpose. Although TPACK was not completely new in 2006, it quickly became well-known. There were other scholars (Bruce, 1993; Papert, 1980) who argued that knowledge about technology was not context-free, and good teaching required an understanding of how technology related to pedagogy and content. TPACK represented a class of knowledge that was central to teachers’ work with technology.

Observations in teachers’ classrooms facilitated continual agreement with the perspective of Mishra and Koehler (2009b), who claimed that “there was no single technological solution that applies for every teacher, every course, or every view of teaching” (p.66). If technology was to be integrated effectively into classroom practice it needed to consider all three elements of content, pedagogy and technology – not in isolation, but in complex, vibrant operational relationships that defined teaching practice. At the same time, other academics working in education and considered leaders in the technology field in Australia speculated that traditional methods of technology training were ill-suited to produce the deep understanding that could assist teachers to become intelligent users of technology for integration (Freebody, Muspratt & McRae, 2008; Hedberg, 2006; Oliver et al, 2007). It was clear to me in more discussions of the TPACK framework in school presentations in 2008-9, that there was strong interest in this conception of technology integration from many
teachers. Some teachers already used a TPACK approach; they didn’t necessarily have a language for their practice, however, that is what they did in their increasingly technology-rich classrooms.

TPACK was featured in the *Teaching Teachers for the Future* (TTF, 2008-2012) project, when the Australian Government supported the implementation of the DER and the professional development of teachers (both preservice and experienced) and school leaders under the Information and Communication Technology Innovation Fund (Garrett, 2010; Lane, 2011). The project, valued at $16 million, has a series of evaluation programs and finished in December 2012:

> It has created English, Maths, Science and History digital resources to support the new Australian National Curriculum following the TPACK framework … it provides a schema for thinking about and implementing in classrooms the complex relationships between these three elements of the learning program and helps teachers to ensure that their planning is comprehensive and integrated.

Retrieved from [http://www.ttf.edu.au/about/about-this-site.html](http://www.ttf.edu.au/about/about-this-site.html)

Australian researchers are engaged in a range of TPACK initiatives; the research is ongoing and is widely reported at education conferences (Albion, Jamieson-Proctor & Finger, 2010; Finger, Jamieson-Proctor & Albion, 2010; Jamieson-Proctor, Finger & Albion, 2010; Kearney, Pressick-Kilborn & Maher, 2012). This work adds to a long chronology of international studies that have described accounts of technology integration into teaching. Yet, such descriptions are often replete with commentary of it either not happening, happening too slowly, or having little or no effect on teachers’ or students’ learning (Cuban, 2001; Mishra & Koehler, 2008; Ross, Smith, Alberg & Lowther, 2004; Schrum, 2011).

Education research into technology integration globally is at an important crossroads. The
significance of the problem of how teachers in Australian classroom settings conceptualise their knowledge of technology integration is attracting long overdue attention.

1.3 Significance of the problem

At the commencement of this study it was documented that the problem of technology integration in learning in the school context was not well understood and was considered complex (Condie & Munro, 2007; Kennewell, 2006; Rittel & Weber, 1973). In the past, international scholars such as Selfe (1990) expressed concern that technology research gave little insight into understanding how teachers integrated technology in broader social, cultural or educational contexts. He suggested that “until we share some theoretical vision of technology integration we will never glimpse the larger picture that could give our everyday classroom efforts direction and meaning” (p.119).

In the United Kingdom, in 1996-99 the Blair Government fitted an interactive whiteboard into every British school classroom and there have been countless education and policy reports (BECTA, 2004, 2005; OECD, 2008a, 2008b) about the effectiveness or otherwise of teachers’ integration of technology into teaching and learning (Higgins, 2005). A different picture surfaced in the 1990s in the United States that really shifted the focus from merely looking at technology in schools, to studying how it was used and understood. What teachers needed to know in order to appropriately integrate technology into learning was discussed, and it soon became evident that more emphasis was needed on viewing technology integration in classrooms through a rigorous theoretical lens (NCATE, 1997; Mishra & Koehler, 2003, 2007, 2008, 2009a, 2009b; Zhao, 2003). The full review of literature citing historic and landmark studies are detailed in Chapter 2 of the thesis.

Studies of technology integration in teaching and learning underpinned by theoretical constructs in the Australian context are scant; however, teaching with technology in classrooms in Australian schools is ubiquitous. This research is both significant and timely,
given the current education context and the large financial commitments by Government to increased technology capability in schools. Studying four ‘exemplary’ teachers in NSW public schools, who are extraordinary users of technology and how they conceptualise technology integration using the TPACK lens, provides considerable insight into the phenomenon.

1.4 Aim of the research

The aim of this study was to understand the dynamic relationships between technology, pedagogy and content, and the interactions between these knowledge components. The central research question and two sub-questions are:

How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?

And,

How does the conceptualisation of teachers’ knowledge of technology integration form a ‘fresh’ understanding for technology implementation in teaching and learning?

What is the emergent form of ‘new knowledge’ about technology integration that can be shared more widely across school contexts?

One of the main challenges for teachers in schools, then, is to provide children with an experience of learning that is both important and relevant to their differently lived social futures. Better education cannot be more of the same; the focus of learning is moving beyond the individual and the cognitive to incorporate the aesthetic and the moral, and the interplay among these elements. What many adults may call using technology, children and young people may experience simply as living. Technology is not mysterious or magic, but is integrated into their lives, more like “prostheses than gadgets” (McWilliam in Craft, 2011b, p. xxii).
The purpose of this research is to provide an important conduit to addressing the challenge articulated above. The four ‘exemplary’ teachers in the study, both consciously and unconsciously, integrate the elements of technology, pedagogy and content effectively every time they teach. What these teachers do is flexibly navigate all three elements and the complex interactions between them, in specific contexts. Often perceived as a complex, active problem, the teachers designed curricular solutions to fit their unique learners and goals of creativity, in particular teaching situations. Advancing our knowledge of technology integration in the classroom where students are empowered might be the lever for a fresh approach for teachers, to consider when they integrate technology in learning. The understanding offered in this study will suggest more directions for future research. A major strength of the research was the methodology used to uncover the technology integration conceptions of the four ‘exemplary’ teachers and this is outlined very briefly in the next section, and given more detail in Chapter 3.

### 1.5 Overview of the methodology

A qualitative approach with case study methodology was used to address the main research questions. Four case studies formed the collection of cases and all are located in an interpretive frame within a socially constructed world view (Creswell, 2007; Kamberlis & Dimitriadis, 2011). The research was designed using a set of carefully constructed ‘purposive’ criteria to select four ‘exemplary’ teachers from thousands of teachers in NSW DEC primary and secondary schools.

### 1.6 Thesis overview

The thesis is set out in nine chapters that present the intention, progression and results of the study. Each chapter is described below.

**Chapter 1** introduces and sets the scene of the study.
Chapter 2 provides a review of current literature from international and national sources, and scrutinises its contribution to what is known about technology integration and the TPACK framework.

Chapter 3 justifies and details the methodological approach taken in the study and re-states the central research question on which this study is based.

Chapter 4 is the first case study of the collection in the thesis; this chapter presents Gabby, a teacher of Stage 1 students in a northern Sydney primary school.

Chapter 5 examines Gina in a Stage 2 classroom, as well as her work with teachers and students in a number of inner Sydney schools.

Chapter 6 presents Nina, a teacher of 28 gifted students in a Stage 3 classroom located in the north-west of Sydney.

Chapter 7 showcases Kitty, a film maker and visual arts teacher in a secondary school in Sydney’s south-west region.

Chapter 8 sets out the cross-case analysis and discussion. The chapter details conceptions and pedagogical themes of technology integration that have emerged from the study, and how they address the main research question.

The thesis concludes with Chapter 9, which summarises the results and discusses their implications, with suggestions for future directions for research with teachers who integrate technology in highly creative and imaginative ways.
Chapter 2: Literature review

The integration of new and emerging technology into teachers’ classroom practices is a highly significant educational issue and the TPACK framework (Mishra & Koehler, 2006) has been identified as a crucial way of understanding technology integration in classrooms. Despite this, in Australia and across the globe, few – if any – qualitative technology studies in schools have examined in depth what exemplary teachers in technology-rich contexts do, when they integrate all three components of the TPACK framework in their classrooms. It is important to acknowledge the many studies documented in research-based articles, conference papers and dissertations around the TPACK framework (Dilworth et al, 2012; Harris, Grandgenett & Hofer, 2012; Jordan & Dinh, 2012). In Australia, several significant quantitative contributions to TPACK research (Albion et al, 2010; Finger et al, 2010, 2013; Jamieson-Proctor et al, 2010; Kearney et al, 2012a) have focused on preservice teachers’ pedagogical knowledge and confidence with TPACK, identified in survey findings, for example, in the Teaching Teachers for the Future (TTF) project (Finger et al, 2010, 2013). Scholarship that addresses how TPACK knowledge can be assessed in both preservice and experienced teachers using particular testing instruments is more widespread (Abbitt, 2011; Chuang & Ho, 2011; Figg & Jaipal, 2011; Hofer & Harris, 2012; Jang, 2012; Koh & Divaharan, 2011). The focus of this chapter will utilise the TPACK framework as a basis for examining international and national research in teachers’ knowledge of technology integration in education settings. This examination will identify several emerging key issues and debates, and these issues and debates form the basis of why the research in this thesis is timely and critical.

The chapter is in five sections. The first establishes the history of the TPACK framework and its development over time, and how other international and national research links to the leading groundwork the TPACK framework established for technology integration in education. In the second section, the review extracts several calls for technology integration
from education policy and reports. The third section examines some of the main issues and
debates that emerged from studies of technology integration in education. In the fourth
section attention is given to creativity, and in the fifth section, literature pertaining to futures
for education is examined. This literature review now turns to the first section that features
background to the development of the TPACK framework (Mishra & Koehler, 2006).

2.1 Background and significance of the TPACK framework in
technology integration

The framework of technological pedagogical and content knowledge (TPACK) emerged
over the last decade and changed from TPCK, to its current TPACK form. As mentioned in
Chapter 1, the framework built on Shulman’s (1986, 1987) conception of pedagogical
content knowledge (PCK) by explicitly integrating the component of technological
knowledge. How teachers teach subject matter was an overarching concern of Grossman
(1990), whose ideas on PCK keenly supported Shulman’s argument. Shulman (1987)
defined seven categories of teacher knowledge, of which pedagogical content knowledge
(PCK) was the most distinguished as it identifies the distinctive bodies of knowledge for
teaching and represents the blending of content and pedagogy. The central role of subject
matter or the role of content specialists in classroom learning was added to by Pierson (2001)
in an articulation of technology knowledge (TK). This articulation arose from a study of in-
service teachers who, although identified as ‘exemplary technology users’ who knew
content, had limited skills in integrating technology with content. The Pierson study (2001)
was significant, as it added TK to Shulman’s PCK and illustrated that there were different
definitions of what it meant to integrate technology into classroom practice.

The influence of technology in pedagogical decision making by teachers was examined the
year before in an important study (Applefield, Huber & Moallem, 2000) in which a
traditional classroom lesson and a constructivist design of the same lesson were described
and analysed. Six constructivist principles of learning were cited: raising questions;
challenging ideas and experiences by generating inner cognitive conflict or disequilibrium; reflection through journal writing, drawing, modelling and discussion; opportunities for dialogue; students communicating their ideas, defending and justifying them; and students working with big ideas, central organising principles that have the power to generalise across experiences and disciplines. To this list was added “clear content goals designed around an authentic learning task, question or problem” (p.50). What followed were several studies that suggested similar conceptions of more content-specific orientation to technology integration (Angeli & Valanides, 2005; Koehler & Mishra, 2005; Lee & Gaffney, 2008; Margerum-Leys & Marx, 2004; Niess, 2005). Just prior to publication of these studies, effective ways to improve teachers’ technology skills and pedagogical practices were identified by Mouza (2003). In spite of “earlier research from the Pierson study (2001) that stressed importance of the development of pedagogies associated with technology and its actual integration in classrooms” (Hervey, 2011, p.14). The understanding was acknowledged in Hervey’s study of experienced teachers in one-to-one (1:1) settings where it was pointed out that: “It was Koehler, Mishra & Yahya (2007), who really articulated that there were complex interrelationships between users, tools and instructional practices” (Hervey, 2011, p. 15)

Furthermore, research at the time was starting to identify how effectively teachers could be prepared for teaching in technology-rich contexts (Hughes, 2005; Niess, 2005). Such work recognised the need for specific professional learning to support teachers’ technology use at schools. It is interesting to note that the ‘right kind’ of professional technology support for teachers is still contested in many schools and education jurisdictions. Defining exactly what constitutes effective technology professional learning is problematic, as technology use by its very nature means everyone is at a different developmental stage (Finger, Russell, Jamieson-Proctor & Russell, 2007; John & Wheeler, 2008; Staples, Pugach & Himes, 2005).
Other ways to think about and implement technology professional learning for teachers in schools are referred to in analysis in Chapter 8 and the conclusion in Chapter 9.

The TPACK framework gained widespread popularity in 2006, after Mishra and Koehler’s seminal paper was published. The paper outlined the framework and articulated the relationship between content, pedagogy and technology both in isolation, and in pairs of content knowledge (CK), pedagogical knowledge (PK) and technology knowledge (TK). This move evolved into pedagogical content knowledge (PCK), technological content knowledge (TCK) and technological pedagogical knowledge (TPK) and all three came together as technological pedagogical content knowledge (TPCK): “This was similar to the move made by Shulman in which he considered the relationship between content and pedagogy and labelled it pedagogical content knowledge ...we introduce two new pairs and one new triad” (p.1026). In the text of the American Association of Colleges for Teacher Education’s *Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators*, there are studies of TPACK in specific subject areas, including literacy education, English teaching, Social Studies, Mathematics, the Arts, Science, Technology and Physical Education (AACTE, 2008). There is also inclusion of TPACK in teacher professional development, with an afterword from the AACTE Committee on Innovation and Technology at the time for “a new direction for technology integration in teacher education” (AACTE, 2008, p.289).

The cry was heard by educators around the world and was a major catalyst for the 2010 Australian *Teaching Teachers for the Future* (TTF) project with academics in teacher education faculties in universities (Romeo, Lloyd & Downes, 2013). Alongside these developments were studies that continued to show technology integration could have a significant effect on teaching and learning (Barron, Kemker, Harmes & Kalydjian, 2003; Ertmer, 2007; Ferdig, 2006; Russell et al, 2003). The momentum around TPACK has continued to build, in spite of significant and repeated critiques of both PCK (Cochran,
DeRuiter, & King, 1993; van Driel, Verloop, & De Vos, 1998) and TPACK (Graham, 2011; Kereluik, Mishra & Koehler, 2010).

Before examining the further evolution of TPACK it is important to be re-acquainted with the framework components and their relationships. These are detailed in the next section.

2.1.1 The TPACK framework

In Chapter 1, Figure 1 displays a full diagram of the framework. To re-cap, the seven components and their relationship are:

i) Content knowledge (CK): this is knowledge of the actual subject matter that is to be learned or taught. Knowledge and the nature of inquiry differ greatly between fields and it is important that teachers understand the deeper knowledge components of the discipline they teach.

ii) Pedagogical knowledge (PK): this is deep knowledge about the processes and practices or methods of teaching and learning and encompasses educational purposes, values and aims.

iii) Pedagogical content knowledge (PCK): this is similar to Shulman’s (1986, 1987) idea of pedagogy that is applicable to the teaching of specific content. This knowledge includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching.

iv) Technology knowledge (TK) is knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies, such as the Internet and digital video. This involves the skills required to operate particular technologies.
v) Technological content knowledge (TCK) is knowledge about the manner in which technology and content are reciprocally related. Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations.

vi) Technological pedagogical knowledge (TPK) is knowledge of the existence, components and capabilities of various technologies as they are used in teaching and learning settings, and conversely knowing how teaching might change as the result of using particular technologies.

vii) Technological pedagogical content knowledge (TPCK) is an emergent form of knowledge that goes beyond all three components (content, pedagogy and technology). This knowledge is different from knowledge of a disciplinary or technology expert and also from the general pedagogical knowledge shared by teachers across disciplines.

(This is a brief summary of the framework components which includes verbatim material from Mishra & Koehler, 2006, pp.1026-1031).

It is acknowledged that the framework evolved to include an A to make the TPCK into a new acronym TPACK (Thompson & Mishra, 2007-2008). This evolution was significant and leads examination of the framework in the next section.

2.1.2 TPACK from 2008 - 13

Review of the TPACK literature shows there are six key movements that are relevant to this thesis in terms of the framework’s evolution from 2008 until early 2013. This review highlights that some are not widespread and might be better referred to as ‘interpretations’ by individual or small groups of scholars. The core body of TPACK research focuses on either survey-based or case study research with preservice and experienced teachers. Some
of that material are presented in the sections below and describe how TPACK is either enacted or described. The first movement was a name change and examines suggestions that the initial framework was ‘fuzzy’ and difficult to identify in practice. The second movement included studies of TPACK in practice, in online contexts and with graduate students. The third evolution is an interpretation of TPACK and involved the integration of ideas around play. The fourth development is a movement that focused on self-efficacy, one-to-one computing and TPACK. The fifth, an interpretation, was a concentration on self-directed learning and TPACK, and the sixth is a key movement and reviews plans for TPACK in 2013 and beyond. The first movement, involving changes to the acronym follows.

Change of name

TPACK was called “TPCK” in the literature until 2008, when some educators in the research community proposed using the more easily spoken term, TPACK. This name was widely accepted and was referred to as “forming an integrated whole, a ‘Total PACKage’” (Thompson & Mishra, 2007-2008, p. 38). At that time, ongoing clarification of the concept of TPCK using only three of the constructs TCK, TPK and TPACK was presented (Cox, 2008). Thus, as pointed out by Hervey (2011), “TPACK includes all three knowledge areas of content, pedagogy and technology, and when in concert with the use of content-specific strategies, sets itself apart from TPK, which employs general pedagogical strategies, and TCK, which is independent of pedagogy (p.19). In later work (Cox & Graham, 2009) stated that teacher selection of technology should be based on the imperatives of a particular content area. Evidence in the study was from two cases, a scientist and a history teacher, using observations and interviews that suggested boundaries between TPACK are ‘fuzzy’ and sometimes instances of TPACK are difficult to identify. Cox and Graham (2009) concluded that appreciating exactly what TPACK looked like “slides along as new technologies emerge” and “more in depth case study research of practicing teachers was necessary to shed light on these understandings” (p. 64).
The ‘sliding’ proposition matched with what Koehler and Mishra (2009b) termed “technology choices made by teachers” that “afford and constrain the types of ideas that can be taught” (p.61). This observation occurred just after, an influential matrix for understanding how teachers clarified their ideas about content while thinking about technology integration was developed (Niess, 2008b). This matrix referred to “declarative, procedural, schematic and strategic knowledge” (p. 234) and arguably accounted for how teachers identified content and attached a choice of technology to that content knowledge. This action could determine why and when students might use that knowledge and then, at a strategic level, what might the product or performance be that demonstrated students’ specific content learning.

At the time, an invitation for more study of the TPACK framework by researchers was offered by Koehler and Mishra (2009):

Options for looking at a complex phenomenon like technology integration in ways are amenable to analysis and development. Moreover, TPACK allows teachers, researchers and teacher educators to move beyond oversimplified approaches that treat technology as an “add-on” instead to focus again, and in a more ecological way, upon the connections among technology, content and pedagogy as they play out in classroom contexts.

Retrieved from http://www.citejournal.org/vol9/iss1/general/article1.cfm

Research in this thesis responds to further research calls by Koehler and Mishra (2009) and Cox and Graham (2009) as well as the need for more TPACK studies of practice in school classrooms with teachers, as revealed in the review of research from 2006-11 (Jordan & Dinh, 2012).
TPACK in practice in online contexts and with graduate students

Questions around the existence of TPACK in practice continued (Archambault & Barnett, 2010) in spite of earlier clarification using other knowledge terminology (Niess, 2008a). New work, a quantitative survey of online teachers, contended that “TPACK experienced the same difficulty as Shulman’s old conception of PCK” (Archambault & Barnett, 2010, p. 1660). In particular, the survey highlighted that measuring the domains of TPACK was convoluted and complicated, and that there might be more accurate ways to describe teachers’ content, pedagogical and technological knowledge. It is perhaps the case that the nature of online teaching in the Archambault & Barnett (2010) study required new-found or different constructs and that for face-to-face classroom teaching TPACK was still considered to be highly valuable.

Close observation of the TPACK framework in the context of what teams of graduate students developed in micro-blogging, visual search engines and music DJ software was undertaken (Mishra & Koehler, 2009a). These instances demonstrated repurposing of technology for an educational end. The examples made the case that creative input from teachers was required, to subvert or redesign what was produced to fit an educational purpose and this could not be done without “deep, complex, fluid and flexible knowledge of the technology, the content to be covered and an appropriate pedagogy” (p.18). Inspiring teachers to play with technology and seeing technology tools as educational was noticed by many educators around the world. However, more visible technology in schools at the time wasn’t necessarily translating into evidence of technology integration into practice in classrooms. Technology integration wasn’t happening fast enough in classrooms, nor was it being done well enough (Bauer & Kenton, 2005; Ertmer, 2005, Frank, Zhao & Boreman, 2004; Gulbahar, 2007; Harris, Mishra & Koehler, 2009; Keengwe et al, 2008). The identification of technology integration barriers and what this meant for teachers was often cited in education literature (Borko & Putnam, 1995; Brinkerhoff, 2006; Ertmer &
Ottenbreit-Leftwich, 2010). Much of the research found that providing opportunities for teachers in schools to witness how the integration of technology benefitted students, and finding time to play with technology, were essential. Ideas of play and TPACK are examined in the next section.

Play, content and TPACK

The notion of play crept into TPACK work and formed one of “seven trans-disciplinary habits of mind” (Mishra, Koehler & Henriksen, 2011, p.22). This interpretation extended the original framework and arose in response to “misconceptions that TPACK was only about integration of newer technologies and offered little guidance about what to teach, what pedagogical approaches were useful and what kinds of technologies are worth using in teaching” (p.5). There was concern at the time that content was being ignored, or only being conceptualised in traditional ways. Ideas of creativity in learning content were being called for by many researchers, including Gardner (2006, 2008). Content was starting to be conceived as domain-general and domain-specific and there was some sort of transactional relationship between the two domains (Mishra et al, 2011). In order to keep pace with changes in disciplinary knowledge, it was deemed advisable to move across disciplines, to cross-pollinate ideas from one field to another. The “seven habits of mind” were a response to this observed need for greater creativity and were cited as being about “transformative” and “trans-disciplinary learning”; they included: “cognitive tools of perceiving, patterning, abstracting, embodied thinking, modelling, deep play or transformational play and synthesising” (p. 25-26). The work built on conceptual ideas developed earlier by Robert and Michele Root-Bernstein (1996, 1999) and the “cognitive tools” were described as universal in their application. After all, this still left room for teachers to repurpose existing technology for pedagogical purposes (Mishra et al, 2011). The combination of trans-disciplinary cognitive tools and technology enabled students to learn the domain and therefore examine how they themselves learned. The notion of “deep-play” received more
attention. Examples of deep-play assignments using an instructional approach, through micro- and macro-design projects with 46 design students, showed how “to scaffold students’ growth and development of TPACK” (Koehler et al, 2011, p.155). In macro-design projects in the study, participants fully engaged with the TPACK framework by explicitly navigating the competing tensions between content, pedagogy and technology. At the conclusion of such learning, “deep-play activities forced students to learn technologies in context, develop their identity as technology savvy teachers of content and allowed them to visualise possible futures for themselves (reflecting on the total PACKage)” (p.159). Play led to considerations of self-efficacy underpinned by TPACK and its value in one-to-one (1:1) technology contexts.

**Knowledge, self-efficacy, 1:1 classrooms and TPACK**

Knowledge growth in teaching with technology was identified as necessary in supporting teachers’ learning trajectories (Niess, 2008a). The expansion of a more robust and mature TPACK framework sustained teaching with current and emerging technologies, but also “meant greater effort in thinking about planning, implementing and evaluating their knowledge” (p. 299). This development led to ideas around TPACK and self-efficacy. Findings in an exploratory study (Abbitt, 2011) of preservice teachers about technology integration illustrated the changing nature of the complex relationship between knowledge and self-efficacy beliefs. Research (Harris, et al, 2012; Hofer & Harris, 2012) reinforced the usefulness of the TPACK framework, not only for preservice teachers’ pedagogical development but for all teachers. It provided a relevant knowledge base for technology integration in the classroom, which was echoed in new studies (Kohen & Kramanski, 2012). Professional knowledge and instructional practice in 1:1 classrooms with experienced teachers, acknowledged the role of technology in the TPACK framework, in helping to

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5 The term 1: 1 is used and delineates how the technology is available to students and teachers in the classroom.
differentiate learning for students (Hervey, 2011). Examples in this study showed the “evolution of teachers’ TPK as a key driver for meeting the learning needs of students” (p.31). The assertion fitted with an earlier study, that teachers in 1:1 settings must not only understand content and use effective pedagogy but also know how to use technology (Zucker and Hug, 2008). Sets of supportive conditions, for example leadership, professional development and collaboration at the school level, were determined as instrumental in developing teachers’ TPACK for 1:1 settings (Hervey, 2011). This conclusion built on what had been known for some time in broader education literature: that creativity and placing students at the centre of teaching practice were significant factors in technology integration (Craft, 2001, 2005, 2006; Gibson, 2011; Lytras, 2008; Papert, 1980; Zhao, 2009, 2012).

**Self-directed learning and TPACK**

In recent publications by Mishra and the Deep-Play Research Group (2012a; 2012b; 2013) at Michigan State University, the TPACK framework continues to feature the phrase “trans-disciplinary creativity”. The term is described as emanating from two myths: one highlighted reconnecting technology and creativity through in-discipline learning, using examples drawn from mathematics to illustrate the development of students as creative, divergent thinkers; the second myth accommodated deep disciplinary knowledge and the ability to move across disciplinary boundaries (Mishra, Henriksen & The Deep-Play Research Group, 2012a). The notion of “trans-disciplined learning” on the other hand honours creativity in discipline or context, while “understanding that at the same time learning and gathering ideas by crossing over into others” (Mishra, Henriksen & The Deep-Play Research Group, 2012b, p.20).

The focus of TPACK interpretation has shifted in recent times to suggestions of a skills framework that can be used by teachers for lessons and learning experiences. In this framework, learners must be able to see connections and synthesise information both within and across disciplines (Freedman, 2007; Mishra, Fahnoe, Henriksen & The Deep-Play Research Group, 2013). What is noteworthy is that in their new work (Mishra et al, 2013)
references are made to the work of Zhao (2009, 2012) and other project-based learning approaches (Chen, 2010). These later ideas have sparked interest in self-directed learning by the Deep-Play Research Group in a middle school classroom with a team of teachers who are ‘TPACK savvy’ (Mishra et al, 2013). The latest study suggested there was increased likelihood of students displaying self-directed learning when they engaged in “problem based learning steeped in real world contexts and guided practice, with time for collaboration, exploration and inquiry” (p.11). The call is also made for educators in today’s classrooms to “see themselves as architects and designers of learning environments that allow students to develop the kind of mental disciplines to think outside of the disciplines” (p. 12).

**TPACK now**

The continuing influence of TPACK was flagged in a recent editorial (Dilworth et al, 2012), which cited the number of peer-reviewed articles TPACK had attracted and in a review of papers housed on the TPACK website, considerable interest in the framework was apparent (Jordan & Dinh, 2012). Of 98 selected papers, most were published by US researchers and “three of 22 papers outside of the US are cited as being from Australian contributors” (p. 6). Since 2006, more than 500 TPACK studies have been presented and published (Hofer & Harris, 2012). The TPACK strand is strong at the annual Society for Information and Technology (SITE) and International Society for Technology in Education (ISTE) conferences in the US, and the latest TPACK initiative to support teacher educators is the development of a series of modules for content areas (Dilworth et al, 2012). These modules will have supportive teaching cases for each content area and are being developed in collaboration with classroom teachers. It is anticipated that this package of professional materials will form the basis of a Practitioner’s Guide to TPACK. The sense of urgency continues to grow, for changes in technology integration in classrooms in schools to better reflect 21st Century contexts.
In summary, the development of TPACK features movements and more minor interpretations that range from Pierson and Shulman’s original ideas around PCK, to a change of name, to research using TPACK in online contexts and with graduate students. Interpretations involving play and TPACK, and related developments in self-efficacy and self-directed learning have been found to be important in how TPACK is constructed. There are plans to publish modules of professional materials to support teachers’ technology integration using the TPACK framework. Important materials in education policy and key reports in the United Kingdom, the United States and Australia are examined in the next section.

2.2 Major policies and reports on technology integration

Key policies, recent reports and findings and development from peak technology groups relevant to the research question are reviewed and presented in this section. There are three parts, covering the UK, the US and Australia. This literature review acknowledges that the number of published materials is vast. Studies most relevant to the research are selected for focus. The Review of the Government Education White Paper, *The Importance of Teaching* (DfE, 2010) and other influential reports from the UK now follows.

2.2.1 The United Kingdom

Encouragement for school leadership and teachers to drive school improvement is important to education jurisdictions around the world (DfE, 2010, 2011; OECD, 2008; Ward & Parr, 2011) and so it is in the UK. In *The Importance of Teaching* (DfE, 2010) it was argued that “schools will be freed from centralised bureaucracy and government interference, in return for greater accountability to parents and local communities” (p. 8). Emphasis was placed in the report on successful school systems “in Alberta, Hong Kong, Finland and Singapore that closed the gap of student achievement” (p. 6). It is crucial to mention these jurisdictions here, as in education policy terms; the agenda outlined in *The Importance of Teaching*
competed with a focus on technology integration in schools (Ball, 2008; DfE, 2010, 2011; Ward & Parr, 2011). There was a commonality in the language used in similar reports from the US (US Department of Education, 2010) and Australia (MCEETYA, 2009).

The government agency that supported the role of technology integration in education to change teachers’ classroom practices was the British Educational Communications and Technology Agency (known as ‘BECTA’). Until 2011, this organisation led the national drive to ensure the effective and innovative use of technology in learning was a priority in education (BECTA, 2004, 2007). In his closing address at its final meeting, the Rt. Hon. Michael Gove MP said:

Closing the agency was not an easy decision for Government to take, but a necessary one in helping make savings across Government through our wider program of reform. The challenge will be to draw on the knowledge and skills that BECTA has embedded in schools and enable teachers and school leaders to have the flexibility to make their own choices. Retrieved from

http://www.education.gov.uk/aboutdfe/armslengthbodies/a00192537/becta

How the choices referred to will unfold, is as yet unknown. The move was significant because it hailed the beginning of technology integration decision-making at the local level. Historically, much of the technology-related research had been done by education researchers in universities (Thomson, Hall, Jones & Sefton-Green, 2012) and three other bureaus: London Knowledge Lab⁶, Futurelab – which is now the National Foundation for Education Research (NFER)⁷ – and the international NGO, Creativity, Culture and

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⁶ LKL is a unique collaboration between two prominent centres of research – the Institute of Education and Birkbeck. The Lab brings together computer and social scientists from a very broad range of fields, including education, sociology and social media. The National Endowment for Science Technology and the Arts (NESTA) commissioned LKL to examine how technology has been used in UK education systems and were there lessons that could be learned from around the world.

⁷ Futurelab was selected to lead a group of experts to build a global network of consortia to develop more effective approaches to science, technology, engineering and mathematics (STEM) education.
Education (CCE). One report commissioned by NESTA was *Decoding Learning: The Proof, Promise and Potential of Digital Education* (Luckin et al., 2012). Eight new approaches to learning were proven to be effective in this new report that analysed data from 210 technology innovations. Better technology integration involved learning from experts, learning with others, learning through making, learning through exploring, learning through inquiry, learning through practising, learning from assessment and learning in and across settings based on analysis of learners’ actions, and the way technology was resourced and structured in schools (Luckin et al., 2012). These research outcomes resonate with past Futurelab projects on thinking and knowing (Vass, 2008), as well as with current projects, for example, on the right for young people to have a well-rounded, or *whole education* (Dunford, 2012).

Technology integration was a focus in research that measured digital literacy interventions in nine British schools with 12 teachers. Findings from the study demonstrated that there were important school-based practices that developed the expansion of subject knowledge in classrooms. These practices included, for example, “more choice for students fostered independence and collaboration, and importantly, the teachers’ pedagogical processes focused on developing these ends” (p 8). It was also shown that students with lower academic abilities had greater opportunity to develop their subject knowledge. Integral to these learning methods were more effective approaches to Science, Technology, Engineering and Mathematics (STEM) to “transform learning and teaching and to inspire students to use their technical and creative ingenuity to address urgent social challenges in their

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8 CCE is a UK based charity where the focus is on the creativity of young people in and out of formal education, accessed 6 February 2013 [http://www.creativitycultureeducation.org/](http://www.creativitycultureeducation.org/)

9 The teachers in the study gave tentative definitions, some suggested it was about having technology skills to teach literacy and for others it meant whether students actively and critically engaged with multi-modal forms of technology and media – they used the term multi-literacies (Hague, 2010).

10 STEM is the acronym for the fields of study referring to teaching and learning in the categories of Science, Technology, Engineering, and Mathematics.
communities and around the world” (Hague, 2010, p. 22). Literature about technology integration in STEM is increasingly more common in education debates (Franklin, Ozercan Lui & Andre, 2012; MacKinnon, Alcorn & Avery, 2012; Stowe & Lin, 2012).

Creative projects involving partnerships with schools and creative practitioners from outside the school are the focus of recent CCE reports. Studies from these partnerships programs are useful in seeing the contextual picture of technology integration. The report *Creative Partnerships: Changing Young Lives* (2012) found creativity in schools’ organisation and teaching practices led to “hybridity” in teachers’ creative pedagogical practices. This notion refers to “greater permeability to let the outside world in with technology and family partnerships” (p.17). Evaluations of large partnerships programs with 4000 schools in England found “the programs gave students more mobility and time-flexibility to establish a space within the school world in which alternative ways of being and relating could be practised” (CCE, 2012, p.18). *Signature Pedagogies* (Thomson et al, 2012), in a partnerships report on 12 Midlands schools, found a repertoire of 19 pedagogical practices distinctive to creative practitioners’ teaching and they included:

- Provocation, use of artefacts, moving out of the classroom, making an occasion,
- use of ‘the texts of our lives’, the self as a teaching resource, costume, use of the body, different classroom discourse patterns, the creation of a rich narrative environment, the use of professional norms, alignment with disciplinary expectations, the valorization of collective endeavour, managing behaviours differently, the use of routine, flexibility in pacing, the use of open-ended challenge, building commitment to the community and permission to play. (p. 46).

Research from innovation units in universities, such as from the Centre for Applied Research in Educational Technology (CARET) at Cambridge University, found that design of social media tools had implications for the way technology was used by young people (James et al,
Aspects of technology design have pedagogical consequences for how social media tools, like blogs and wikis, are repurposed for learning by teachers in classrooms. Across various reports and projects there are commonalities in the need for better integration of technology developed around making, exploring, creativity, subject knowledge and inquiry-based approaches. This requirement often competes with discourses around school improvement. Partnerships in schools with creative practitioners are one way to support a fusion in teachers’ pedagogical practices that can open up more creative possibilities for technology integration in classrooms. Materials generated in the US have similar, yet different threads in various education policies and reports, and it is to that literature the review now turns.

### 2.2.2 The United States

The *No Child Left Behind* Act of 2001 (NCLB), well-known in education circles, was legislated to support standards-based education reform on the premise that high standards and the establishment of measurable goals improved individual outcomes for students in education settings (Hanushek & Rivkin, 2012). Now, well over a decade later, whether NCLB has achieved its original aim is the subject of significant ongoing debate (Darling-Hammond, 2010; Linn, Eva, Baker & Betebenner, 2012; Marx & Harris, 2012; Ravitch, 2010; Zhao, 2009). Education Acts, like NCLB, set a powerful focus for government policy agendas. In another blueprint for education reform, *Race to the Top* (US Department of Education, 2010a), the spotlight was on tests and accountability which arguably led many teachers in schools to “teach to the test” (American Federation of Teachers, 2012; Darling-Hammond, 2005; Strauss, 2012; Volante, 2004; Wurdinger, 2012). Testing regimes in the US policy context are important. When the education focus shifted to these concerns there was less time for schools to prioritise technology integration in classrooms and technology
research in schools had a diminished role in school reform in general (Ball, 2008; Schrum & Levin, 2009; Schrum, 2011; Ward & Parr, 2011).

However, diminution of the importance of technology integration in education was not apparent in five essentials of learning in a plan identified in Transforming American Education Learning Powered by Technology (U.S Department of Education, 2010b). It stated that “the gap in technology understanding influences program and curriculum development, funding and purchasing decisions about educational and information technology in schools, and preservice and in-service professional learning” (p.10). The report recommended that teachers empower and engage in learning that embraced technology (U.S Department of Education, 2010b). The importance of technology integration was placed alongside assessment, teaching, infrastructure and productivity. Such moves create tensions for schools and teachers, in terms of expectations about where to place the learning focus, and therefore issues of policy enactment arise (Ball, 2012; Goldman & Lucas, 2012; Jukes, 2010; Spillane, 1999; Ward & Parr, 2011; Zhao, 2009).

One technology integration initiative that arose out of Transforming American Education Learning Powered by Technology was STEM and the other was the Teacher Education Initiative (TEI) (Dilworth et al, 2012; Holman, 2010; Roschelle, 2010; U.S Department of Education, 2010). The first initiative required teaching STEM content to students in schools to promote deeper understanding of complex ideas and engagement in solving complex problems (U.S Department of Education, 2010b). Research in STEM and its intersection with TPACK knowledge growth for teachers was significant (Bos & Lee, 2012; Mishra et al, 2012b). Focusing on content in subjects like Science, Technology, Engineering and Mathematics was seen as an important lever for economic productivity and governments around the world became concerned that students were not learning this content nor making these occupations post-school career choices (OECD, 2011). At the same time, TEI, the

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11 The first STEM conference was held in Australia 2010.
second initiative, is part of the National Technology Leadership Coalition’s (NTLC) collaboration with Microsoft. This work builds on *Preparing Tomorrow’s Teachers to Use Technology* (PT3) and previous *Partners in Learning* (PiL) initiatives, and forms part of a ten-year, $500 million global initiative designed to support teachers use of technology in K-12 schools (Dilworth et al, 2012).

Technology-focused studies from public policy organisations and research hubs (Ito et al, 2013; Jerald, 2009; Pellegrino & Hilton, 2012), as well as technology social enterprises like KnowledgeWorks (combining New Tech Network, ED works and Strive) and The George Lucas Foundation (*Edutopia*), push imagination and possibility for what schools must look like into the future. Studies on websites like *Edutopia*, as a case in point, detail reports of technology integration targeting student-created media, online learning and project-based approaches to learning\(^\text{12}\). The study, *Connected Learning* (Ito et al, 2013), published by the Digital Media and Learning Research Hub, developed a model that focused on the links between “peer culture, interests and academic subjects to better support interest-driven and meaningful learning that takes advantage of the democratizing potential of digital networks and online resources” (p.87).

Research on deeper learning and 21\(^\text{st}\) Century skills is quite sparse and how learning is transferred between disciplines and contexts is not yet fully understood (Jerald, 2009; Pellegrino & Hilton, 2012). Some new understandings link to ideas of “learning to learn” and “creativity” in assessment frameworks comprised of dimensions of affective, cognitive and meta-cognitive skills (Jerald, 2009). Research from Harvard’s *The Good Project* (2012), as another example, found that technology integration had major implications in how young people respond to the changing world in schools, at home and in social environments (Carrie, 2009; Pettingill, 2008). This research, together with findings from a model of “good play” (James, 2009) determined that there are unique affordances of new digital media

\(^\text{12}\) A full list can be obtained at [http://www.edutopia.org/technology-integration-guide-description](http://www.edutopia.org/technology-integration-guide-description)
environments. Affordances relate to technical and new media literacy “as well as cognitive and moral development and values, online and offline peer culture, and ethical supports, including the absence or presence of adult mentors and relevant educational curricula” (p. 8).

Key technology integration enterprises like EDUCAUSE, International Society for Technology in Education (ISTE) and Society for Information Technology and Teacher Education (SITE) produce salient research. It is important to acknowledge the role of EDUCAUSE for instance, and its place in the close examination of technology in the higher education section. Often research from these contexts, such as, Bring Your Own Device (BYOD), has important repercussions for learning in schools (Grajek & Pirani, 2012). The peak body, ISTE, sweeps under its purview research leadership through the work of CARET (Centre for Applied Education Research in Technology) and the National Educational Technology Standards (NETS). In the US, education policy and reports that target testing regimes and accountability create resourcing, curriculum and pedagogical concerns for teachers. Broader issues of the creation of engaging learning environments that students require to move out into the world beyond school are often lost to more prescriptive models of teaching where technology integration is missing, or at best, given a glance in passing. Professional technology organisations that are education focused, like those in the US, are fewer in number in Australia, and it is to policy and report literature from Australia that the review now turns.

2.2.3 Australia

In a four-year plan that targeted the *Melbourne Declaration* (MCEETYA, 2008a) goals, there was policy concentration on school partnerships, quality teaching, school leadership, world class curriculum, improving outcomes for disadvantaged young people and transparency and accountability (MCEETYA, 2009). No specific mention of the role of ICT or technology integration was made, although it could be assumed technology integration
was wrapped up in delivery of key education strategies and initiatives identified and
developed at the same time and more recently (ACARA, 2012; DEEWR, 2008). The shift in
education policy to focus on issues of performativity was noticeable during this time and
reflected international education policy trends (Ball, 2009; Dfe, 2010; Lingard, 2012; US
Department of Education, 2010b; Ward & Parr, 2011). Research on the effects of
technology integration on learners in OECD countries was identified as scant, and hesitation
about emerging technology environments was evident in *New Millennium Learners* (OECD,
2008). The report found gaps in empirical findings of the value of technology in learning:

> There is an urgent need to know more about these effects, but it would be misused if
it only served to draw attention to a fictitious image of empowering effects of
technologies on all children and youngsters equally. (p.20).

The view reflected findings from a review of literature commissioned by the Australian
Information and Communications Technology in Education Committee (AICTEC) that
identified how teachers rarely changed the way they taught when they used technology
(Moyle & Owen, 2008). Technology in schools was not used to “foster higher order
thinking, analysis, synthesis or creativity in their learning” (p.11). In a framework released
later the same year, ten elements of quality schooling were identified (MCEETYA, 2008b).
Among those elements that targeted technology were “personalising and extending learning;
connecting learning beyond the school; developing, measuring and monitoring digital
literacies; providing, accessing and managing teaching and learning resources; and the
provision of reliable infrastructure”(p.4). Scattered among the elements were others that
focused on “enabling leadership, professional learning, improving assessment and reporting,
accessing and utilising student information and business processes” (p.4). This listing of
elements might suggest that technology integration in Australia was not as important in
schools, although it was given equal attention in policy documentation. Not long afterwards
the need for a stronger role for technology integration was cited in new education policy. For
example, the Department of Education, Employment and Workplace Relations (DEEWR, 2008) turned the focus on schools to provide “sustainable and meaningful changes to teaching and learning in Australian schools that are vital for education, training and work in a digital world” (p.1).

After this time, funding flowed from the Australian Government’s Digital Education Revolution (DER). In NSW, the site of research in this thesis, funding meant a significant proportion was allocated to one laptop for every Year 9-12 student in a public school over a period of four years (Howard et al, 2012). The roll-out of hardware into schools across Australia had a flow-on effect, with importance being placed on the growth of students’ technology capabilities through curriculum. This action was most visible in national curriculum documentation from ACARA, in General Capabilities in ICT (2012) in which the following definition was presented: “capability involves students learning to make the most of digital technologies available to them, adapting to new ways of doing things as technologies evolve and limiting the risks to themselves and others in a digital environment” (p.4). Notions of safety and risk to students from technology were seen as important. More urgent were significant variations in students’ ICT literacy found in numeracy assessments across the country (COAG, 2008). Results were associated with “socioeconomic background, Indigenous status and geographic location” (p.45). This was a pivotal moment, with all states and territories in Australia accepting more responsibility for technology integration in schools, and this move was reflected in education reports, research and teaching standards frameworks.

Attention given to technology integration in Toward Q2: Tomorrow’s Queensland (Queensland Government, 2008) was one such case. It focused attention on the issues of economy, lifestyle, education, health, and safe and caring communities. In Victoria, technology integration revolved around an Ultranet to deliver a standardised learning platform with data about students (Department of Education and Early Childhood
Development, 2010). Central to State priorities in these jurisdictions was $16 million from the ICT Innovation Fund that supported four further initiatives: the first was *Teaching Teachers for the Future* (TTF) project, aimed at building technology capacity among preservice teachers in universities; the second was development of ICT in everyday learning in an online teachers’ toolkit; the third was pathways for learning anywhere, anytime involving a network for educators (PLANE); and the fourth was leading ICT learning in technology-enabled schools to create a technical framework for sharing, discovery and use of content in different eLearning environments to support the Australian National Curriculum (DEEWR, 2012).

Evaluations and research on DEEWR initiatives began to emerge (Albion, 2012a, 2012b; Jamieson-Proctor et al., 2012). In one study (Finger et al., 2013), data from preservice teachers in 39 higher education institutions in a TTF TPACK survey reported “measurable growth in confidence of initial teacher education students to use ICT as a teacher” and also “measurable growth in their confidence to facilitate students’ use of ICT as future teachers” (p.23). Positive effects of growth in confidence are mirrored in an evaluation report that showed NSW teachers starting to use DER laptops 2-4 times per week with students in classrooms (Howard et al, 2012). Furthermore, “increased usages were found in English and Human Society & Its Environment” (p.48). Parents were found to believe laptops made a difference to their child’s learning and teachers cited the importance of school leadership in enhancing positive beliefs about using laptops in teaching (Howard et al, 2012).

Professional bodies play a vital role in technology integration in Australian education contexts. For instance, the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) supports research into the use of technologies for teaching and learning, and in schools, the Australian Council for Computers in Education (ACCE) conducts teacher professional learning in technology. Professional teaching standards are a further avenue used by government to ensure technology integration in classrooms.
Particular standards aimed at improving professional preparation of teachers cite teachers’ technology practice through the lens of safety, responsibility and ethics (for example, in Standard 4.5 in AITSL, 2012)\(^\text{13}\).

In summary, policies and reports in Australia, the UK and the US focus on supporting technology integration in practice. The policy agenda in all three countries is replete with a dual focus on accountability and testing, along with calls for more creativity in learning at education sites. Reports on research from UK organisations target technology innovations, digital literacy and partnerships with schools and creative practitioners. In addition, in the US, STEM and the *Teacher Education Initiative* (TEI) are important in technology integration, and websites from research hubs feature new research on *connected learning* and *good work* projects. In Australia, the shift in policy focus to standardised regimes was palpable after reports flagged gaps in the valuing of technology (OECD, 2008) and significant variation in students’ ICT literacy emerged (COAG, 2008). Three Australian States have used Federal funding for technology initiatives in schools and in NSW teachers’ confidence in technology integration using laptops has grown since the start of the DER in 2009. The TTF project, targeting teacher education institutions, has reported measurable growth in preservice teachers’ technology confidence (Howard, Thurtell & Gigliotti, 2012).

In all three countries, professional bodies play an important role in ongoing development and enhancement in teachers’ technology integration learning. Nevertheless, there is little research and few reports to date on what technology integration looks when it is going well in education settings (Ertmer, Gopalakrishnan & Ross, 2001, 2006; Finger et al, 2007; Lane, 2012; Schrum, 2011). Arguably, the proclamations in education policy, reports and professional standards (AITSL, 2012; DEEWR, 2008, 2012) have commonalities with

\(^{13}\) Full detail of the standard can be accessed at [http://www.teacherstandards.aitsl.edu.au/Standards/AllStandards/4](http://www.teacherstandards.aitsl.edu.au/Standards/AllStandards/4)
international education contexts in schools (DfE, 2010; U.S Department of Education, 2010), as do key debates and issues in technology integration reviewed in the following section.

2.3 Major issues and debates

Five major issues important to this thesis are located in further relevant research. The first issue of importance focuses on various technology integration approaches used by teachers in classrooms. The second issue shows how social networking tools are being conceived for learning in classrooms. The next involves scrutinising the popular catch cry of 21st Century learning. The fourth looks at specific research on the role of technology integration and student achievement, and in the final section research on professional development in technology integration for preservice and experienced teachers are examined. Each of these will be discussed in turn in the next section of the Chapter, starting with issues surrounding different technology integration approaches used in classrooms.

2.3.1 Technology integration approaches used in classrooms

Technology integration in school classrooms varies; issues of what device, what approach and what strategy require examination. This first section of the Chapter divides research on technology integration issues into two areas: one-to-one computing, the interactive whiteboard and mobile learning; and research benefits of project-based learning (PBL) approaches.

What’s in a name: one-to-one computing or 1:1 or personal laptops?

When Papert wrote the seminal edition of Mindstorms (1980) he reported that children learned to use computers in masterful ways and that learning by using computers could change the way they learned everything else. Since then, many studies (Dunleavy, Dextert & Heinecke, 2007; Dunleavy & Heinecke, 2007; Fluck, 2011; Hayes, 2006; Howard et al, 2012; Larkin & Finger, 2011; Penuel, 2006; Russell, Bebell & Higgins, 2004; Toy, 2008;
Zucker & Hug, 2007) have uncovered positive effects of learning with one laptop for each student (1:1) in classrooms. One of the main obstacles to implementing this teaching possibility was what it would mean for pedagogy and teachers’ lack of understanding in how laptops were, or could be, used as learning tools (Owen, Farsail, Knezek & Christensen, 2005-6; Peneul, 2006). Teachers started to adjust their practice, although not all teachers started to teach in more student-centred ways (Garthwait & Weller, 2005). This was not the case in another study in English and Humanities, History, Mathematics and Science teaching, where teachers reported students as being more involved with other students and engaged in in-depth research, helping one another and being excited about giving presentations (Grimes & Marschauer, 2008; Zucker & Hug, 2007). Furthermore, research on laptops in classrooms in a one-to-two ratio (1:2, one laptop between two students) challenged the assumption that one-to-one was better (Larkin & Finger, 2011). In a NSW evaluation, teachers’ knowledge of technology integration had improved when one-to-one laptops were used in classrooms, but less usage of laptops was reported by mathematics and Personal Development Health and Physical Education (PDHPE) teachers (Howard et al, 2012). Another technology tool that requires specific scrutiny, in terms of its place in the classrooms of teachers in this study, is the interactive whiteboard.

*Interactive whiteboards: For the teacher or the students?*

Interactive whiteboard installation in NSW schools and across Australia is now ubiquitous and the phenomenon reflects international patterns (Hunter, 2011; Kearney & Schuck, 2008). Understanding how interactive whiteboards aid learning is still not well understood and few studies (BECTA, 2003; Higgins, Beauchamp & Miller, 2007; Kennewell, Tanner, Jones & Beauchamp, 2008) have managed to confirm or deny the technology’s learning impact (Beauchamp & Parkinson, 2005; Jang & Tsai, 2012; Jewitt, Moss & Cardini, 2007; Northcote, Mildrenhall, Marshall & Swan, 2010). The value of the technology as an organisational tool was positive in research that found it encouraged teacher-student
interactivity (Winzenried, Dalgarno & Tinkler, 2010). Notwithstanding, often its use could be too teacher directed with little work that incorporated student-centric uses (Kearney & Schuck, 2008; Jang & Tsai, 2012). Benefits of self-efficacy and perceived value to teachers in classroom learning were associated with higher levels of interactive whiteboard training and support. More attention to teacher professional development was required for better technology integration of specific content (Peled, Medvin & Domanski, 2012). Mobile learning devices are another technology used often by teachers in this thesis, and the theoretical basis for the technological, pedagogical and content impacts in school contexts are only just starting to be better understood.

**Mobile learning, also called learning with technology when not at a fixed location**

Authenticity, collaboration and personalisation are three central features of a pedagogical framework that was tested in two projects aimed at critiquing pedagogy in a range of mobile learning scenarios with preservice teachers (Kearney et al, 2012a). Important socio-cultural perspectives were found from the study, including unique teaching challenges in emerging mobile environments. These have implications for the ways experienced teachers design learning experiences for students and the resources they allocate to them (Kearney et al, 2012a). This advice is heeded in research (Bennett, 2011; Melhuish & Falloon, 2010) on affordances and limitations of the iPad, in the wider context of emergent mobile learning theory. While technology may aid learning in education contexts, the way it ends up being used cannot be determined until it is used by real students in real settings (Sharples, 2007).

In their critical review of the iPad in learning, Melhuish and Falloon (2010) placed importance on ensuring teachers created learning experiences that were flexible and co-constructive in their approach. The iPad was not primarily designed to solve problems in education. Apps\(^4\) and the role they play on mobile devices are therefore important in

\(^4\) The term “app” is an abbreviation for “application” and has been used in the information technology (IT) community for a long time.
teachers’ pedagogical decision-making (Dickens & Churches, 2013). The notion of bring you own device (BYOD) means there is an element of choice in what technology to bring to class and technology policies in Australian schools are beginning to embrace the idea (Wever, 2012). The ready access to personal learning devices, in the context of project-based learning approaches, creates powerful student engagement in classrooms (Chen, 2010).

**Project-based learning approaches**

Students learn more deeply when they can apply classroom knowledge (Chen, 2010). These findings and other benefits were revealed in a comprehensive review of hundreds of innovative classroom practices that investigated project-based, inquiry-based and cooperative learning approaches (Barron & Darling Hammond, 2008). What was essential in these studies was that teachers provided students with support and assessment as projects unfolded (Boss & Krauss, 2007; Chen, 2010; Thomas, 1999). Active learning practices were found to have more significant impacts on student performance than any other variable, including student background and prior achievement. When students are taught how to learn, as well as what to learn, they are successful (Barron & Darling Hammond, 2008). Social networking tools played a role in project-based learning approaches for the teachers in this thesis and this issue is the focus of the next section.

**2.3.2 Teachers and social networking tools for learning**

“We are a nation of bloggers” state two US based technology researchers in education (Solomon & Schrum, 2007, p.14). The same could be said of blogging activity in the UK and Australia. School blogs in some classrooms were found to be highly useful constructivist tools for teachers (Churchill, 2009; Hunter, 2010; Kist, 2010; Richardson, 2010). Research in two classrooms showed how one teacher’s use of blogs supported activism and engagement in school life, and the other used a series of blogs for learning (Hunter, 2010). The first blog in the series was private and students could make entries on a ship’s log in a study of
explorers; a second was used for parents to view what their child learned in the classroom, and a third blog facilitated interaction between classrooms in different countries (Hunter, 2010). Teachers liked using blogs for many reasons, including hearing from quiet students, enhanced written output from all students, encouragement of independent work and parent-school partnerships. The use of blogs for learning in classrooms forced teachers to take pedagogical risks (Hunter, 2010; McWilliam, 2009; Warlick, 2007). The term 21st Century learning is often heard in the context of social networking tools like blogs and as such, requires closer study. This issue forms the centre of literature scrutiny in the next section.

2.3.3 21st Century learning: fact or fiction?

Some years ago, a call was made for education leaders to dig deeper than the “flashy phrases” and “poorly defined buzzwords” that tended to characterise “21st Century skills or 21st Century learning” (Jerald, 2009, p.2). Ideas of teachers and students needing particular skill-sets are built on the premise that the world has changed and therefore, acquiring and applying new knowledge with dexterity in problem-solving, communication, teamwork, technology use and innovation are necessary (Ananiadou & Claro, 2009; Hargreaves, 2011; Trilling & Fadel, 2009). The shift to a 21st Century Knowledge Age was central to this definition “where the balance of what is needed and valued in work, learning and life in lifelong learning is here to stay” (Trilling & Fadel, 2009, p.19). The vision of 21st Century schools arose out of the plan Transforming American Education: Learning Powered by Technology (US Department of Education, 2010b). School leaders were expected to enact change, and technology, with “enhanced pipes and wires” as the drivers (Hargreaves, 2011; Schrum & Levin, 2012). Simply asking teachers to address a long list of inadequately defined skills was not sufficient and in one framework alone 22 separate sub-skills were deemed necessary to succeed in the 21st century (Jerald, 2009). So what kind of skills and what kinds of knowledge? Attention was drawn to content knowledge and applying knowledge to solve real world problems, as preferable to thinking knowledge of disciplines.
Arguably, skills like problem-solving should not be taught in isolation. Skills set out in the *Partnership for 21st Century skills* (2011) framework\(^\text{15}\) were endorsed by professional organisations and government entities in the US and were propelled by three considerations:

The US is losing its position as a world leader in education, schools have been slow to integrate technology and preservice education and professional development are not supplying teachers with the knowledge and skills needed to provide the type of education currently demanded.

(Joyce & Calhoun, 2010, p. 51).

The sense of global urgency around technology integration in schools was also felt in Australian and UK education jurisdictions (Ananiadou & Claro, 2009; Hargreaves, 2011). Other literature reinforced the notion that 21st Century skills were contestable and therefore it was the role of teachers in their contexts to define what technology developments were essential (Darling-Hammond, 2008; Hattie, 2009; Kay, 2010; Wagner, 2008; Zhao, 2009). It is not perhaps an either/or debate, but more the case of “what” 21st Century skills and curriculum (Chen, 2010). Reservations around technology integration and its impacts on student achievement are another contentious debate that may account for slow rates of technology adoption in some schools. The issue was raised by the teachers in the research in this thesis, and the next section turns attention to the controversial issue of technology integration and student achievement.

2.3.4 Technology integration and student achievement

On the home page of the website *Edutopia* (2012) there is this statement:

A growing body of evidence supports the contention that collaborative learning methods and leadership aimed at improving schools through technology planning impacts student achievement and academic performance in content learning, higher-order thinking and problem solving skills and preparation for the workforce.


Not all education documentation holds the same unequivocal view. There was contention in some research (Finger et al, 2007; Means, 2010; Schrum, 2011) that teachers’ practices need to be investigated in conjunction with studies of technology effects on student learning. Many studies centred on how technology was used for performance assessments of students in portfolios, online tests and digital proficiency (Barrett, 2007; Finger et al, 2007; Howell, 2012; Pellegrino & Quellmalz, 2010; Tuttle, 2008).

Two studies that demonstrated strong links with technology integration approaches and student achievement involved Quest Atlantis16 and research on teachers’ use of reading and mathematics software in classrooms. The first study involved sixth grade students using such software, who showed larger gains in understandings and achievement than those in classes that used expository texts to learn the same skills (Hickey, Ingram-Goble & Jameson, 2009). The other, a study of teachers in 14 schools who were given new software products, found that implementation practices mattered, and the differences in school results arose out of consistent instructional vision, principal support, teacher collaboration, technical support, formal and informal training, and access to a helpdesk/email/website (Means, 2010). There are challenges for education research in this area. Some scholars (Jordan & Dinh, 2012; Schrum, 2011; Staples et al, 2005) have already identified unrealistic expectations for

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16 Quest Atlantis is now being maintained as part of the Atlantis Remixed Project, it is an international learning and teaching project that uses 3D multi-user environments to immerse children, ages 9-16, in educational tasks, access the site http://atlantisremixed.org/
technology-based reform, lack of consensus on research questions and methodologies, and a diminished role in general of research in education reform as causal factors. Professional development of teachers in technology integration is consistently raised as an important issue in debates on improving student achievement in schools (Ertmer & Ottenbriet-Leftwich, 2010). Matters of professional development in technology integration are reviewed in the following section.

2.3.5 Professional development for preservice and experienced teachers

At times, technology integration in education means ‘hardware roll-out’, with little or no funding allocation for teacher professional learning (Baldwin, 2011; Hunter, 2011; Kinash, 2012; Mitchell et al, 2010). Research in this area shows common themes and it is useful to appraise a few significant examples. In a study that used an online survey of teachers of Year 9-12 students, it was demonstrated that a greater amount of professional development did increase both readiness and implementation levels (Baldwin, 2011). In addition, professional development models that included instructor-organised sessions and individualised learning had a positive and significant relationship with readiness and implementation levels. These findings confirm what Hughes (2005) had found earlier, in case study research that revealed positive effects when teachers shared their knowledge and questions, connected their professional learning to the contexts of teaching in their subject area and actively engaged with other teachers.

It was hardly surprising that if teachers were required to be transformative around their technology use in classrooms, then examining what informs, develops and propels their professional knowledge when leveraging technology during instructional practice was crucial (Darling-Hammond, 2008; Hervey, 2011; Mishra & Koehler, 2008). In a study of 15 mathematics and biology teachers the TPACK framework was highly useful in teacher development projects (McGrath, Karabas & Willis, 2011). Also identified in the study were
important knowledge domains outside of TPACK, for example, “logistics and collaboration, diffusion of learning and differentiated instruction” (p.22).

In summary, recent research on major issues and debates in technology integration targets personal laptops, interactive whiteboards and mobile learning, and useful approaches to the inclusion of blogs in classroom practice. The research also shows that understanding what 21st Century skills mean for teachers and schools are more effective when based on contextual considerations. Student achievement and its links to technology integration are strong in some schools and when teachers use games like Quest Atlantis in subjects like Mathematics and English for understanding concepts and expository texts, students’ results improve. Professional development to support technology integration learning is often scant, but when it does occur, examples found that if teachers can share their knowledge, ask questions and practice what they are learning in their subject area it is preferable. When opportunities are provided for in situ mentoring, with a technology leader in a co-teaching relationship in the classroom, confidence levels in less ‘technology savvy’ teachers increase. Teachers’ knowledge of technology integration in this thesis foregrounds creativity in pedagogical practice. It is to that topic the focus now shifts.

2.4 Creativity

If 21st Century skills are appearing more frequently in education jargon, then so too, is creativity. Recent decades show increased awareness of the societal need to cultivate creative thought, leading to what Craft (2005) refers to as a “revolution of creativity in education” (p.3). To maintain appropriate focus in this section of the literature review and address the central research question in the thesis, it is important to examine aspects of creativity in three parts. The first part appraises definitions of the term and cautions around notions of creative learning. The second section features seminal research in creativity, in particular the work of Craft, Gardner and Robinson. The third section sifts through creativity and its appearance in
some media and digital cultures research. The review now turns to definitions of creativity and creative learning.

2.4.1 Definitions of creativity, creative learning and other creative ... things

Extracting a concise definition of creativity in the literature ranges from ideas around ‘novelty considerations’ to ‘intrapersonal creativity’, sometimes called Little c or Mini c, to creativity in Pro-c and Big C constructs (Beghetto & Kaufman, 2007; Craft, 2001; Plucker, Beghetto & Dow, 2004; Runco, 2007). The view about Mini c, or intrapersonal creativity, is that it can be achieved by anyone because the judge of creativity is oneself (Beghetto & Kaufmann, 2007). Little c was seen to be more prosaic in that it referred to producing a novel outcome that was appropriate to other people in particular social contexts (Craft, 2000, 2001, 2005). Recent research in Australian classrooms identified another type of creativity referred to as ed-c or educational creativity that was found in student outcomes of learning in schools or universities (Lassig, 2012). In contrast, creativity in Pro-c is demonstrated by individuals who have made a significant contribution to their field, and Big-C is rare, and refers to those people whose creativity was unquestionable – for example, Shakespeare, Einstein and Mozart (Beghetto & Kauffman, 2007; Craft, 2001; Csíkszentmihályi, 1996). An important distinction was made that creativity emerged from the individual who mastered a discipline or domain or practice, and the cultural domain within which the individual was working, as well as the social field that provided access to the relevant educational experiences (Csíkszentmihályi, 1996). All of these understandings are useful for education and in practice, assist educators to think about and identify creativity. Possibly, the newer notion of ed-c or educational creativity provides a working definition for this thesis and in school contexts this description will resonate with teachers. The question of who judges creativity is significant and in the context of ed-c, the judge was the teacher, or students in peer-
assessment tasks. It is necessary at this point to consider creativity in the broader idea of creativity. This term is also useful for this thesis.

A term that emerged through education policy as opposed to research, creative learning, is still an expression in search of meaning (Sefton-Green, 2008). Its definition is situated “somewhere in the ‘middle ground’ between creative teaching and teaching for creativity” (Jeffery & Craft, in Sefton-Green, Thomson, Jones & Bresler, 2011, p.129). Controversial was the contention that school success rarely demands creative learning and if it really meant ‘genuine learning’, then thoughtful understanding and effective transfer were more accurate notions (Wiggins, 2011). Such accounts stand in stark contrast to regimes of testing and accountability (Craft, 2011; Darling-Hammond, 2008; Zhao, 2012).

It is helpful to map some of the definitional rhetoric around creative affordances of technology and conversations on creative classrooms. Caution is warranted in education settings as the relationship between users, that is, teachers, students and applications are often under-theorised. Furthermore, there is strong belief that narrowly marketised responses to creativity in some schools may limit creative engagement (Craft, 2011b). Questions are raised around whether the use of technology is inherently creative in, and of, itself (Banaji, 2011). Banaji’s critique states that a focus on pedagogy must consider “contextual and cultural anchors rather than rigid boundaries of discipline” (p. 41). This view aligns with recent moves to shift emphasis in TPACK, for example, to notions of trans-disciplinary thinking (Mishra et al, 2012b). Teachers being able to practically interpret what this means and to focus on creative learning, given current excellence and standards debates and intrusive ‘audit cultures’ in schools, is sometimes identified as problematic (Balshaw, 2004; Banaji, 2011; Chen, 2010; Jeffery & Craft, 2004a; Craft, 2011a; Lassig, 2012; Newton, 2012; Starko, 2005; Zhao, 2012). Whose voices are heard in creativity debates? The voice turned to first, in the next section of the Chapter are the shaping contributions made by Craft, Gardner and Robinson. Their ideas are critical for this thesis, because these scholars conceptualise
visions of schooling that are inclusive of creative and empowered visions for classrooms and see engagement in learning that is more in tune with the ‘connected lives’ of young people in today’s world.

2.4.2 Craft, Gardner and Robinson ... a few creative minds

One creative mind: Craft

Solutions to debates about creativity in education often revolve around Western conceptualisations that focus on the role of curriculum, flexibility and school structures, domain knowledge and interdisciplinary links in creative thinking (Craft, 2005). Such solutions have led to examination of the connections between knowledge and creativity, and the relationships between creativity and innovation (Craft, 2001a, 2001b, 2002, 2005, 2007, 2008). Ideas such as these invite educators to rethink matters of contextualisation in schools, and if actions like these occurred in the realms of research and education then there are significant implications for perspectives on creativity, language, curriculum and pedagogy. An important and provocative lens (Craft, 2005) was provided quite early on, that on the one hand questioned the promotion of children’s creativity in schools, and on the other, identified a “parallel drive towards technicisation and bureaucratisation, which, it was argued had the effect of reducing creativity in the teaching profession” (p.10). Absent from this early work (Craft, 2005) was the issue of how to assess creativity. Since then, ideas and assessment frameworks have shaped creativity characteristics around useful proposals that incorporate shared learning goals and self-assessment (Baer & Garrett, 2010; Banaji, 2006, 2011; Burnard, 2011).

Identification and analysis of the creative process were both seen to be grounded in newer socio-cultural theories (Bandura, 1989) that grew out of original work by Vygotsky (1986). The position was, that if creativity was conceived in these terms it could move away from innovation for innovation’s sake and into more human approaches that reflect on the
personal, social, cultural or environmental value of the creative product (Craft, 2007, 2008).

Key shifts in conceptions of creativity were described as dependent on economic, social and technological drivers in spite of the palpable “performative backdrop” in schools (Craft, 2011). Craft argued that this shift, in turn, linked to “environment/ecological and spiritual drivers for creativity” (p.21).

Important considerations are determined in Craft’s (2011) “probable education futures” and these are reviewed in the next section of the Chapter. Knowledge of technology integration manifests in highly creative ways in the pedagogical processes of the teachers in this thesis. Visions for school classrooms described by Craft (2011, 2012) align with views of childhood and youth as “empowered not at risk” in digital landscapes, and also mirror what was observed at the four sites in this research. There is balance in Craft’s (2005) notion of LifeWork between how “creativity must engage with the needs and rights of the inward, in the home and the personal, and with the outward, in work and in public life” (p.150).

Arguments for fostering creativity in ethical or humane contexts are found in research and ideas of Gardner (2006, 2008).

Projects and the work of Gardner

Research and ideas concerned with notions of humane creativity are captured in the work of five minds (Gardner, 2006) and build on thinking from multiple intelligences, creating minds and the Harvard Project Zero (Gardner, 1983, 1993, 2006, 2008). The minds (disciplined, synthesising, creating, respectful and ethical) could also be described as ‘five capacities’ or ‘five perspectives’ but, for educators serve as reminders that actions, thoughts, feelings and behaviours are products of the brain (Gardner, 2008). The idea of a creating mind comes together with the synthesizing mind and plays out in different work settings; it offers opportunities for working alone, but more powerful was working in concert with others (Gardner, 2008). In this model, creativity goes hand-in-glove with disciplinary thinking, which suggests it is not possible to be creative without the relevant disciplines. Gardner
(2008) invited teachers to embody the five minds. He pointed out society was relatively blind to the importance of these minds until recently; instead it was preoccupied “with standardised test mentality that has gripped both policy makers and the public” (p.164). Such views resonate with other creativity scholars (Craft, 2005; Robinson, 2001).

The call to “focus on the content” was also made by Gardner (2000) who determined that the realm of truth, beauty and morality are the “meat and potatoes of education” (p. 16).

Drawing on studies of Art, Science and historical inquiry, his assertion was that education for all human beings needed to explore, in some depth, a set of key human achievements based on these realms. He argues that it is the preserve of education to fashion certain kinds of individuals who are literate as a consequence of probing important issues and learning how to think about them in disciplined ways. The focus on individualised education with a lack of a ‘fixed canon’ caused considerable debate (Hirsch, 1996) as did Gardner’s belief that preservation of the strengths of ‘traditional humane education’ was the best preparation for younger generations for the challenges of the future.

Globalisation and its impacts have contributed to further developments of Gardner’s thinking and warnings were issued for the need for vigilance on STEM disciplines, for instance, that they did not come at the expense of other fields of human knowledge and ethical practice (Gardner, 2011). The Good Work project, Our Space: Being a Responsible Citizen of the Digital World, was designed to encourage high school students to reflect on curriculum in terms of the ethical dimensions of their participation in new media environments such as Facebook\textsuperscript{17}, YouTube, online games and blogs. Findings showed adolescents try to take their activities seriously, and confront day-to-day interactions ethically, in online communities\textsuperscript{18}.

Core themes in the curriculum targeted identity, privacy, authorship and ownership,

\textsuperscript{17} Facebook is an online social networking tool that connects people with friends and others who work, and live around them.

\textsuperscript{18} The project can be accessed at \url{http://henryjenkins.org/2011/11/ourspace_being_a_responsible_c.html}
credibility and participation. When this thinking was proposed it was found that it tested teachers’ own conceptual frameworks, and encouraged them to act out of reason and not out of fear in new digital environments (Jenkins, 2011).

In a recent address, *Reframing Education*, the struggle between ‘test scores’ in current education policy and the ‘focus on the individual’ again raised its head (Gardner, 2012). Be that as it may, the overriding emphasis was given to teachers developing notions of respect and trust, alongside “depth, breadth and stretch” in the disciplines. There are many synergies in the scholarship of creativity in Gardner’s work, with that of Craft, and of Robinson. Synergies also exist in notions of creativity and humane learning in the classrooms of the teachers’ in this research. If teachers have to spend significant amounts of time with highly prescriptive elements of curriculum, then there is less time for creative, open-ended projects. Such approaches to learning feature in the work of Robinson.

**Robinson: “Schools kill creativity”?**

Robinson’s 2006 proposition went viral on YouTube. Another of his important understandings about creativity was that “as children we thought of ourselves as highly creative when as adults most of us do not” (Robinson, 2001, p. 4). Questions were raised at the time on why schools, business leaders and politicians must promote creativity in education (Robinson, 1998, 2001). The thinking behind these questions was that many people think they are not creative and understanding what happens at school to curtail this thinking is vital. Arguably, steps could be taken at a societal level to develop creativity in a deliberate and systematic way (Robinson, 2006). Like Gardner, Robinson (2011) pleaded for radically different approaches to education leadership, teaching and professional development to help meet the challenges of living and working in the 21st century. These ideas sought recourse to consciously developing “imagination and creativity within a

19 The proposition had over 14 million hits on YouTube, and can be viewed at [http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html](http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html)
different framework of human purpose” (Robinson, 2009, p. 260). Cries for a creativity focus in education are long-held and yet, it is only in comparatively recent times that creativity is being talked about in broader education debates (Craft, 2001, 2005, 2011, 2012; Gardner, 2008; Resnick, 2012; Sefton-Green & Bresler, 2011, Robinson, 2001, 2006, 2011, 2012). The early report of a national advisory group chaired by Robinson (1999), the *Committee on Creative and Cultural Education*, showed there was recognition that the promotion of creative and cultural education would not be a simple matter, it would “require education on many levels to develop the capacities of young people as fully as possible, so they will be equipped for whatever futures they do meet” (p. 10). The report unleashed a range of policy activity in the UK, including work to codify creativity in the curriculum (Craft, 2011) and some critique of what creativity would mean for education practice (Peters, 2009).

Literature in this section of the review suggests momentum for creativity and creative learning in education in schools has arrived. While there have been significant movements in scholarship and the notions of creativity for more than a decade, perhaps global disenchanted with ‘testing regimes’, disengagement with schooling models in their current form, the call for different learning approaches, plus a critical mass of technology in the hands of young people – and now teachers in schools – have converged to hasten a more serious focus on creativity and imagination in education (Chen, 2010; Craft, 2011; Darling-Hammond, 2010; Gardner, 2008, 2012; Pink, 2005; Ravitch, 2013; Resnick, 2012; Robinson, 2011; Sefton-Green, 2011; Thomas & Seeley-Brown, 2011; Zhao, 2012). For example, digital media and tasks like film making in classrooms, encourage development of students’ visual literacy skills (Knobel & Lankshear, 2010; Scorsese, 2012). It is notable that such schemes feature in conceptions of technology integration in the classrooms of teachers in this thesis, and in the next section, some important research in that area is examined.
2.4.3 Creativity, media and digital cultures research

Attention was drawn in some educational research to the deleterious effects of technology and media on children and young people, and often it is these kinds of pronouncements that make teachers, parents and education systems nervous (Healy, 1999; Palmer, 2006). Others argue that commencing with an ‘asset model’ allows texts to be seen as porous and that when teachers use various technology mediums it allows children to develop a range of potentially transferable competencies (McCredie, 2007; Newton, 2012; Thomas & Seeley-Brown, 2011; Willett, Robinson & Marsh, 2009). In research that drew on conversations from readers, viewers and players, Mackey (2009) developed the idea of ‘thick play’ and ‘big worlds’ are used to describe “forms of activity that extend beyond the limits of one text” (p. 93). Such activities offer opportunities for lingering in a particular fictional world. Many computer games create ‘big worlds’ as they allow ever-expanding content and in games like Scratch\textsuperscript{20} for example, students have opportunities to create interactive stories, animations, mathematics games, music and art that can be shared and worked on collaboratively. The existence of such activities and the opportunities for playful moments, were important considerations in framing the selection criteria for the teachers for the case studies in this thesis.

Beliefs that students become expert and develop specialist expertise supports development of tacit skills in both old and new media in what Mackey (2009) stated meant “both excitement and safety became powerful supports for learning” (p.106). This view corresponds with earlier research involving video-making projects in curriculum, which pointed to the importance of teachers being focused on the pedagogical uses that shape these kinds of technology-rich learning scenarios (Levin, 2003; McKenny & Voogt, 2011; Scorsese, 2012; Sefton-Green, 1999; Theodosakis, 2002; Sawyers et al, 2007). In summary, research in creativity found there are various definitions and ideas that are suitable for creative learning.

\textsuperscript{20}Scratch is a programming language that is used to create interactive stories, animations, games, music, and art.
approaches in schools. More humane approaches are core drivers, suited to the future of schooling and a focus on STEM disciplines may come at the expense of others field of human knowledge and ethical practice. Across the literature, radically different approaches to education leadership, teaching and professional development may be required to foreground the importance of creativity in education, and much can be learned from digital media and the making of films to develop students’ visual literacy. Play and notions of ‘thick play’ and ‘big worlds’ activity have an important pedagogical role in teachers’ development of students’ creativity.

2.5 Futures

Seismic shifts occur in nature and in education in schools from time to time (Craft, 2011). Such moves require addressing the changing ends, or goals of education, as well as the means. Several important themes rise in the plethora of new literature generated almost daily in what constitutes the future for education. However, it must be acknowledged that wider coverage of ‘futures’ literature is beyond the scope of the thesis. The final section of the Chapter addresses three seismic shifts for education in schools through the lens of educators whose work is of key importance to the central research question in this thesis. The first shift is big learning for the future. The second shift involves spaces for the future, and the final section, focuses on thinking for the future. The first shift of big learning for the future draws on ideas of lifelong learning, play and imagination.

2.5.1 Big learning for the future

In this thesis, the term big learning for the future can be used to refer to the combination of three visions: the first is from lifelong learning in futures literature (Jukes, 2010, Facer, 2011); the second places focus on the importance of disciplined learning (Gardner, 2008; Richardson, 2012) and the third is about possibilities, including playfulness (Craft, 2011b) and shared imagination (Thomas & Seeley-Brown, 2011).
In defining new lifelong learning roles for educators, emphasis was given to making the transition from teaching students, to learning with students – and possibly learning from students (Jukes, 2010). Ideas like these suggest that schools’ essential purpose will be of learning organisations, where teacher learning makes the organisation stronger and keeps it relevant. This notion has implications for the broader education landscape beyond school (Facer, 2011). Further propositions are made that the new landscape will comprise professional educators who work in schools and universities, community and folk educators who share expertise in local communities, employers who seek to enhance their employees’ contributions to their businesses by generating new research and knowledge, and professional educators who provide content, give freelance lectures, tutor and educate the community (Facer, 2011). Of great importance is being able to re-imagine and re-think school, rather than proclaim its impending doom.

Implicit in these ideas are that students will be able to construct their own education pathways, using technology from a range of different education providers and resources – and this is where expert professional knowledge in disciplines is located. Disciplines constitute a way of thinking about the world that is different to a school’s focus on subject matter, which can be limited to memory facts, figures and formula (Gardner, 2008). For example, in Science, study of the discipline would mean coming up with tentative classifications, concepts and theories, designing experiments to test them and then revising the theories in light of the findings. Another way to think about the idea of a knowing discipline is for teachers to become “master learners” who have content expertise and learn alongside students (Richardson, 2012).

Other conceptions important in big learning for the future are “possibilities and playfulness” (Craft, 2011) and how they connect to “shared imagination” (Thomas & Seeley-Brown, 2011). Possibilities arose from qualitative work conducted by researchers in six universities, with children and young people aged 3-18 years, which examined teachers’ pedagogical
strategies in various education settings (Craft, 2011). Research demonstrated that when teachers gave students time and space to develop their ideas, they could reach their own conclusions. The action is similar to “meddling in the middle” (McWilliam, 2009, p.281). Possibility thinking crossed over into agency for young people and questioned how far teachers are prepared to balance their authority with a more self-directed agency for students to engage with technology demands (Craft, 2011). Playfulness stems from dispositions of curiosity that children have in “deep-level learning” (Lavers, 2000, p. 20). Such dispositions harness imagination, creativity, intuition, self-management, social competence, physical exploration and communication skills (Craft, 2011). Exploratory drive is highly critical to these notions of play, especially when children and young people learn in technology-enabled contexts. Afterall, ethical dilemmas can arise for some teachers as they consider how playful education might be achieved within command/control structures that are often associated with schools (Craft, 2011b). The role of play in game-based learning is also important in fostering shared imagination to develop what Thomas and Seeley-Brown (2011) refer to as “the development of questing dispositions in children” (p.114). These ideas of big learning for the future flow into ramifications for technology spaces and research that examines several new conceptions follows in the section below.

2.5.2 Spaces for the future

Some researchers refer to conceptions of new public spaces (Facer, 2011), others refer to a “time and place edge” (Chen, 2010) and terms like “hanging out and geeking around” (Thomas & Seeley-Brown, 2011) are also common. Networks, collectives and crowds are often the places where young people, including teachers, participate in conversations about futures (Facer, 2011). Twitter\(^{21}\) is the prime example. Such places are new sites for citizenship, and arguably, schools need to ensure that all students have access to the

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\(^{21}\) Twitter is an online social networking and microblogging service that enables its users to send and read text-based messages of up to 140 characters, known as “tweets”.

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resources and competencies to allow them to participate (Facer, 2011). Ideas of time and place in Chen’s (2010) “fourth edge” are built upon learning anywhere, anytime and the “destruction of the old view of education happening within the four walls of a classroom” (p.13). Chen draws attention to a report from 1994, titled Prisoners of Time, in which US schools were described as captives of the “tyranny of time”, in clocks and calendars that dictate short episodes of learning across the school day. Chen (2010) referred to this as learning interruptus and numerous cases are detailed from learning programs where “unbounded time works better to reflect school being equal to real life” (p.173).

Such plans for the future align with participation or “hanging out” in digital environments and require “a sense of learning to be” (Thomas & Seeley-Brown, 2011). These are the first steps in what was referred to some time ago as “indwelling” (Polanyi, 1966). This idea is used in “messing around” because it allows young people to take an interest in and focus on the workings and content of technology and media themselves (Thomas & Seeley-Brown, 2011). For teachers, this means supporting students to develop their sense of social agency.

The last aspect of participation in spaces for the future was “geeking around”. Here, students use the internet and ensure that technology infrastructures supported them to “learn to navigate esoteric domains of knowledge and practice and participate in communities that traffic in these forms of expertise” (Ito, 2009, p.10). Such spaces for the future require rethinking – or a re-pioneering – of school building design. There is not room to elaborate on the research here, only to acknowledge that it is an issue that has been embraced at many education sites (Bourke, 2011; Heppell, 2012). The final section in Chapter 2 on thinking for the future follows below.

2.5.3 Thinking for the future

Literature published by particular scholars interested in futures for education have attended to ideas around thinking (Chen, 2010; Craft, 2011b; Facer, 2011; Gardner, 2008; Heppell,
In this section the “futures” work of Pink (2009), Chen (2010) and Zhao (2012) is examined. This literature deepens understanding of teachers’ knowledge of technology integration from a real-world or futures orientation. Thus, perspectives of motivation, a ‘thinking edge’ and the need for ‘entrepreneurial, creative and globally minded young people setting forth from schools, are important.

**Pink shines a light on autonomy, mastery and purpose**

Three elements of autonomy, mastery and purpose arise from research into motivation (Pink, 2009) and add to cognition elements identified in earlier work (Pink, 2005). The elements of design, story, symphony and play were recognised as necessary for professional success into the future. Research from numerous business examples were used to place importance on self-direction (Pink, 2009). The first motivation element, of autonomy over task, was cited as critical for workers in future workplaces and when cultivated, leads to engagement. The second motivation element of mastery was preceded by a poignant example from influential work on flow by Czikszentmihalyi (1975). Encouraging flow-friendliness is what smart organisations do, to create opportunities for employees to achieve mastery (Pink, 2009). Pink’s study from the Mayo Clinic showed how pressures from work demands caused doctors to burn out. Implementation of a trial policy, where doctors spent one day per week on an aspect of their job that was most meaningful, led to half the burnout rate of those who did not have the allocated time. Pink referred to the third motivation element as “time with a purpose” (p.141). Also referred to as the gap between ‘what Science knows and what business does’, the message is useful for teachers at all levels of education in their preparation for future workers. It should be noted that Pink’s earlier notions (2005) minimised the role of discipline, asserted Gardner (2008), who said: “those who do not have a discipline or a sense of discipline will be without work in the future, or confined to working for someone who does have a discipline” (p18). There was also concern that ethical
and respectful behaviours were left out. Though, Gardner (2008) did concede that ideas of meaning are captured in Pink’s notions of synthesising and existential intelligence.

Chen and the first edge…. the thinking edge

Key to the “thinking edge” is making changes to the learning process itself; it must be child-centred (Chen, 2010). Finding the correct mindset was central to research conducted by Dewey (1916) and in work (Chen, 1994) conducted for a PBS Children’s Science Series, 3-2-1 Contact. The questions children asked led to many threads of investigation. Big Sur was a community devoted to “mindfulness” led by George Leonard (1987) and its imprimatur was that learning is fundamentally a “joyful” activity (Chen, 2010). Findings from a study (Blackwell, Trzesniewski & Dweck, 2007) on student interest in brain growth was used as motivation for learning and for expending greater effort on learning. It was time for cessation of the ‘turf wars’ or the ‘either/or debates’ in education to justify thinking approaches to learning that set students up for futures outside of school (Chen, 2010). Approaches found in project-based learning, like those mentioned in Section 2.3.1, where technology integration is central and where teachers hold high expectations for student achievement are essential.

Zhao and entrepreneurial, creative, globally minded students

A strong case was made in research that the three elements of explore, experiment and express matter in futures for schools (Zhao, 2012). These approaches focus the need to develop young people’s creativity and entrepreneurship, and contradict the race for higher test scores. Powerful examples are made to prevent regression to industrial models of standardisation and conformity. Instead, schools “must give students freedom to think, invent and differ from what is termed bureaucratically-devised norms” (p. 42). Some literature reports that innovation and individuality are being driven out of public schools globally (Chen, 2010; Richardson, 2012; Salkowitz, 2010; Zhao, 2012). If teachers make practical skills, student autonomy, product-oriented learning built around creativity and
technology integration priorities, it will better prepare young people for an entrepreneurial world. Critical of East Asian models of education, the examples given by Zhao (2012) show test results are higher in South Korea, China and Singapore, and yet these education systems are trying to emulate Western public schools as they produce citizens who can think, create and innovate. Attention was drawn to education bureaucracies in the UK, the US and Australia who hold East Asian models of schooling as the future of education.

In summary, research has found that changing the means of education for the future is important and that this involves different understandings of learning. For example, discipline learning versus subject matter, and the roles of playfulness and shared imaginations are highlighted as essential elements. Teachers’ conception of technology integration that includes time and place considerations – ‘hanging out’ and ‘geeking around’ – are also central. Ideas of thinking linked to autonomy, mastery and purpose, as well as project based approaches with high expectations for student achievement are critical. The literature also cautions that great perils lie ahead for the world and its citizens, if education continues on the worn out path that is aimed at ‘ever higher’ test results and a ‘narrowing of the school curriculum’.

2.6 Conclusion

This review of literature consisted of five sections. The first was the history and development over time of the TPACK framework and its importance to this research as a point of reference for case studies of exemplary teachers’ knowledge of technology integration in classrooms. The second section focused on major policies and reports on technology integration from the UK, the US and Australia and confirmed the tensions between accountability and testing regimes, and the requirement for education to equip young people with the necessary digital dispositions for the future. The third section discussed major issues and debates linked to particular technology devices, social networking tools, ideas around
21st Century learning, technology integration and student achievement, and professional development. Implications for the research in this thesis centre on better understanding how each of these ideas and debates inform teachers’ knowledge of technology integration. The fourth section was about creativity, in particular definitions of creative learning relevant to this research. Ideas from scholars like Craft, Gardner and Robinson were discussed, whose work provides insight into practices of classroom teachers who view students as empowered in learning, as opposed to being at risk in digital environments. The fifth section investigated futures; central to this section was big learning for the future, spaces for the future and thinking for the future, and the saliency of all three ‘futures’ for the proposed research.

Across the literature, there appears to be a significant gap in education research about exemplary teachers’ knowledge of technology integration in classrooms. For some time now, there have been invitations for research including case studies of what well integrated technology might look like in schools (Ertmer et al, 2001; Ertmer, Ottenbreit-Leftwich & York, 2006; Finger et al, 2007; Schrum, 2011; Staples et al, 2005). Choosing a group of extraordinary teachers and examining what they do, will assist the development of deeper knowledge of technology integration in classroom settings. Contextualised studies, like the one proposed in this thesis, offer insights that may be helpful for other teachers to integrate technology more effectively if they, too, can conceptualise knowledge of technology integration in particular ways.

The TPACK framework provides an excellent point of reference for the research in this thesis, and its original developers (Mishra & Koehler, 2006) have consistently encouraged researchers to add to the value of the TPACK framework, to better implement technology integration in schools. There is valuable new knowledge of technology integration to be gained from conducting research in exemplary teachers’ classrooms and in gaining answers to the central question in this study:
How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?

The methodology important to the research practices and processes in the thesis are detailed in Chapter 3.
Chapter 3: Methodology

The purpose of this research was to understand how four ‘exemplary’ teachers conceptualised knowledge of technology integration in the classroom within Australian school settings and whether there was something fresh in their approach that could be shared more widely across other education contexts. This Chapter details and rationalises the methodology utilised to investigate the central research question and two sub-questions stated in Chapter 1:

- How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?

And,

- How does the conceptualisation of teachers’ knowledge of technology integration form a ‘fresh’ understanding for technology implementation in teaching and learning?

- What is the emergent form of ‘new knowledge’ about technology integration that can be shared more widely across school contexts?

Chapter 3 commences by situating the research within the qualitative paradigm, and continues with a review of interpretive case study literature, and validates its selection. The research was conducted in four phases; the processes for each phase in the design are described in detail, including the data collection and analysis methods used to attend to the research problem. Concerns around validity and reliability are addressed. The chapter closes with a summary of the assumptions and limitations of the study and a reflexive story.

3.1 Qualitative research

Situating the research within a suitable epistemology and appropriate research methodology was necessary in order to facilitate deep examination of particular teachers’ perceptions of technology integration in their classrooms. The chosen qualitative approach was case study,
or in this instance a collection of case studies, located in an interpretivist frame within a socially constructed world view (Creswell, 2007). This frame suggests all research is to some degree subjective, as it is difficult to be totally objective. Research is based on interpretation and within qualitative study, the researcher plays the dominant role in the interpretation (Corbin & Strauss, 2008; Stake, 2005). The lens is a contested space and therefore defining exactly the type of study this is may speak volumes to some and to others it may be treated as simply words on a page; which gets to the root of the problem: subjectivity and interpretation (Abma & Widdershoven, 2011; Greene, 2000). The reader cannot be compelled to accept an analysis and subsequent conclusions based on observations and interviews alone (Guba & Lincoln, 1994). Questions concerning subjectivity on behalf of the researcher are easily heard: ‘why was that observed and not that’; ‘why was this considered more important than that’; and ‘was this really the way things happened’ or ‘would I have seen it differently?’

The point of raising these hypothetical questions is to illustrate some of the strengths and limitations associated with qualitative data and to provide some understanding as to the rationale for framing the study in this way. The study is both descriptive and interpretive. An interpretive study is “unabashedly and unapologetically subjectivist” (Greene, 1994, p.536). Interpretation provides for both the elaboration of existing concepts and the creation of new concepts surrounding a particular construct, idea or occurrence (Altheide & Johnson, 2011; Corbin & Strauss, 2008; Peshkin, 1991). This is particularly relevant for this thesis, given problematisation of an existing, theoretical framework i.e. Technological and Pedagogical Content Knowledge, or “TPACK” (Mishra & Koehler, 2006). Concerning the subjective nature of qualitative research, methods exist to compensate for this, such as the use of transparent processes like triangulation, cross-case analysis and member checks of transcripts.
The discussion of phenomena, in this case related to the experiences of teachers, “can only be understood within the context within which they were studied” (Guba & Lincoln, 1989, p. 45). This notion of validity was borrowed from the positivist and scientific traditions, during early efforts to establish the rigour and acceptance of findings emanating from qualitative research (Abma & Widdershoven, 2011; Hamilton & Corbett-Whittier, 2013; Winter, 2000). It could also be argued that qualitative research was originally defined and defended based on what it was not, using quantitative methodology as a means for this comparison. As such, the concepts of validity have taken different forms and names, ranging from trustworthiness, creditability, relevance and the notion of “auditability” (Denzin & Lincoln, 2011; Lincoln, Lyneham & Guba, 2005; Sandelowski, 1986; Silverman, 1993; Winter, 2000). An account could be valid or true if it accurately represented, described and explained features of phenomena under investigation (Hammersley, 2007). At the heart of arguments concerning validity in qualitative research is the issue of how a researcher believes truth or reality is constructed. Internal validity, or what Sandelowski (1986) referred to “auditability”, is a concept that seeks to satisfy both researcher and categorisations, relationships between categories and the eventual findings presented have a reasonable and accessible trail that can be followed, in other words:

Any reader or another researcher can follow the progression of events in the study and understand their logic. More important and less misleading than using terms such as analytic induction and content analysis, are describing what was actually done and why.

(Sandelowski, 1986, p. 34)

The emphasis is on providing transparency in the analysis process, as it moves through description of grounded theory in the analysis, as a way to document how codes, categories and relationships between categories were established; this is discussed later in the Chapter.
External validity, another important issue in qualitative research, is concerned with whether the results of the research are generalisable. In other words can findings be applied to other situations. Nonetheless, if the study is internally valid “there is no point asking whether meaningless information has any general applicability” (Guba & Lincoln, 1989, p.115). In this study the use of consistent questions and rigorous cross-case processes enhanced the generisability of findings in the traditional sense (Flyvberg, 2011, Miles & Huberman, 1994; Yin, 2008).

While being a qualitative study, this thesis embraces the notion of constructivism, taking heed of an observation that “many qualitative researchers accept this as part of their overall epistemology” (Stake, 1995, p.40). The idea is that the ‘inquirer and the inquired’ are fused into a single reality (Guba & Lincoln, 1989) and therefore findings in a case study approach are the creation of a process of interaction between the two. Examination of case study methodology follows in the next section.

3.1.1 Case study

The goal of this research fits with the notion of case study as it “relies as much as possible on the participants’ views of the situation” (Cresswell, 2007, p.20). Similar justification for a case study approach is found in Cohen, Manion and Morrison (2011), and Anderson and Burns (1989) has suggestions that “case study allows the researcher to probe deeply and to analyse intensively the multifa riuous phenomena that constitute the life cycle of a particular educational setting or context” (p. 313).

The exploration of phenomena is one of the underlying purposes for conducting case study research. This approach invites intensive examination of participants and provides a foundation upon which description, induction and interpretation can be laid in light of their perceptions and experiences: “I suggest that [a] case study can be appropriately regarded as an outcome or format for reporting qualitative/descriptive work” (Wolcott, 1992, p.36). Such
qualitative and descriptive work is facilitated by interviews, observation and document review, each of which are cornerstones of most case study and qualitative approaches (Hamilton & Corbett-Whittier, 2013; Miles & Huberman, 1994; Stake, 1995).

Distinctions are made between types of case studies, such as intrinsic, instrumental or collective (Stake, 1994). Of these, collective case study is suited to this research because of its focus on more than one case in an investigation of phenomenon, population or condition:

> Individual cases in the collection may or may not be known in advance to manifest the common characteristic [of a phenomenon or condition] … they are chosen because it is believed that understanding them will lead to better understanding … about a still larger collection of cases.

(Stake, 1994, p.237).

In this research, four cases studies were undertaken, reflecting classrooms in different stages of schooling. Using more than one case “offers the researcher an even deeper understanding of process and outcomes of cases, the chance to test (not just develop) hypotheses and a good picture of locally grounded causality” (Miles & Huberman, 1994, p.26). Much as in the fields of medicine or law, the accumulation of several cases can lead to a deeper and more profound understanding of a given phenomena. This strengthens one of the key arguments for case study methodology in that it enables ‘closing in’ on real situations, allowing the research to test views directly in relation to phenomena as they unfold in practice (Flyvbjerg, 2011). Case studies have been criticised, for their lack of definition and bias as a research tool, for their “methodological cop out” (Atkinson & Delamont, 1989, p.208). Such commentary used a select group of case study research to critique their approach and this criticism paralleled early debates between qualitative and quantitative research. For example, Atkinson and Delamont (1989) argued that the:
... notion of a bounded system was unhelpful ... boundaries are matters of construction, by actors and analysts and that in failing to address methodology within a case study, many researchers inadequately address how these constrictions are formed. (p.207).

Insight was provided into this criticism by Stake (1994) who claimed that people with competing world views or differing purposes will change both the definition of a case and most likely what can be learned from a case, to purposely incorporate their needs and world views. The role of the researcher’s interpretive stance influencing the case has been addressed extensively in the literature, in handbooks on case analysis (Miles & Huberman, 1994), in coding (Saldana, 2009; Strauss & Corbin, 1997), the ongoing debate about the notion of interpretation in qualitative research (Denzin, 2008; Flyvberg, 2011; Lincoln, Lyneham & Guba, 2005; Stenhouse, 1985; Tripp, 1987) and in the role of hermeneutics in education research (Crotty, 1998; Guba & Lincoln, 1989). These texts provide qualitative researchers with methodological tools and theoretical considerations which readily address earlier concerns raised by Atkinson and Delamont.

To address any potential limitations in the research design such as bias, the transparent process of self-disclosure is included in a reflexive account later in the Chapter. This explains the choice of teachers for the study and includes justification of the process of writing up the cases. The next section details how the study was conducted.

3.2 Research design

Central to the research design in the study is the sample of exemplary teachers who form the collective case study. With this overarching purpose in mind, a sample was constructed, mindful of stages of schooling, use of various technology/ies, diverse education sites and years of teaching experience (Charmaz, 2006; Glaser, 1978). Six criteria were defined on the
basis of what was observed in schools over several years and were used to identify the study participants. Each teacher:

- was highly proficient in using a range of technology;
- used technology daily with students in almost all teaching and learning activity;
- used technology in an innovative and engaging manner for teaching and learning with students;
- initiated, guided and contributed substantively to professional learning in technology with colleagues in the school context and beyond;
- had trialled new technology when the school participated in previous projects and research; and
- was highly regarded by colleagues for their commitment to the profession (based on Miles & Huberman’s (1994) notion of qualitative sampling, a similar idea to Stake’s (1998) opportunity to learn).

My previous work in NSW Department of Education and Communities (NSW DEC) schools gave knowledge of where outstanding teachers, teaching specific stages of schooling, were located. This work “at the grass roots level in the field” gave me “insider knowledge” of where particular practice could be matched against the set of “purposive” criteria (Hunter & Mitchell, 2011). These teachers used technology in their classrooms in ways that was exemplary and satisfied the criteria. It was, as Stake (1995) suggested “important to maximise what can be learned about a phenomenon” (p.4). Three of the four teachers in the study had expressed interest in being part of any future education research I conducted in schools, after my employment in the NSW DEC had concluded. One teacher, previously unknown to me, was recruited after it was clear that this teacher matched the criteria for the purposive sample. Timing of my employment within a teacher education context in 2010 and the desire to undertake the study with particular teachers coincided. The study was conducted using ethical and informed consent guidelines implemented by the University of
Western Sydney and was approved by the University of Western Sydney Human Ethics Research Committee (Approval No: H8247). As the study took place in NSW DEC schools it was also approved by the State Education Research Approvals Process (Approval No: 2008023). Copies of the relevant participant information and consent forms used in the study can be found in Appendix A.

The following sections set out the school contexts and give brief information about the talented teachers in this study.

3.2.1 The context and the teachers

In Australia, each state and territory has its own education bureaucracy and all schools within these structures are deemed either ‘government’ or ‘non-government’ (‘public’ or ‘private’). The study took place in four NSW DEC schools located in the greater Sydney Region. Sydney is the most densely populated geographical area in NSW and has the largest concentration of public schools, teachers and students in Australia. NSW DEC is the leading employer of teachers in Australia, with more than 25,000 full-time teachers and over 750,000 students enrolled in 2400 schools from Kindergarten to Year 12. Each public school relies on funding from the government and a significant proportion of the students are designated ‘special needs’. For example in 2010-11, NSW DEC spent more than $1.1 billion, or more than one-tenth of its entire budget on special needs students (NSW DEC, 2011).

The four teachers and the schools in the study are identified by site number and pseudonym. Collectively, the teachers taught students in Stages 1-5, aged approximately 6-17 years old, in both primary and secondary contexts.

To introduce each teacher, briefly:

- **Site 1**: Gabby taught Stage 1, a composite class of 28 Year 1 and 2 students, at Cumera School.
Site 2: Gina taught Stage 2, a composite class of 26 Year 3 and 4 students at Marcus School. Gina also worked as a PSP\textsuperscript{22} consultant to surrounding schools from Archdale Regional Office for the duration of the data collection period.

Site 3: Nina taught Stage 3, a ‘gifted and talented’ Year 6 class of 28 students at Starton Public School. The category of ‘gifted and talented’ refers to students who have been identified and placed in developmentally appropriate programs.

Site 4: Kitty was a Visual Arts teacher at Farner Secondary School. She taught students in Stage 4 and 5, in Years 7 - 11, a total of 120 students. This included teaching some lessons in History, as well as a number of multi-media project teams.

The individual case studies for each teacher are found in chronological order in Chapters 4, 5, 6 and 7 of the thesis.

After the study was formally approved, all principals were contacted to seek the participation of the particular teacher in their school. It was noted in the letter of invitation that the identified teacher had been recruited on the basis of six selection criteria. Neither the principal nor the teachers were compelled to involvement in the research. Yet, without hesitation all agreed. In research it is always desirable to include willing participants (Janesick, 1998); the willingness of the teachers in this study to share their understandings of technology integration was evident throughout and beyond the data collection period.

Multiple sets of data were collected from four sites.

3.2.2 Multiple data sets including triangulation

Research findings, derived from multiple sets of data, need to persuade the reader that they are worth paying attention to and are relevant and rigorous. Therefore, the collection of rich, sufficient data that is triangulated is important (Lincoln, Lyneham & Guba, 2005). The

\textsuperscript{22} PSP, previously known as Priority Schools Funding Program (PSFP), means the school receives extra financial assistance to reduce the achievement gap for students in schools with high concentrations of students from low socio-economic status backgrounds.
collection of case studies in this research and the data gathered over 12 months are significant and it was desirable to make “smart choices about samples and contexts that were appropriate to study a specific issue” (Tracy, 2010, p. 841).

Each teacher in the study was interviewed and observed in their teaching context, and the researcher was conscious of the concern around whether or not it was right (Stake, 2010). This search for accuracy and validation in collecting multiple sets of data from different sites is supported through various triangulation protocols (Bassey, 1999; Denzin, 1978). Findings from multiple data sets may be judged valid when different and contrasting methods of data collection yield similar findings on the same research subjects (Bloor, 2001; Stake, 2010).

The researcher’s own learning processes in the collection of substantial data sets and the further development of skills required to conduct high quality research were important. The researcher wanted to enable and acknowledge to the reader the applicability of the study to her or his own context, ensure the writing up process facilitated the potential of the study’s practical application, and to recognise that the “the role(s) of the researcher and the data s/he is able to gather are inextricably related” (Hammersley & Atkinson, 1995, p.9).

Data collection processes are discussed in the next section, including the phases of data gathering, the use of in-depth semi-structured interviews, observations, student focus groups and document collection.

### 3.3 Data collection

Data was collected in four phases across 12 months. The staggered nature of the data collection period was a clear advantage, as there was opportunity to analyse each case intensely prior to starting the next, drawing out individual themes and comparing them to subsequent uses and to the TPACK framework. The section on cross-case analysis later in the Chapter gives further insight as to why this approach was important. The following table provides an overview of the data collection for each participant.
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<th>Term 4</th>
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<td><strong>Site</strong></td>
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<td>4</td>
<td>2</td>
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<td><strong>Name</strong></td>
<td>Gabby</td>
<td>Nina</td>
<td>Kitty</td>
<td>Gina</td>
</tr>
<tr>
<td><strong>Process: Data collection</strong></td>
<td>Pre site visit</td>
<td>Pre site visit</td>
<td>Pre site visit</td>
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<td></td>
<td>Interviews x 3</td>
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<td></td>
<td>Week of teacher observations</td>
<td>Week of teacher observations</td>
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<td></td>
<td>Student focus groups x 1</td>
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<td></td>
<td>Post site visit for member-checking of interview data</td>
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<td><strong>Name</strong></td>
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<td>Nina</td>
<td>Kitty</td>
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<tr>
<td><strong>Process: Cross-case analysis workshop</strong></td>
<td>Within case consideration</td>
<td>Within case consideration</td>
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<td>Cross case analysis</td>
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<td>What’s common and what’s different?</td>
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<td>What’s common and what’s different?</td>
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</tbody>
</table>

Table 1: Types of data collected at each site across the four phases of the study.

After a pre-site visit to each observation context, suitable dates and times for interviews were agreed to for the in-school week. Focus groups with students also took place during this period, the details of each process follows in the next section.
3.3.1 Interviews

Structured interviews generate “precise data of a codable nature in order to explain behaviour within pre-established categories”; conversely, the unstructured interview is used to “understand the complex behaviours of members of society without imposing an *a priori* categorisation that may limit the field of inquiry” (Fontana & Frey, 2005, p.696). The style of interview suited to this study lay somewhere between these approaches, in a semi-structured style. Given that interviews served as a primary source of data for this study, it was necessary for some *a priori* categorisation to accompany the interviews. That is, by narrowing the research to focus on the understandings of the teachers, boundaries were set around the questions that examined their conceptions using the seven components of the TPACK framework (Mishra & Koehler, 2006) as a stepping-off point. Semi-structured interviews allowed a partially comparable data set to emerge, through a somewhat directive researcher role that encouraged the perspective of the individual to be expressed (Anderson & Burns, 1989; Bogdan & Bilken, 1982; Fontana & Frey, 2005).

Each teacher was interviewed three times, in total 12 interviews, which lasted between 90-100 minutes each session. Interviews took place with each teacher prior to the first observation, mid-way through and towards the end of the in-school week. Questions were progressively explored through the three interview sessions, with each interview adding depth and clarity to both the new observations and the responses from the prior interview. Details of the teacher interview questions are found at the end of Appendix A. An example of data from one interview transcript is located in Appendix B. The interviews featured discussion on the teachers’:

- Teaching background including teaching experience;
- Understanding of the term ‘technology’;
• Understanding and conceptualisation of learning and teaching pedagogy, subject matter and use of technology/ies;

• Conceptions of pedagogy, subject matter and the use of technology/ies in reference to what was observed in the school/classroom context;

• Perceptions of the role of subject matter knowledge when integrating technology into learning, and an exploration of this link to pedagogical knowledge, and pedagogical content knowledge;

• Technology knowledge and how that fitted their subject matter and pedagogical goals, instructional strategies and processes;

• Development of their technological pedagogical and content knowledge and whether that was a unique teaching approach in comparison to colleagues; and

• Practice that could be shared more widely with colleagues.

A series of prompts were devised to uncover further details during each interview session; however, the conversation flowed freely and it was rarely necessary to use prompts. Each teacher was given a copy of the interview after transcription and was asked to read and confirm it for accuracy; this served as the member-checking exercise, confirming what was said, and providing a sense of co-authorship to the interviews. Participating teachers were given the questions a few days prior to each interview. This pre-delivery served to familiarise the teachers with the questions, to help them feel more relaxed and to encourage reflection on their practice before the interview (Fernandez-Balboa & Stiehl, 1995). Seeing the questions prior to interview day provided the researcher with an opportunity to probe deeply into the issues raised, while taking into consideration the need for “persistent involvement” with the participating teachers (Maykut & Morehouse, 1994, p.181). This type of sustained involvement in the field was also achieved for collection of the observational data.
3.3.2 Observation

Observation is the most fundamental aspect of qualitative research, it complements interview data and serves as “hard evidence supplementing subjects’ recollection and sometimes self-serving perceptions gained through interview sessions” (Adler & Adler, 1998, p. 90). The use of observation as a data collection instrument has a number of key advantages. In the first instance, observation balances subjectivity and objectivity by recognising the centrality of the researcher’s experiences in the research process while maintaining objectivity and distance. It also means the researcher was able to study the phenomena in its natural setting. Access to participants at each site was viewed as a continuing process and has implications for the kinds of data collected. This is not necessarily problematic: “... by systematically modifying field roles, it may be possible to collect different kinds of data ...” (Hammersley & Atkinson, 1995, p.123).

At the start of each week of observation the researcher’s role was explained to the students in the class. The role in effect was that of a non participant observer meaning the researcher would shadow the classroom teacher over the week, and make notes and ask questions about what the students were doing when necessary. However, it was agreed that if students needed assistance with a simple task, for example, ‘looking up a word in a dictionary’ or ‘opening up a file’ then the researcher could respond. This would be less disruptive to the flow of activity in the classroom. The researcher quickly became part of the classroom landscape and after a while became less noticeable. At Site 2, where observations took place at two additional schools, the researcher was introduced to both the staff and students. This consistent approach proved valuable from a research point of view, as it fully supported the data collection and also gave the researcher a sense of continuity. It established trust with both teacher and students. The notion of the ‘ebb and flow’ of the school day is often hard to capture. Immersion in the context for one week at a time facilitated the sense of ease in the
school/classroom setting: “observation allows familiarity and increases the likelihood of getting better acquainted with the subject of your inquiry” (Kellehear, 1993, p. 125).

The following figure explains how various data collection forms uncovered phenomena in the study:

![Figure 2: The relation of data to phenomena as revealed in data collection.](image)

An observation schedule, based on one used in a study by the Fair Go Team (Munns et al., 2006; Munns, Sawyer & Cole, 2013), was adapted to assist recording observation notes (see example in Appendix C). The schedule required noting pedagogical, content and technology knowledge components, as well as integration that was both conscious and unconscious, together with classroom layout and instances of innovative or fresh practice. Photographs as well as notes were used as discussion triggers for reliability and independent interpretation, mindful of the value of observation “as an alternate source of data for enhancing cross-checking or triangulation against information gathered through other means” (Adler & Adler, 1998, p. 90).

Focus groups with small numbers of students in each teacher’s classroom provided valuable data that served to triangulate the perception of technology integration in the classrooms. This data collection method is described in the next section.
3.3.3 Focus groups with students

Focus groups allow for the observation of a large amount of data, on a specified topic in a limited time (Morgan & Kreuger, 1993). A focus group is more than a group interview, “the focus group sets up a situation where the synergy of the group, the interaction of its members, can add depth or insight of an interview” (Wellington, 2000, p.125). More recently, Kamberlis & Dimitriadis (2011) suggested that these are the political dimensions of focus group work that couple with the traditional empirical dimension and the pedagogical, referred to as “prismatic … with all three faces of the prism visible to some extent no matter which way we fix or direct our gaze” (p.547). As a vehicle for triangulation, focus groups allowed comparison of this data with teacher interviews and classroom observations.

In this study, focus groups were semi-structured and these prompts guided the process:

- Tell me something you like about using technology in this class.
- Is there something you don’t like about it?
- Tell me about a favourite technology lesson.
- Is it better to work in groups with technology or alone?
- What other examples can you think of?

A good moderator in a focus group strives to create an atmosphere in which groups of students are free to express their perspectives (Morgan & Kreuger, 1993; Stewart & Shamdasani, 1990). In practice, with younger students at Site 1 for example, this proved quite challenging as the students’ attention span was short and they often repeated what other students had said. Nevertheless, when they were brought back to the focus of the question, the process was worthwhile.
It was the teacher who determined who would participate in the focus group at each site. All students had parental approval to join in, yet, for purely practical reasons groups of 6-8 students, inclusive of gender and equity concerns, were most productive.

3.3.4 Field notes and document collection

Throughout the study, field notes were kept and written up to assist understanding what occurred. These notes were later used as memos. Such annotations were often more detailed and allowed me to tinker with early categories after each site visit concluded. At all sites, relevant documents were collected from the school and the classroom.

As a form of social phenomena, documents are often ignored according to Hammersley and Atkinson (1995), who suggest they play a role in literate societies, but are an important feature of the social world and should not be ignored: “the argument is that rather than being viewed as more or less biased sources of data, official documents and enumerations should be treated as social products: they must be examined not relied on uncritically as a research resource” (p. 168).

The documents collected at each site were primarily lesson plans, paper or electronic, school annual reports and student work samples. Folders were created for each case study to hold the gathered materials.

The following section details the study’s important validity and reliability processes.

3.3.5 Validity, reliability and member-checking

Questions of validity and reliability are critical to my aim of writing effectively about education research. Validity is a relative term in this study, as what is reported is the product of a convergence between my own world view and those of the teachers. Reliability in education research is achieved through minimising errors and bias (Yin, 2008). An important question was considered here: if another researcher was to replicate this study using the same
four teachers, would they arrive at the same findings? It is, in reliability terms, more important to think about whether “the results make sense given the data collected and are they consistent and dependable” (Merriam, 2009, p. 206).

During this stage of the research process, misinterpretations were queried and meanings clarified to ensure that each teacher was satisfied with their interview account and any requested changes to transcripts were carried out. The teachers in the study carefully attended to a thorough reading of their case and made minor improvements to the original account, which is not always what occurs (Merriam, 2009). Such a process allowed “the actor to review the material for accuracy and palatability” (Stake, 1995, p.114). One student from each focus group read over the group’s account and indicated to their teacher that it was accurate. In some ways, what happened was more of a member-reflection, which provided additional data, reflection and complexity, not strictly seeking only the “one truth” of what was observed by the researcher (Tracy, 2010, p.839). After each data collection phase, in addition to the interview/focus group transcripts, partially formed within-case accounts (Miles & Huberman, 1994) were returned to each teacher for further member-checking. Each teacher had expressed a desire to be involved, and this action, in addition to the cross-case meeting, added to the reliability and validity of the final case studies.

Throughout the study, conversations with supervisors ensured the data analysis process was congruent with emerging findings. A full account of the analysis process is provided in the next section.

3.4 Data analysis

The prime purpose of data analysis is to make sense of the data (Merriam, 2009). Data analysis in this study involved the conscious method of selection, consolidation, reduction and interpretation of what was collected and collated from the actions of the research participants (Coffey & Atkinson, 1996; Silverman, 2010). These simultaneous processes are
associated with the main stages in Strauss and Corbin’s (1997) grounded theory method:
open coding, axial coding and selective coding.

The rationale behind open coding is similar to Merriam’s (2009) discussion of first and
second levels of analysis, where moves are made between “concrete description … [and]
systematically classifying data into some sort of schema consisting of categories, themes, or
types … they interpret the data” (p.187). The first three interviews from Site 1 were initially
read without specific coding. The goal was to promote familiarity, jotting notes in margins,
summarising ideas or potential themes at a macro-level. Each step in the process of analysis
was designed to reduce or break the primary data down into “more manageable chunks”
(Miles & Huberman, 1994; Welsh, 2002). This ‘pilot’ data from Site 1 generated over 60
codes; the names assigned to the codes were created from the literature and included the
seven components of the TPACK framework (Mishra & Koehler, 2006). At this point, the
codes were reduced, prior to the importation of Site 1 data into NVivo 9 qualitative software
to commence open coding in earnest.

NVivo 9 was chosen to manage the data at the initial research design stage as it was the best
fit for analysis of the case study data. This software features easy text storage for interview,
focus group and observation data, storage of files in single “hermeneutic” units, affixing
codes to words or groups of words, establishing queries, creating memos, establishing
families of codes and establishing network views, and it draws on grounded theory in its
design (Bazeley, 2007; Miles & Weitzman, 1994; Muhr, 1997). There has been some
criticism that Qualitative Solutions & Research (QSR), the manufacturer of NVivo 9, jumped
on the “grounded theory bandwagon” as the software’s “memoing tools facilitated theory
building from the data” (Kellehear, 1997, p.20). Other literature has since pointed out that
“the tools do push the researcher to draw theory from the data, however it is not necessary to
follow grounded theory guidelines when using this software” (Welsh, 2002, p.5). Using
software in data analysis is thought by some researchers to add to the rigour and
thoroughness of the qualitative research process (Welsh, 2002; Bazeley, 2007). This was true when data imported into NVivo 9 from Site 1 was initially open-coded into themes (called nodes in NVivo 9), moreover when this data was searched in terms of ‘attributes’, interrogating the text in more detail was difficult; this drawback of the software is also documented (Brown, Taylor, Baldy, Edwards & Oppenheimer, 1990; Welsh, 2002). This aspect of the analysis process was possibly added to by a sense of urgency, with impending cross-case processes, ever mindful of Miles and Huberman’s (1994) plea to “understand the dynamics of each particular case before proceeding to cross-case explanations” (p.207).

The established first level, or open codes (Strauss & Corbin, 1997), from Site 1 were comprehensive and ‘manually coding on’ continued from the recognised themes for Sites 2, 3 and 4 (see Appendix D for a list of the original open or first level codes from Site 1). It was useful to think of this part of the qualitative process as a type of “rich tapestry, the software was the loom that facilitated the knitting together of the first rows of the tapestry, but the loom cannot determine the final picture on the tapestry” (Welsh, 2002, p.6). In critiques of qualitative software, Bandara (2006) and others (Asensio, 2000; Bazeley, 2007) reinforce the importance for researchers to recognise the value of both manual and electronic tools in qualitative data analysis and management, and “not deify one over the other but instead remain open to, and make use of the advantages of each” (Welsh, 2002, p.7).

Axial coding or the search for regularities within and across the data resulted in narrowing or synthesising relationships between categories (Corbin & Strauss, 2008; Merriam, 2009). This synthesis process is displayed in the paradigm model, a representation of which is found in Figure 3 below. This model is made up of the causal condition, phenomenon, intervening conditions, action/interactional strategies, context and consequences or outcomes in the classroom. It attempts to reflect an individual’s perception of the data generated from interviews and observations and enabled its visual display and representation. It was “made more valid when aided by data displays that are focused to permit viewing a full data set in
one location and are systematically arranged to answer the research questions at hand” (Miles & Huberman, 1994, p.188). In each case, the causal condition was technology integration and the phenomenon while generally referred to as the “set of actions” are the conceptions drawn on by the teachers.

Figure 3: Interpretation of the paradigm model, adapted from Strauss & Corbin (1990).

The result of axial coding was the development of categories, based on connections made between existing categories and sub-categories. The data was reduced again by further collapsing similar categories together, where distinct categories become sub-categories of others (see Table 2 in Chapter 8).

Axial coding elaborated the relationship of this category to other categories, again uncovering its role by using the paradigm model in light of teachers’ perceptions of technology integration. In this way, theory testing was applied to grounded theory. During this process, observation data was used in an effort to determine evidence of a category and its informing properties. This served to triangulate the claim being made. This was useful, for example, when I compared the teachers’ interview remarks with their instructional practice in specific lessons.
The third stage, selective coding, established the main phenomena of the study, which included several existing codes summarised into one new category or theme as they are now referred (Strauss & Corbin, 1990). With the central phenomena identified, selective coding required analysis of the remaining categories in order to determine their possible relationship to it. The core conception was validated through the creation of a storyline explicating the relationship. This sometimes took a narrative or diagrammatic form and through testing the fit of each supporting theme with the paradigm model, I was able to see the “central phenomenon around which all other categories are integrated” (Strauss & Corbin, 1990, p.116). This provided a starting point for the discussion of findings.

3.4.1 Cross-case analysis

The final process of data analysis was the cross-case meeting involving the four teachers in the study, at the conclusion of the data collection period (see agenda for the day in Appendix C). The goal of the day was to deepen knowledge and explanation of the teachers’ understandings, by examining the similar and different properties within conceptions and the relationships that appeared within each case study (Miles & Huberman, 1994). All of the teachers met each other formally for the first time, although as it happened, some had met one another at previous professional development courses. Opportunity to gather together like-minded individuals who are the subject of education research cannot be underestimated (Groundwater-Smith, Mitchell & Mockler, 2007); Gina from Site 2 expressed it this way, “there has to be reasons for what we are doing – coming here today and meeting everyone makes me feel more confident and validated in what I do as a teacher – so often we work in isolation” (i13, p.19).

Prior preparation of “interim case summaries” (Miles & Huberman, 1994, p.77) for the cross-case meeting provided opportunity for the researcher to review and understand multiple data sets better, and for each teacher on the meeting day to see what was common
and different across their collective practice (Denzin, 1997; Hamilton & Corbett-Whittier, 2013; Stake, 2005). Were the conceptions emerging from the data correct? The group examined the quality of data supporting the research questions and built a storyline for each case from agreed conceptions. A conceptual overview of what had occurred was mapped and this understanding was further shaped and altered by the teachers’ voices (Groundwater-Smith et al, 2007; Kemmis & McTaggart, 2000). Audio recordings and transcription of responses from the cross-case meeting, as well as more streamlined within-case summaries, were added to the total data set to support the final written case studies. It seemed that a smooth set of generalisations did not apply to any single case (Miles & Huberman, 1994); this fitted with the idea of making comparisons while preserving the uniqueness of each case.

In light of this process in analysis of the data, it is important to note some of the assumptions and limitations of the study and these aspects are addressed in the following section.

3.5 Assumptions and limitations

The research aims to provide a clear understanding of a particular group of teachers’ knowledge of technology integration in four case studies. The data was collected by the researcher and it cannot be denied that the researcher, having been a senior officer within NSW DEC, has provided an insider perspective. There are both positive and negative aspects to the researcher’s position. Objectivity and subjectivism sit on a continuum and if combined with a third epistemological position of constructionism (Hamilton & Corbett-Whittier, 2013) it may give the researcher a clearer understanding of beliefs about the world. The choice of the TPACK framework (Mishra & Koehler, 2006) as a point of reference, in terms of a theoretical perspective, assisted all aspects of methods choice (Hamilton & Corbett-Whittier, 2013).

Some of the teachers had knowledge of the researcher’s expertise and leadership of past NSW DEC projects. The researcher was also a former classroom teacher and this, too, meant
closer attention was paid to issues around subjectivity and what constituted effective integration of pedagogy, content and technology. Personal reflection is important, but there was recognition that it constituted only one part of case study (Hamilton & Corbett-Whittier, 2013; Kemmis, 2005). Also pertinent is the notion of “gatekeepers” as defined by Hammersely & Atkinson (2007) and the idea that the researcher had at their disposal knowledge of where outstanding practice of technology integration in schools was located. It must be noted that not all teachers in the study were known to the researcher prior to the commencement of the study. The researcher constructed participant selection criteria for the purposive sample to support such objectivity concerns.

The selection of four teachers could be a further study limitation, and that is the nature of case study research to a large degree and assumptions about purposive samples (Glaser & Strauss, 1967). It is, as Stake (1995) comments, “the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances” (p. xi). In addition, there are at least four other misunderstandings about case studies and their generalisability identified by Flyvberg (2011), yet in spite of these drawbacks, “case study can certainly contribute to the cumulative development of knowledge” (p. 312).

The data collection timeframe was in four phases, over a one year period. It was quite intense, which could have affected the researcher’s distance from each case. Although the cases were quite distinct, the timeframe had positive effects for cross-case analysis. One participant was no longer in her original location at the time of data collection, so the recreation of a classroom scenario that had been sustained for as long as the other participants may have influenced the nature of data collected. To anticipate this, the researcher relied upon interactions at a range of sites and commonalities in pedagogy, technology and content were consistent across contexts.
In interviews between the researcher and the teachers, there was freedom to express and share personal and professional knowledge and at times it seemed participants would forget the recorder was on. Member-checking and respect for truth (Bassey, 1999) to ensure accounts were what the participants wanted, overcame any concerns about having said ‘too much’. In the focus groups with students, the researcher was aware of limitations raised about focus groups, around issues to do with small numbers, the interactions of respondents to one another and the ‘live’ and immediate nature of the interaction (Stewart & Shamdasani, 1990). These assumptions were accounted for, as one student from each group member-checked transcripts to ensure what was transcribed reflected what the group expressed (Tracy, 2010).

The writing of qualitative research is shaped by the researcher and their stance (Flyvbjerg, 2011) and it is for this reason that complete objectivity was difficult to achieve: “reflexivity in the research process will ultimately lead to better understandings of the social world” (Hammersley & Atkinson, 1995, p.7). In acknowledging this point, a reflexive account is offered to close the Chapter; below is a description of the professional background and the various influences that have informed the researcher’s particular academic perspectives.

### 3.6 Reflexive story

I was a classroom teacher in schools for 10 years. I taught in teacher education for six years (1995-2001) and then for seven years (2002-9) I worked in the NSW DEC, as a senior education officer. During this time I led, researched and supported the implementation of large technology projects, for example, the *Teaching and Learning exchange (TaLe)*; *Engaging Pedagogy* (Hunter, 2007a, 2007b; Hunter & Mitchell, 2011) and *Connected Classrooms Program* (Hunter, 2008, 2011). In this role I worked alongside hundreds of teachers at various sites, gained a ‘bird’s eye’ view of what they did with various technologies in their classrooms (Hunter & Mitchell, 2011) and learned how they were
coming to terms with rapidly changing technology-driven contexts in schools (Mitchell, Hunter & Mockler, 2010).

The main project which informed key directions for this thesis was Engaging Pedagogy. This study focused on teacher professional learning and led to increased understanding of how a group of primary and secondary school teachers used three technologies (at the time all were relatively new) in the classroom: the interactive whiteboard (IWB), digital content from a school education portal, and a learning management system (LMS). Outcomes from Engaging Pedagogy indicated substantial variation in the teachers’ choice of content, their pedagogical approach and the effectiveness of technology integration and how it harnessed, or otherwise, the engagement of students. Most importantly, all teachers in the study believed technology was central to student learning in 21st Century classrooms (Hunter, 2011).

At the time of Engaging Pedagogy, the NSW DER was also being planned, and major policy commitments across all Australian education jurisdictions emphasised the need for principals, teachers and students to embrace implementing more technology in classrooms (MCEETYA 2005, 2006, 2008b; Rudd, Smith & Conroy, 2007). Studies of interactive whiteboards and their effectiveness or otherwise were in their infancy around the globe (Condie & Munro, 2007; Higgins, 2005; Kennnewell, 2006; Schuck & Kearney, 2007). A major focus of most technology research was on studying what “hardware” teachers were using in classrooms (Cuban, 2001; Jones, 1998; Zhao, 2003), the barriers to its use (Rogers, 2000) and how teachers could use technology more effectively if they had particular skill sets (Hedberg, 2006). Various research studies emphasised technology tools and what they offered in terms of information processing in computer labs in schools (Downes & Faturos, 1995; Mills & Roblyer, 2003; Mumtaz, 2000).

These studies were all valuable; I had now developed a curiosity about why there was hesitation by many teachers in using technology in certain school settings, and yet in other
classrooms, within the same context, technology was embraced. Teachers who integrated technology seamlessly into all aspects of student learning in the classroom piqued my interest. I wanted to deeply understand their pedagogical approach. This revelation coincided with a conference presentation I attended that suggested the “whole area of technology integration in education was not really well theorised” (Zhao, 2003) and how the less well-known (at the time) TPACK framework (Mishra & Koehler, 2006) explained what teachers needed to do in their increasingly technology-rich classrooms. At first glance, TPACK aligned with my views about technology integration. I always believed technology and learning in classrooms wasn’t just about the technology tools; it was about the teacher’s pedagogical decision-making and choice of subject matter. Is that what more ‘effective teachers’ were doing, or was there something more going on in these classrooms? I wanted to find out, to be that “disciplined inquirer” (Dewey, 2001, p.85), to do the research “to poke and pry with purpose” (Hurston in Janesick, 1998, p.2) Answering these questions could mean narrowing some of the gaps in current education research in exemplary teachers’ knowledge of technology integration, as described in Chapter 2.

3.7 Conclusion

This chapter commenced by situating the research within the qualitative paradigm, reviewed some of the interpretive case study literature and validated why this approach was chosen. The conduct of the research in four phases was considered in detail, including explanation of the processes for each phase of the design. Data collection and analysis methods used to attend to the research problem were also addressed. Featured was a discussion of issues around validity and reliability, as well as a summary of the assumptions and limitations of the study. A reflexive story concludes the chapter. Findings are presented in four case studies, after a short preamble to set out the approach taken, then in sequence: Site 1 in Chapter 4, Site 2 in Chapter 5, Site 3 in Chapter 6 and Site 4 in Chapter 7. Chapter 8 presents
the fresh equation for technology integration, drawn out of in-depth analysis of
commonalities and differences in the teachers’ approaches. Chapter 9 concludes the thesis by
directly addressing the study’s central research question.
Preamble in reflexive mode

Writing up collected data that is subsequently analysed into case studies, using mere words alone, acknowledges my struggle to adequately portray the unique teaching contexts in which I was immersed. Each case study in this thesis begins with a short vignette (Stake, 1995), which I trust in some small way honours the enormous ‘creativity and playfulness’ of the teachers in this research. I include a short narrative, an image of picture books, a poem and a wordle\textsuperscript{23}, as symbols of their innovative approaches to learning and teaching in schools. By beginning each case study in this way, I hope to evoke the notion of resonance (Tracy, 2010). The term describes the researcher’s ability to meaningfully reverberate and affect an audience on the basis of what has been observed: “key to this approach is aesthetic merit, transferability and naturalistic generalisation” (Tracy, 2010, p. 845).

These factors stem from emotional responses which arise from a study’s ability to be valuable across a variety of contexts or situations; such processes are performed by the readers of the research. The idea of ‘transferability’ occurs when the reader feels the research overlaps with their own situation and ‘naturalistic generalisation’ is the feeling of personal knowing and experience – all of which can lead to improved practice (Stake & Trumball, 1982). Effective writing in qualitative research, and there is agreement with Tracy (2010) here, tries to illuminate “the topic’s worth, its rigor, sincerity, credibility, resonance, significant contribution, ethics and meaningful coherence” (p. 849).

The focus of the four case studies is to explore the central research question of this study:

\textit{How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?}

Following an opening vignette in each case study is detail of the teacher’s professional background and the school context, and then the findings are set out in five main

\textsuperscript{23} Wordle is an app generating “word clouds” from text that users provide. The clouds give greater prominence to words that appear more frequently in the source text.
conceptions. Across the four case studies some of the conceptions are common, while others are different. This is followed by detail of their understandings of content, pedagogy and technology knowledge using components of the TPACK model. The case then proceeds by presenting five main conceptions of the teacher’s knowledge of technology integration. Important considerations of what is fresh in their understanding are featured in the final section of each case, as well as emergent knowledge of technology integration from their practice that is valuable and worth sharing with teaching colleagues. The first case of Gabby, the Stage 1 teacher, follows.
Chapter 4: The Case of Gabby

A story with music to start the week …

Red velvet curtains on the Punch n’ Judy booth in the corner of the classroom first caught my eye. This structure was quite large and looked like it had lost its way from a fairground. Its presence seemed out of place in this space of high-tech resources, where an interactive whiteboard occupied centre-stage. Several of the walls displayed colourful, scanned, child-made puppets and at the far end of the classroom hung a sophisticated “wow–word” poster. Around one corner of the room, tucked out of sight, a mathematical city made of angles and numbered cardboard sheets. Scattered on top of cupboards surrounding the wet area, were imaginative recycled objects, made into musical instruments and storybook sculptures. As I gazed at one structure, I asked myself, is that really the pantry in the Gingerbread House?

Students arrived at the door of the classroom within minutes of me placing my notebook and camera on a low desk. Overflowing bags were hung on pegs outside. It was obvious they all knew the routine. Each student walked inside and settled on the floor in front of Gabby. No teacher desk in the room, just a pink chair in front of the interactive whiteboard. The class roll was marked on the interactive whiteboard and all noise settled. I was introduced to the class and it was explained that I would be in the classroom for the rest of the week. A few students questioned me about what I would do.

Today there was also another ‘guest’ in the classroom, Charles the music teacher – not really a ‘guest’ as he was well known to the students – only today wasn’t the usual day for music. There had been a change of plan. I could easily tell the students really liked it when Gabby and Charles taught together. These two also seemed to enjoy the chance to team-teach during

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24 This literacy lesson was based on “Into the forest” (Browne, 2004) and a Reader’s Theatre piece centred on the book “I am So Handsome” (Ramos, 2007).

25 Wow words are new words; this idea was introduced to Gabby by another teacher at the school who had recently arrived from the UK. This is the link to materials the K-2 team at Cumera used: [http://www.sparklebox.co.uk/literacy/vocabulary/wow-words.html#T45nXLMzCRO](http://www.sparklebox.co.uk/literacy/vocabulary/wow-words.html#T45nXLMzCRO)
the regular music lessons each week. Gabby had planned the lesson and in later reflection shared that music was not her strength. She was happy to draw on the talents of colleagues like Charles. This was a literacy lesson and Gabby wanted the students to learn a short piece of music to accompany the narration of a forest scene for their ‘storybook houses’. A SMART Notebook appeared on the interactive whiteboard with musical notes and quavers. This tune of ‘evocative spooky music’ was one that each group could use as accompaniment for their narration. Charles taught the students to count the beat and to keep in time with the written music. They soon joined in. The whole class tapped out the beat, using an array of musical instruments made from recycled kitchen objects.

Gabby and Charles performed a narration for the class and each group followed in turn. One pair of students performed the role of the ‘lost children in the forest’, accompanied by dialogue and music tapped out by the rest of their group. In the background, displayed on the interactive whiteboard was the ‘storybook house’; all of the images were uploaded by the students during the previous lesson. Each group watched one another and commented on what happened next. As suggestions arose, Gabby recorded ideas, using the Record function on the interactive whiteboard and a hand-held microphone. When each group stepped up to the interactive whiteboard for their recording, you could see them palpably ‘puff up’ prior to giving their rendition. “Highly imaginative, redolent, mature language”, I thought to myself. “It’s extraordinary to hear Stage 1 students use language like ‘flamboyant’ to describe the wolf in the forest, while another student described a ‘quaint cottage’ and others used phrases like ‘pale and peaky’ to describe poor Gretel’s demeanour”.

When Gabby played the narrations back later, students liked hearing their voices – this public aspect of learning caused them to pause and think carefully about what they wanted to say, prior to pressing the Record button. I could not help but wonder – an ambitious lesson and only my first day in this classroom.
4.1 Introduction

This chapter presents Gabby, an experienced Stage 1 teacher at Cumera Primary School. The opening vignette captures the experience of the initial observation day in Gabby’s classroom. Students in Gabby’s class produce scanned puppets, make spelling films, use digital games and podcasts, and also create Notebooks in SMART lesson creation software\(^{26}\). They use a range of technologies to do this work including flip cameras, digital microphones, an iPhone and an iPad, digital scanner, several desktop computers and the interactive whiteboard.

4.2 Cumera Primary School

Cumera is on the northern beaches of Sydney and offers tuition to approximately 755 students between Kindergarten and Year 6. The coastal suburb’s socio-economic background is described as “mainly middle class”, with the majority of families in the surrounding community owning their own small businesses (Annual School Report, 2011)\(^{27}\). Less than 20% of the students at Cumera come from families who have a language background other than English. The school was involved in a learning alliance of project-based initiatives established in 2008 involving local primary schools and works in close collaboration with five campuses of a nearby secondary college, as well as academic colleagues from one of the city’s largest universities. At the time of the study there were 38 full-time teachers, most of whom were female. The school has specialist programs in drama, critical literacy and environmental sustainability.

All classrooms have an interactive whiteboard and since 2005 this feature of the school was used to promote its place as a centre of learning innovation. It was one of the first schools in NSW to embrace this particular technology, and this gives rise to its recognition as a

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\(^{26}\) The interactive whiteboard uses lesson creation software, version SMART Notebook 10. In this case study, the software is referred to as Notebook.

\(^{27}\) At each site the Annual School Report was consulted for contextual data; for anonymity these are not individually referenced.
“lighthouse school” and a “leader in integration of interactive technology into teaching practice” (School Annual Report, 2011, p.5). In 2011, the school hosted more than 500 teachers in technology-focused professional learning sessions. There is an abundance of technology resources throughout most learning spaces that are currently in the process of being reviewed, as much of the hardware is outdated.

With a highly focused approach to literacy and the creative arts, the school excels in drama and the inclusion of drama in learning. Cumera is extremely proud of its extensive resources in reading and maths, the established gardens and playground areas for outdoor learning. These were built by teachers, students and families from the wider school community. The school provides many opportunities for students to participate in extra-curricular activities such as chess, languages, music, band and sport; these are offered by outside providers on the school premises. Sport is promoted and there is good access to extensive playing fields, with many teachers in the school being expert coaches. An atmosphere of community and support between students and staff is evident, and the foyer of the school near the front office displays an array of student work samples and sporting awards.

4.3 The classroom

Cumera received funds in 2010 from the Federal Government’s Building the Education Revolution (BER) for construction of a two-storey structure with six classrooms. This building includes Gabby’s new classroom which has an adjacent quiet work room with six desktop computers. The classroom is spacious, colourful and child-centred. Walls are adorned with student created work that is original, non-stencilled and features recycled material, including the infamous Punch n’ Judy puppet theatre.

On most days the classroom is interactive, with high levels of activity and conversation interspersed with periods of quiet writing time and listening to the performances of peers. This Stage 1 class of 24 students is grouped on the basis of ability and friendship, and is an
equal mix of Year 1 and 2 students. In interview, Gabby describes them as, “generally happy, well behaved, respectful and confident. I have high expectations and they reach them”. In addition to their familiarity with a range of technology, it is apparent students like the ready access and visibility of technology. For example, one Year 2 student in focus group discussion says: “It’s really great to have an IWB in the classroom. We can look up stuff quickly, scan things and it doesn’t make us confused – when we can see things”. This aspect of the visual nature of technology is well documented and its consequent aid to engagement recognised (Higgins, 2005; Schuck & Kearney, 2006). Gabby’s professional teaching career began in adult education and it is described below.

4.4 Professional background

Gabby’s foray into teaching, via adult education more than 20 years ago, commenced with Teaching English as a Second Language (TESOL) to migrant students. She moved into primary school teaching 13 years later, and since 2005 has been at Cumera. She considers herself: “a specialist Kindergarten to Year 2 (K-2) teacher” and teaches composite classes in her role as team leader for Year 2. Regarded as the technology leader in the school, Gabby first used interactive whiteboard technology in 2005, as she acknowledges: “I see my technology leadership role as a great way to influence people and what they do in their classroom … I like to get people motivated to think about their teaching”.

Her professional learning growth and support in technology comes from outside the school, primarily from a specialist technology innovation centre attached to a nearby university. One of Gabby’s former colleagues, who used interactive whiteboards in UK schools when they were first introduced by the Blair Government (Higgins, 2005), initiated her venture into the possibilities of technology in learning. In interview she says: “In 2005 I watched her and was in awe of her skill. I then spent hours practising and making things”. Frequently, international educators come to Gabby’s classroom to observe what she does with
technology and she is also in demand to lecture to postgraduate students in teacher education. She is a frequent iPhone and laptop user in her personal life, nonetheless, she doesn’t use social media such as Twitter or Facebook (see glossary). Most out-of-school time is spent learning the art of story-telling with a professional storyteller and in her words: “preparing Notebook files and editing movies made in class if there were parts unfinished”. The following section details Gabby’s perceptions of technology integration in light of the TPACK framework.

4.5 A representation of Gabby’s perceptions of technology integration

The main focus points of lessons observed in Gabby’s classroom are literacy and numeracy. Learning each week involves extended periods of time devoted to a single theme for the whole school term. In this case study week, the theme is ‘Fairy Tales’, integrating content from English, Mathematics and Creative and Performing Arts K-6 syllabus documents (Board of Studies28 NSW, 2003). Content knowledge (CK) in English covers word blends, grammar rules and punctuation, as well as spelling and vocabulary. In Mathematics, measurement, area and number are the main topics. Pedagogical knowledge (PK) is exhibited in the varied approaches to student learning that Gabby utilises. These approaches include using technology as the basis, together with high levels of visible student activity, and detailed lesson preparation and assessment. Content is embedded into both teacher and student Notebook files. Pedagogical content knowledge (PCK) is tailored to her explicit knowledge of each child’s learning needs in all key learning areas (KLAs). She knows their education background and how play and fun are central to advancing their knowledge of ‘Fairy Tales’. Her technology knowledge (TK) is fluent and Gabby continually repurposes the available technology for learning in her classroom (Mishra & Koehler, 2006). The

students are also skilful technology users – mainly because of Gabby’s ability to respond to their curiosity about how technology works – and she lets them practise, when they ask questions about it. This comment by a Year 2 student in focus group discussion is typical: “Having the IWB, cameras and scanners in our classroom show us our work and we can practise using it.” Technology like this allows seamless integration into learning for students and this hallmark of Gabby’s technological content knowledge (TCK) is readily seen in classroom observations. Student learning demonstrating deep understanding of content is displayed in rich digital stories, animated in elaborate Notebook files.

Gabby understands how teaching and learning changes (Mishra & Koehler, 2006) when particular technologies like the interactive whiteboard and computers are used in the classroom, and she readily reconfigures technology for her own pedagogical purpose. Gabby is able to bring all seven knowledge components of TPACK together when she teaches and this case study is the story of how her technology integration is conceptualised.

4.6 The main conceptions

Conceptions of Gabby’s knowledge of technology integration in the Stage 1 classroom fall into five distinct areas. Each conception was developed from groupings of pedagogical themes that emerged from the data analysis. Pedagogical themes comprise diverse teaching strategies and student learning processes. The five conceptions are:

1. Learning made public through performance: better quality outcomes, audience and active engagement;

2. Creativity: continuous co-creation of products, peer support and modelled and guided practice;

3. Differentiation and negotiation: experimentation, going with the flow and unfinishedness;

4. Play and fun: dressing up, story-telling and mathematical thinking; and

29 IWB is an abbreviation for referring to the interactive whiteboard, used by teachers and students alike.
5. Extended learning time: imagination and length of session time.

The following sections of the case study note each conception of technology integration and the pedagogical themes with reference to teacher and student interviews, classroom observations of students and document analysis. The first conception, learning made public through performance is outlined next. Specific data describing the conception is provided and this is supported by detailed data for each of the contributing pedagogical themes.

4.6.1 Learning made public through performance

Conceptions of knowledge of technology integration appear in several ways in Gabby’s classroom, in particular when she consciously gives students opportunity to perform in front of peers. At times this is in dramatic fashion, using techniques like ‘Reader’s Theatre’ where texts are recorded using portable digital microphones plugged into the interactive whiteboard. Students chronicle their own transcripts, spelling lists and dramatic acts that are played back later for peers, as well as for reflection and comment by the teacher. During interview, Gabby describes this move from “passive to active student learning processes” in the following way:

Using digital microphones and flip cameras lifts the level of thinking once the students know it’s being recorded …. if you are going to be recorded or filmed you become active, you get out of that passive learning role. This can then be linked to repetition and to the students hearing their own voices or actions being played back, and being critical of them.

Comments from students triangulated what Gabby said, with this remark made by a Year 1 student in focus group discussions emblematic: “It’s great hearing our voices … you have to really think before you say something”. Performing in front of peers using technology serves as rich, extrinsic and intrinsic reinforcement in this classroom, and students never seem to tire of seeing either themselves or their peers performing. The conception of learning made
public through performance is explored through the pedagogical themes of better quality outcomes, audience and active engagement.

**Better quality outcomes**

Gabby argues in interview that when students use technology independently, it allows for repetition and problem solving. This action leads to better quality outcomes, because students’ learning is immediately publishable. She says:

Technology enables students to add to, and improve their work; the drafting of work can always be added to, or changed, recorded over – we might all look at someone’s work and try to improve it by modifying the final copy.

The sense of immediacy, pace and improved thinking are also aspects of this pedagogical theme. Better quality outcomes in students’ work are possible because technology provides a clear, visual account. It gives accessible documentation of students’ learning and Gabby comments: “I see what the students do, then what I do, and we can add to that in a new class”. This practice of building lesson and assessment documentation is a type of historical artefact, or primary source material. Gabby shares what her students learn with colleagues in fortnightly team meetings and at after-school professional learning workshops. In interview, she confirms this, observing: “It’s more about making sure that I’m continually trying to do different things, be innovative and give examples of effective technology integration”.

**Audience**

The act of performing for an audience is an important catalyst for quality learning and central to the conception of learning made public through performance:

If students know there is an audience, then the quality of what they do improves – if it’s being captured then it’s better work; the technology acts as a type of audience – all because students use it to hear, display or modify what they have produced.
Gabby talks in interview about the “public displays of learning lifting student engagement”. Such behaviours are readily observed in Gabby’s classroom when pairs of students, engrossed in arranging a new Notebook file, explain their understanding of mathematical concepts, or when they assemble scanned images for extended narratives in group performances. This remark by a Year 2 student supports Gabby’s perception: “Doing the word blends in Notebook means we give other kids the chance to learn what we learn”.

Active engagement

Engagement in learning is often so intense in the classroom that when the bell goes, Gabby has to ask most students to leave: “The bell has gone … go out and run around … it is recess now”. Eventually students leave the classroom and then race back when the bell goes, to take up their work just as intently as when they had left off. This sense of intensity continues in the classroom when she draws upon past work of students to reinforce the learning of particular concepts with new groups of students. She explains: “Notebook is useful because you can look back and reflect on what other students have done and add to it”. Gabby always informs her current class that what is recorded might be seen by parents and students she teaches in the future. The information is frequently accompanied by this reminder to students: “The quality of what you do matters”. In observations of the playground, older students ask Gabby if they can see the videos they made when they were in her class. When asked why this happens, she says: “Students seem to have fond memories of what they did with me in Stage 1 and regularly remark how they don’t do that type of work anymore … they miss it”.

Saved Notebook files are exemplars for scaffolding new syllabus topics and fresh assessment tasks. Gabby explains:

Content is never as good the second time round, and it has got to engage me. In addition to what they create, I also like to film students during performance; it allows
me time to reflect on what they did, and I can use the recording when it comes to
assessment time and show parents on parent-teacher night.

Technology provides unlimited possibilities for teachers like Gabby to maintain ‘living
assessment recordings’ of what students do, and often digital portfolios are used by many
schools to report to parents and other teachers about student learning. The experience of
learning being made public (or public learning) through performance, as a mechanism to lift
the quality of student assessment, links to Gabby’s belief that creativity is an important
component of her knowledge of technology integration. This conception is explored below.

4.6.1 Creativity

In Gabby’s classroom, technology integration in learning involves students continuously
creating products like short films and podcasts, as well as digital games and stories. This
creative style of technology integration is central to her practice and it is the main
pedagogical method she uses to engage students in learning. She acknowledges that:
“learning happens when students create things and this means they are deeply engaged”. Her
classroom is a consistent scene of industrious design, where the co-creation of products
means students often work in flexible ways on different tasks as individuals, in pairs or in
groups. For example, in one corner colourful puppets are being laminated, while other
students work on re-used puppets to commence story writing. Another group continues to
script drama performances and several more make props in the form of beautifully painted
storybook houses in the wet area. It is this artwork that acts as background on the interactive
whiteboard. The scene is detailed in the opening vignette to this case study. Significance of
the conception of creativity in technology integration is explored through the pedagogical
themes of continuous co-creation of products, peer support, and modelled and guided
practice.
Many traditional\textsuperscript{30} approaches to education overlook learning through “hands on activities” (Thomas & Brown, 2011). Although such approaches often require a deep practical knowledge of what the student is trying to create, it could also considerably alter their personal investment in learning. Ideas like this sit alongside leading European theories of learning as keys to exploratory drive and play inherent in young children (Bruner, 1960; Piaget, 1930, 1951; Vygotsky, 1976, 1978). Gabby discusses this observation of her practice in interview, where she confirms her emphasis towards hands on learning approaches. The notion of co-creation stems from the idea of creation for one’s own purposes, a type of user-centred design (Resnick, 2007). She says: “Creating products makes the learning tangible, the idea is learning is doing and doing is learning … student-created responses are the most important aspect of pedagogical knowledge because it’s important to students”.

Her interactive whiteboard facilitates creativity and co-creation. This tool is used equally by herself and her students and when questioned about this, she agrees: “I use it [the interactive whiteboard] primarily for creation”. Other technology like microphones, scanners, flip cameras and computers all operated alongside her ‘technology system’ and this system belongs to Gabby and her students. It is non-hierarchical. Often in school classrooms, the interactive whiteboard belongs to the teacher and it acts as a reinforcer of didactic and highly teacher-centred approaches to practice (Glover, Miller, Averis & Door, 2007; Merrett & Edwards, 2005). Such a scenario did not apply in Gabby’s classroom, although she is aware that within her own school some teachers use the interactive whiteboard in this way. There are colleagues that do not allow students to touch the board. In technology professional learning after school, Gabby works hard to change this approach by adopting what she refers

\textsuperscript{30} Traditional in this context refers to more teacher-centred models of learning, where there are limited opportunities for group work.
to as: “teach, share and show”. She adds: “others don’t get what I do – I feel a sense of pedagogical isolation – I need to be with other like-minded teachers”.

Technology is used to create beautiful products “where the aesthetic is valued” to demonstrate learning, and Gabby uses the students’ work and what they create for further learning. She reveals what this strategy means in interview: “When students create, there is an automatic buy-in and you see student learning being displayed”. This focus relies on their clear ability to successfully use technology. In focus group discussion the students echo this purpose; as one Year 2 student says: “I like scanning our own stuff onto the computer, we also make cool games and we can photograph the amazing robots we make in art”. The creation of products correlates with being able to tap into the students’ ideas, their creativity and their thinking. In observation of the first teaching session each morning, Gabby routinely reminds the class: “You must switch on your brains to get those creative juices flowing”.

**Peer support**

Earlier in the year, Gabby taught her students how to operate various technology tools in the classroom. They use technology independently and are savvy, only on rare occasions calling for her assistance. Groups or pairs of students work with others of similar ability and on other occasions they work in heterogeneous groupings. Students know how to support one another if something doesn’t work. In focus group discussions, this Year 2 student’s belief is typical: “I like to work in pairs because sometimes if you are stuck on something or the camera doesn’t work, it’s your partner who knows – not even the teacher knows”. Being a composite group means the Year 1 students sometimes tend to work with other Year 1 students, as do Year 2s work with other Year 2s. The school requires them to have separate spelling lists based on ability groups. However, the same students are observed working in heterogeneous maths groups creating numeracy games on computers in the withdrawal room.
Modelled and guided practice

In 2010, Gabby didn’t have any technology tools in the classroom while it was being renovated. After that year, she became more aware of the time it took to integrate technology into learning. Gabby often mentions this point in interviews, congruent with her view that technology is also more about efficient teaching:

It consumes my life but I don’t resent it and when technology isn’t present you actually get used to it ... it’s less complicated teaching, but it’s also less creative and I get to tell the students what to do. But I didn’t like 2010 much and neither did my students.

This pedagogical theme is coupled to her belief and sense of responsibility that as a teacher, if you are going to use technology in the classroom, it has to work every time. She says: “You can’t risk kids’ learning if it doesn’t work and having a range of technology means something will always be working – if there are only laptops then it’s more risky and you can waste valuable learning time”.

She deliberately models interesting language throughout the day in her choice of words to describe, the weather, for example. This encouragement builds the students’ vocabulary and she urges students not to use “pedestrian” language. If they think of a wow word (see glossary) they look it up in a thesaurus and then add it to their own digital text and the poster of wow words on the classroom wall. These words give access to all students to improve and extend writing, and when asked about this practice in interview, Gabby responds: “When wow words are displayed every student has access to expanded vocabulary for writing”. Students echo this sentiment in focus group discussion. For one student in Year 2, wow words are her favourite part of preparing a digital text:
Doing *wow words* and being able to find out what words mean and the images that go with them, I found the word *embarrass*. You get to look closer at what a word is like and maybe how you could use it in your story.

Another example of this pedagogical theme is observed in a narrative writing session that involves the continued theme of “Fairy Tales”. Pairs of students are preparing descriptions of the wolf’s fur being blown off. Banks of word blend games, created as Notebook files with audio recordings on the interactive whiteboard, are used by students to scaffold and guide their writing. They look at what other students have created prior to commencing their own texts. In interview, Gabby reasons this guidance in the following way: “I often model my own quirky examples, or they might look at what’s been done before. It assists guiding the content students create and the work samples they produce”. Emphasis is placed on differentiation and negotiation in the classroom, and this conception is described in the proceeding section.

### 4.6.2 Emphasis on differentiation and negotiation

In classrooms where teachers integrate technology effectively, students often work in ‘project mode’ to produce a product that allows for differentiation and negotiation in their learning (Chen, 2010). Such classrooms feature students working in groups, pairs or as individuals on topics that are important to them. Subject matter for products stems from within and sometimes beyond curriculum requirements (Rushkoff, 2011). Although there is often a high degree of experimentation and choice in Gabby’s classroom, the students direct what is important to them about a topic. This teaching strategy acts to support differentiation of learning (Freidman, 2005; Hedberg & Lefoe, 2005). An additional feature of this conception is the significance of students wanting answers to their own questions and this notion is explored through pedagogical themes of experimentation, ‘going with the flow’ and ‘unfinishedness’.
Experimentation

When Gabby instigates a new topic from the syllabus, she scaffolds subject matter by showing examples of texts from hardcover books and Notebook files. She is observed doing this, and when questioned in interview about this action, she says:

Technology enables them to engage in individual research as a response to content … I like to give them time to experiment with a response to what we have talked about.

They will often come back with something completely different.

Rather than think that this is a threat to her planning, she uses this as opportunity to lead student learning by what they value. Experimentation arises through allowing students to have time to respond to questions and ask about a topic or scenario. Experimentation is observed in one group’s creation of a ‘knight’s galaxy castle’ that is their version of a storybook house for the “Fairy Tale” narrative. The response is highly imaginative and is welcomed, yet is quite different to what Gabby imagined the students might produce.

Going with the flow

There is a strong research argument that ideas of experimentation are better enabled through technology integration (Csíkszentmihályi, 1990; Papert, 1980; Resnick, 2007). This notion underpinned Gabby’s belief that learning goals are not always immediate and ‘going with the flow’ is important. In interview, she acknowledges: “It bends and turns as time goes on, taking learning along different paths. I have a mental map of where I want to go but I don’t often know exactly where to next”. Promoting experimentation and going with the flow is tied to her view that in other teachers’ classrooms “beautiful generic things” are produced and that this outcome links to a particular vision of learning, one entailing “consistency of teacher judgement”, and one that she does not subscribe to:

If everyone produces the same item then it’s easier to gauge which product is better, but this is not what learning is. Learning should flow and teachers should go with the
flow. Seeing what is important to each student is better revealed without everyone producing the same thing at the same time. If teachers control how students use technology and what they produce, they are acting as gatekeepers and that’s why I pulled away from encouraging teachers to use technology creatively … many didn’t know how to do it … [the teachers] have to live with a sense of unfinishedness when technology is integrated.

**Unfinishedness**

The idea of “unfinishedness” arises from recognition that children work in discrete ways and at a different pace in technology-rich contexts (Lytras, 2008; Resnick, 2007). This is not about the provision of open-ended learning tasks. In interview, Gabby remarks: “Students don’t have work in progress or final published work in my classroom, they have ‘unfinished’ work with technology, work that can be returned to later”. At times, this sense of ownership is observed in the classroom and what she wants for her students is for them to see that their learning matters. A student in Year 2 articulates this in focus group discussion: “We mostly do hard work in our class and Miss ... wants us to be good learners”. Gabby believes this priority is achieved by giving students management of their learning direction and “letting go” when they use technology. She mentions in interview: “They know better than me, you need to give them control, let go and the use the technology for what they focus on and finally produce”.

This belief is observed in action when pairs of Year 1 students take turns recording the weekly spelling list, as a podcast (or short movie) made with a flip camera. In this process, students read and record the spelling lists set by the school. They look up the meaning of words on the internet or in a dictionary and then they record themselves using the spelling word in an appropriate sentence. The work is saved as an audio or video file, to be used by the rest of Stage 1 for spelling assessment the following week. Students like this literacy method and spoke about it in focus group discussions. This student from Year 1 expresses a
typical opinion: “It’s really great because you can look up stuff, Google, dictionaries or even the thesaurus”. Not controlling the management of the learning direction by ‘letting go’ and fostering the sense of ‘unfinishedness’ is encouraged. This learning process is observed in other literacy strategies Gabby uses, for example, when students make and re-make short videos to understand spelling rules. It is in this situation that students use flip cameras to make the innovative film *Bossy e*. In interview, Gabby says: “This method leads to deeper understanding of concepts, as does recording spelling lists on the interactive whiteboard; as they record, they focus more and I can’t interrupt their learning either”.

This pedagogical theme also relates to ‘being in the flow’. Gabby acknowledges that when students are deeply involved in learning and they are planning, writing, recording and editing, she observes what they do and only intervenes if they ask for assistance. When students are questioned in focus group discussions about this, their comments affirm Gabby’s pedagogical approach. As one Year 2 student describes it: “We know what to do. If you can actually see it, it tells you more on the IWB screen than out of a book”. Another student from Year 1 mentions the making of the *Bossy e*: “When we use computers and the IWB, it doesn’t make us confused in spelling, it helps us remember stuff and you don’t have to keep it all in your mind”.

Powerful affordances of technology in education and its positive reinforcement of literacy learning in school classrooms are well documented (Hedberg & LeFoe, 2005; Higgins, 2006; Kennewell, 2008; Schuck & Kearney, 2006; Zhao, 2003). Gabby’s conception of differentiation and individuality in technology integration arises from ‘letting go’ and accepting flow, thus experimentation and unfinished work is an important pedagogical theme for her teaching. This is coupled to her firm belief in fun and play when developing effective

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31 *Bossy e* is a film made by the students about a spelling rule. As the ‘e’ changes it changes the sound another vowel makes, for example ‘not’ changes to ‘note’, a short sound changes to a long vowel sound.
technology integration in the classroom and this conception is explored in the following section of findings.

4.6.3 Fun and play

Learning in this classroom at Cumera Primary School is all about having fun and unstructured time to play. Pedagogical approaches that emphasise preferences for exploration are inherent in how young children learn and lead to “extended playfulness as boundaries between work and play dissolve” (Craft, 2011b, p.86). Words like fun and play are conceptions of technology integration and repeatedly manifest themselves in data of how Gabby expresses her passion for technology integration: “I actually get paid to do this job (of teaching)”. She states that what she does is her hobby, too. In interview, she adds: “With my new Year 2 students this year I needed to put the fun back into them, but I make sure they know the difference between fun and silly”. Craft (2011b) cites this as a huge challenge for adults working with young children, when “accepting the possibility that playfulness and seriousness are two sides of the same coin rather than different currencies” (p.68). Fun and play are explored through data collected in the pedagogical themes of dressing up, story-telling and mathematical thinking.

Dressing up

Friday afternoon dress-ups, news circle story-telling and drama performances are manifestations of the importance of fun and play in Gabby’s classroom. In the very first interview, Gabby states:

My prime role as an educator is one of giving students the chance to be creative and have fun. I often say to them, we have 24 brains in this classroom, let’s put them together and see what we come up with.

Such activities occur at other times. Nevertheless, Friday is the designated time in the week when students take what they have learned and make props, or dress up and perform, while
others take turns to film the whole exercise. They watch their films over and over. Gabby likens this to when: “as a child, I would read the same book over and over, it’s no different”. Fun is palpable in this context and could readily fit the notion of “thick play” described by Mackay (2009). In interview, Gabby speaks at length about this pedagogical theme:

They create their own stories during this time. Sometimes it’s based on the news. You are not learning if you are not having fun or you’re not engaged, but it means my classroom is sometimes noisy and messy. Most people say it’s too messy, too noisy, or too out of control and they couldn’t do what I do.

Choosing to work with noise and mess and without a permanent desk in the classroom, means Gabby is highly mobile and she works alongside students. In observations, she has fun creating with them too. In interview, she states: “The school does not foster this idea of learning through play”. Such commentary acknowledges that what she does in her classroom is different to other teachers and this is something else in her pedagogical approach that she thinks is not approved of by colleagues. At times, the classroom is noisy, though students are “in task”\(^{32}\) and there are very few behaviour problems as students engage in their work.

Gabby thinks this teaching strategy is important and she elaborates further: “When kids use technology it makes them happy and there are less behaviour problems”. Each day is characterised by peaks of intense, noisy product creation followed by troughs of quiet, focused learning time. The space is active and productive; everyone plays – including the teacher.

**Story-telling**

Story-telling features in dialogue around fun and play and Gabby knows the theoretical basis of its power to engage students in learning (Egan, 2005; Hertzberg, 2011; Munns et al, 2013). Attendance at story-telling workshops over several years facilitated her decision to

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\(^{32}\) The notion of being *in task* is drawn from the work of engagement in the Fair Go Project (Munns et al, 2013)
employ a story teller as artist-in-residence, during the previous term, for the whole school.

The story-teller spent most time in Gabby’s classroom. Observation of one particular example demonstrates Gabby’s unique story-telling skill and it is in the “Hansel and Gretel” activity. The story is told as part of the unit of work on “Fairy Tales” and involves an account of an old lady whom local school children – including Gabby – believe lives in a haunted house. The decrepit house is near the local beach where Gabby grew up. Students know the location of the house and are mesmerised as she tells the story in graphic detail.

Afterwards, in an interview Gabby explains her approach:

If telling the story does not engage students, I will change course. I am not afraid to change direction. I know about story-telling as a mechanism for engagement in learning, in theories of play and I like to practise that in my classroom. It fosters formation of different opinions and ideas and I see the evidence in their story writing.

If my students are not engaged, or hooked, then it’s my responsibility to get them back on track.

Support for the position of teachers taking responsibility for the engagement of their students in learning is found in education research literature (Hayes, Mills, Christie & Lingard, 2006; Munns, Lawson, O’Brien & Johnson, 2006) and will be taken up further in Chapter 9.

**Mathematical thinking**

The idea of fun in learning is prevalent in other subjects in Gabby’s classroom. In Mathematics, for example, games developed by students in Notebook files, examined in data collected as part of document data analysis, show a focus on engagement in mathematical thinking. There is a view in some education research that technology effectively captures mathematical concepts, as it allows for repetition and problem-solving in the classroom (Glover et al, 2007; Higgins, 2007). This pedagogical theme is observed in action in a morning session one day, when a student in Year 1 is experiencing difficulty understanding
the 100s concept in a Mathematics game. Students are devising the game to gain confidence in this concept. When it is clear that he is finding understanding 100s difficult, he leaves the group and says: “I need more practise”. He takes the Notebook file away on a portable USB and works on it in the adjoining computer room. Gabby notices what happens and later in the day she subtly sets about supporting his understanding of the concept while students engage in another task. In interview, she explains:

I was able to see he was off track; I used praise and reminded him of the great things he did in class last week … I knew he knew he needed to brush up on his chart with a bit more practise. ... Notebook files are useful for that.

Online games for Mathematics are another means to capture play (Attard, 2011; Montgomery, 2007) and Gabby uses a range of games to teach and assess this subject matter. Again, such activity is threaded to her insight in interview data and she says: “Games on the IWB allow whole class and individual engagement in learning maths concepts, and I can pre-test them too. I also like to film them doing maths assessment, it allows me to reflect”. An overarching philosophy of learning with technology links to Gabby’s awareness of the role of play and fun in fostering student imagination. This pedagogical theme, along with the length of session time, is present in the final conception of extended learning time and is detailed in the following section of the case study.

4.6.4 Extended learning time

Time and lack of time are frequently cited in education research in schools (Finger et al, 2007; Howell, 2012) as reasons for why teachers adopt, or choose not to, integrate technology into classroom practice. It is worth noting that Gabby uses the analogy of “choosing the right dress to be worn for an important occasion” in the context of extended learning time. In commentary on her use and preparation of Notebook files and the time taken to prepare thoughtfully, she states the comparison this way: “You choose something
and make it your own. It’s got to be the right dress, it’s a big investment of time and you can’t rush [choosing] it. Some teachers leave at 3.30 and don’t work weekends, I do”. In this conception, extended learning time is connected to pedagogical themes of imagination and the length of session time.

**Imagination**

This idea is prominent in Gabby’s perception that the creation of Notebook files is ‘therapeutic’ and that sometimes her own children at home are also involved. In interview she reflects: “I guess I like to use my imagination too and making Notebook files satisfies that aspect of my work”. Imagination fostered through play is described previously in the category of *play* and *fun*, despite allowing enough time to use technology; it is the critical element that enables the development of imagination. Craft (2011) discusses this observation in recent education research, suggesting that “high levels of participation in digital contexts by students and by teachers foster imagination” (p.87). Craft continues an argument made by the Cheskin Group (2002) that “playing with others and producing digital content gives voice to the imagination” (Craft, 2011, p.88). When presented with this observation of her pedagogy Gabby says: “Giving students time with the chance to imagine and play, working through their eyes, is beautiful”. She concludes with a lengthy statement on this point:

> If students learn the *big ideas* and express them using various technologies, it requires extended learning time. I like long sessions, so the kids can really show me what they can do … often they spend six weeks on a narrative … it makes a lot of sense and they get into the flow.

Writing initiated by hand serves as the basis for elaborate, imaginative digital texts for animated stories produced by students in Notebook files. Often two or more of these are produced and presented to parents by the whole class each term.
Length of session time

There is an argument that teachers set up their classrooms based on what they perceive best enables development of students’ imagination and often this means ‘getting into flow’, and ‘getting into flow’ takes time (Csíkszentmihályi, 1990). Flow is achieved in Gabby’s classroom by students first drafting their work on paper. Writing three- or four-page narratives at a time is not uncommon. In interview, Gabby explains this observation of session time thus:

I give my students longer blocks of learning time to write well, I don’t want to do a recount every Monday morning – I try to do a few quality pieces of writing across the week. I give them a long time to write. I don’t want my students to do the timetabled 40 minute recount. We are not all meant to be doing the same things at the same time.

It takes time to know syllabus documents well and Gabby weaves this pedagogical theme into her beliefs around the importance of time in learning, as she states: “To really know the subject matter well fits with the idea of inquiry-based constructivist teaching around a focus question and big ideas in a subject, and this approach takes time”. She gives an example of this pedagogical theme in her description of a recent Mathematics Day held at the local beach:

This was a whole day of Maths, featuring the creation of ‘maths mascots’ for measurement understanding and the construction of digital maths storybooks afterwards. It was project work that involved extended time … time for students to experience success.

From these observations, it was clear that working effectively with technology requires flow and flow is not achieved without adequate time.

33 I did not attend this Mathematics Day at the beach; however, I was able to review materials developed for the day and examine the Notebook files students produced after the event.
4.7 What is fresh?

This case describes fresh ways to comprehend one teacher’s knowledge of technology integration in the classroom. The conceptions of public learning through performance, creativity, differentiation and negotiation, play and fun and extended learning time are within the reach of teachers in schools who are seeking to integrate technology in learning. Considering each pedagogical theme in Gabby’s conception of technology integration provides possibilities for what is sharable and points to how teachers might enact this knowledge. For example, important vehicles to create audiences for the students’ work are digital stories, Notebook software on the interactive whiteboard, and film products made using digital cameras, the iPhone or iPad. Such avenues for publication often involve production of a learning artefact that exhibits creativity drawn from the student’s imagination. Extended time for learning sessions across content areas allows time for students to get into the flow and experiment with their ideas, especially when it comes to the role of online games in developing mathematical thinking. Going with the students sense of inquiry and pursuit of understanding at their pace, suggests not every classroom task or activity begun may lead to immediate completion, and instead students have multiple work ‘on the go’ at any one time. This is work that students own and can be returned to later. Full discussion of What is fresh? is taken up in Chapter 8. Now it is time to step inside another classroom with a teacher who works with students in Stage 2, the middle years of primary school education. The case of Gina follows.
Chapter 5: The Case of Gina

Figure 4: Front covers of Gina’s ‘handmade’ picture books

34 These books feature in Gina’s conception of her knowledge of technology integration and are discussed in Sections 5.6.2 and 5.6.3.
5.1 Introduction

This chapter introduces Gina, a Stage 2 teacher and Priority Schools Program (PSP) consultant in inner city primary schools in Sydney, NSW. The image on the previous page shows covers of a set of ‘handmade’ picture books she uses in Early Stage 1 - Stage 3 classrooms. The significance of these texts in Gina’s conception of her knowledge of technology integration is discussed in Section 5.4.3. At the time of data collection, she had agreed to be a consultant with a focus on pedagogy in a state education office. In this position she co-teaches alongside teachers in a variety of primary school locations. Prior to her entry to the teaching profession, Gina worked as a computer programmer in a large technology company. She returned to university study during this period of employment to gain education qualifications to teach in schools. Gina writes computer code and is capable of fixing almost any hardware or software problem. Animation and using several laptops at once in the classroom are ‘trademarks’ of her technology use. She multi-tasks using an iPhone and iPad in the classroom, and she teaches students and teachers how to use several computer apps, including SketchUp and CAD software. Gina believes technology is central to learning, although she is aware that for some teachers the mere use of the term causes an emotional reaction. In interview, she quotes various international technology authorities to explain the importance of technology in school education, for example:

Technology is a loaded term. To me it is just another tool. What matters is how it’s used for learning. As Chris Lehmann said a few years ago … technology needs to be like oxygen … ubiquitous, necessary and invisible. We need not to think about it. It just needs to be there.

35 In 2012, Gina was promoted to the role of teaching Principal in a small harbour-side primary school in Sydney.

36 Sketchup and CAD are apps that support designing and modelling architectural structures in 3D.

5.2 Marcus Primary School

Marcus is in the inner-west of the city. The site is new to Gina. Soon after she commenced the PSP consultant position, Gina responded to the school’s request to work alongside a number of teachers in classrooms, to support their technology professional learning. A public school established in 1886 Marcus offers tuition to approximately 270 students from Kindergarten to Year 6. There are approximately 18 full-time teachers, most of whom are female, and the school has specialist relief from face-to-face teaching in Mathematics, PDHPE, and Music. Class sizes range from 21-30 students. Located in a medium to high density housing area, the school has students who live in a mixture of public, private and rental accommodation. The school’s statement of purpose: “We work as one to provide quality equitable education in an inclusive and supportive environment”, reflects its commitment to ensuring that all students have equal access to resources, and that “student welfare is a high priority” (Annual School Report, 2011, p.2). Over 80% of students have families with language backgrounds other than English, representing more than 43 language groups, while 9% of students come from an Indigenous background. Every student is able to learn one of three community languages, and the “targeted educational program and restorative school culture promotes academic and social development at all levels” (Annual School Report, 2011, p.3).

According to the school’s website, enrichment programs in English, Mathematics, Information Technology, Music, Science and Sport are designed to ensure every student accesses his/her personal talents, interests and potential. The learning support team coordinates programs for students in need of additional assistance, or extension in particular aspects of learning. The school also benefits from the support of an active Parents and Citizens Committee and there is a community centre on site. Funds from the Federal Government’s Building the Education Revolution (BER) have provided several new school buildings including a library, assembly hall and additional classrooms. There is a ‘connected
classroom’, an intranet with resources, and internet sites available to students from the many networked computers in the library, in computer labs, and in classrooms. In numerous teaching spaces there are interactive whiteboards, with plans to install them in all learning areas. A palpable atmosphere of community exists among students and staff, and each day many parent helpers work alongside teachers in classrooms.

5.3 The classroom/s

Gina teaches 28 students in Stage 2 at Marcus. Observation of lessons centre on a Science unit and the construction of self-propelled model cars that are balloon or rubber band powered. The classroom teacher, Christina, is the first person to request technology professional learning from Gina. Rationalising, why she requires support Christina says: “I enjoy teaching Science less, in comparison to teaching other subjects, and I’d like some ideas on how technology can be integrated”. In interview and observation sessions throughout the data collection period Gina states: “The way I teach this class is no different to how I would approach teaching Stage 2 at Hickson (her previous school) or any other primary school class”. Gina teaches Science outcomes from the primary syllabus, featuring various systems and sources of energy, using investigations that enable students to observe, question, predict, test, record, and draw conclusions (see Appendix E for a copy of the lesson plan). The unit’s title is “Model Car Challenge – Alternative Energy” and when questioned about the comprehensive lesson plans, Gina offers this reasoning:

I always plan like this … with all the notes-to-self and detailed scripts. It helps me not to forget any important bits and to stay focused on the learning purpose. I have integrated tech in the unit the way I would normally do it … as if I was teaching this to my own class. Once again the tech does not become the focus … learning is the focus.
During the observation week, Gina uses humour to establish rapport with this new group of students and by the time she finishes teaching the unit she is satisfied with the realisation of her learning goals:

I think most of the students made a car that went and they started to use the metalanguage of the various forms of energy and systems. They understood that energy is never created or destroyed, it just changes form.

When questioning students about the learning experience in focus group discussions later, they offer many positive comments: “I liked looking inside the battery using the webcam”, “She’s very funny but we still learned so much” and “She made Science less boring … there was a lot of activity”.

In other observation sessions later in the week, at Alice Primary and Barkwood Community Schools, Gina co-teaches in Early Stage 1 and Stage 1. These classrooms have smaller class sizes and are led by teachers who are taking ‘first steps’ in technology integration. Each teacher has identified their need for support in using particular digital resources for literacy and numeracy.

5.4 Professional background

Prior to promotion to PSP consultant and then to principal, Gina taught Stage 2 at Hickson Primary. This school has a similar demographic background to Marcus. At Hickson she was in a teaching role as assistant principal, as well as supporting the school’s developing technology needs. In interview, she refers to Hickson’s move from hardware orientation to a focus on pedagogy: “It was all about the mechanics of the machines at first, and then we finally thought about pedagogy”. She explains in interview how she sourced grants for new laptops and trolleys, and then set about dismantling the computer lab:

I had to get rid of all the old and broken ones. This meant we had functioning computers, a few in every classroom. The focus was student engagement and raising
the intellectual quality of lessons. I want to say the purpose wasn’t the technology, but the technology supported us to get higher intellectual quality into lessons and better student engagement. It was all that high affective, high cognitive and high operative stuff.

Gina’s promotion is recognition of her outstanding technology, content and pedagogical knowledge. She acknowledges the role enables her to have increased opportunity to influence other teachers, with an explicit aim of creating “better learning” for students in more schools:

As a classroom teacher you have control over the direct end product, that is, the students. Now I am supporting teachers to ensure their students are exposed to the Quality Teaching Framework. I’m one step removed ... it’s a broader role ... a professional learning role and technology gives me the lever to do this work.

Employed as a software engineer for five years at IBM, Gina was fulfilling her parents’ desire to achieve what they thought was “a good job for a girl”. Her interest in technology was sparked by a mother who was highly mathematical and a Dad who fixed everything:

I was always out in the garage with my Dad building and re-making stuff. I used to break my dolls to see how they worked. I had a Lego Mechanics kit, I was nerdy and I liked my Walkman … I was the first kid in my school to have a computer.

From both parents, she gained her personal philosophy: “Questions are more important than answers”. This is an important pedagogical theme and is returned to in Section 5.6.2. At home, she is an avid producer of family digital presentations. She does a lot of video-editing and spends time fixing things for her children, and makes special mention of a humorous

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38 These are terms from the project of the Fair Go Team: School Is For Me: Pathways to Student Engagement. Sydney: Priority Schools Funding Program, NSW Department of Education and Training (Munns et al, 2006).

39 The Quality Teaching Framework is a term used to describe particular pedagogical practices that would normally fit within constructivism. The discussion paper featuring dimensions and elements of the framework, accessed here at https://www.det.nsw.edu.au/proflearn/areas/qt/index.htm
incident of “toy dog repair” for her young daughter. She likes connecting with teaching colleagues using Yammer\textsuperscript{40} and utilises a personal learning network (PLN), as well as other social media like Twitter. For relaxation, Gina plays video games that allow her to get into an imaginary role and extend the storyline\textsuperscript{41}.

In her final years of secondary schooling, Gina concentrated on achieving well in computer studies and this set in motion plans to become a secondary school mathematics teacher. The plan did not eventuate. Instead, she worked in programming and building computer hardware after completing a Bachelor of Information Technology degree. This was the right choice at the time and aligned with her love of solving technical problems. Now, with the benefit of hindsight, she sees teaching as “a lot more fun”. Teaching qualifications eventually followed this first degree, and later, while teaching at Hickson, Gina completed a postgraduate diploma in gifted education.

Gina has eight years teaching experience, mainly with Stage 2 students and including some short stints in Early Stage 1, and Stages 1 and 3. She explains: “I have experienced teaching all of the primary school years”. A great advocate of mobile technology in the classroom, she frequently asks students to look up answers to questions that arise while they are learning, on her iPhone. Several students, in focus group discussion, comment on the practice and unanimously agree that “other teachers never do that”. In interview Gina refers extensively to constructivist learning principles and to the work of ‘technology experts’ like Papert, Stager, and Rushkroff. She is keen to demonstrate that her role as PSP consultant is: “a good fit, although I am missing having a permanent class”. Gina’s pre-teaching background, extensive technology skills, and the timing of her entry into the teaching profession coincided with substantial technology investment by education jurisdictions in Australian

\textsuperscript{40} Yammer is a social networking tool, and it is used by teachers in the DEC to file share, collaborate, and exchange questions and answers, access here at https://www.yammer.com/product/

\textsuperscript{41} For example “Age of Empires” and “Sim City”.

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schools. Her attributes are recognised by her education employer, hence the consultant role, and her contribution is highly valued by colleagues, students and parents in the schools where she works. The following section details Gina’s perceptions of technology integration in light of the TPACK framework.

5.5 A representation of Gina’s perceptions of technology integration

Gina was interested in the TPACK framework from the moment she joined the study. In the first interview she said: “TPACK is saying something complex in a simple way. I like its simplicity”. This sense of uncomplicated knowledge in her view of technology integration is revisited in dialogue in the cross-case analysis, and in Chapter 8 this discussion is returned to in full. Gina satisfies her thirst for content knowledge by “knowing my stuff”. Practical methods and practices of teaching are well understood and observation of Gina in multiple sites demonstrates the adaptability of her pedagogical knowledge (PK) to the context. When pedagogy and content knowledge link in Gina’s classroom, she describes that congruence in terms of: “Being an expert learner … I know something about curriculum, assessment and pedagogy … I would say these are characteristics of a teacher who is driven by values, attitudes and passion for teaching”. Gina uses her technology knowledge (TK) to teach in highly imaginative and creative ways. When combined with deep knowledge of content (CK), she utilises technology to create a classroom context that students often don’t want to leave. They get ‘in the flow’ and are engaged in what they are learning, and often seem oblivious to factors around time and repetition until the learning problems they are working on are solved. The purpose of her technological pedagogical knowledge (TPK) drives technology use. TPACK and how it combines in the classroom as observable classroom behaviours are on display every time Gina teaches. A mix of old and new technology enhances her unique approach to technology integration, and the main conceptions of this knowledge are specified below.
5.6 The main conceptions

Conceptions of Gina’s knowledge of technology integration, demonstrated in this Stage 2 classroom, fall into five distinct areas. Each conception has been developed from groupings of pedagogical themes that emerged from analysis of the observation week data. Pedagogical themes comprise diverse teaching strategies and student learning processes. The five conceptions are:

1. Purposeful teaching: purpose, planning and connections through language and conversation;
2. Theory driven practice: constructivist teaching, teaching for quality and building a questioning environment;
3. Creativity: narratives in action, creating learning products and performance;
4. Real world application: preparation for life, student voice and ownership; and

The following sections of the case study note each conception of technology integration and the pedagogical themes with reference to teacher and student interviews, classroom observations of students and document analysis. The first conception, purposeful teaching, is outlined next, with specific data describing the conception provided. The conception is supported by detailed data for each of the maintaining pedagogical themes.

5.6.1 Purposeful teaching

Purposeful teaching is a feature of Gina’s classroom and is used to guide students’ thinking. In interview, she expresses the importance of this attitude with an often used ‘catch cry’: “It’s not just tech for tech’s sake”. She is able to stand back and talk about learning in domain-specific language. The conception of her knowledge of technology integration is underpinned by the pedagogical themes of purpose, planning and connections through language and conversation.
Purpose

Learning with clear intention is a personal philosophy that informs Gina’s choice of the right technology which fits the purpose. This perception extends to her beliefs about technology and how the use of technology in the classroom must be thought through in advance:

“Teachers should use technology so long as it is purposeful. It is another resource in the classroom, and sometimes it is better if four or five students are working around one computer so they are talking and interacting … they don’t have to all be doing the same thing at the same time … teachers have to get past the idea that they all need one [computer each]”.

Gina likens the regime of the 1:1 classroom as akin to the single desk classroom and asks these two questions: “When teachers use this approach to learning are we doing more of the same with different tools? [With] one student working on a laptop at their desk … where’s the interaction?” These comments will be taken up further in Chapter 8. For Gina, purpose involves teachers knowing when to use technology and how to fit what they plan with an appropriate classroom tool. For example, a glue stick might be the right tool for cardboard construction, but alternatively there are software programs that can be used for construction and these need to be selectively chosen. As Gina says: “You wouldn’t use PowerPoint to build a 3D sculpture”. This image links to her view of critical thinking and technology:

It’s really good when we can use technology to learn. Sometimes it’s appropriate to use SketchUp to create an amazing house structure. Getting students to try to find answers to questions themselves, to think critically. Technology is a tool for learning how to learn and making sure we don’t knock this out of kids.

Observations of vehicles created in the “Model Car Challenge – Alternative Energy” lessons demonstrate the point. Students design their ‘clean energy car’ on paper and build them using cardboard containers, plastic bottle tops and other recycled materials. The cars are
powered by rubber-bands, or balloons. Gina builds interest in the task with questions (see Section 5.6.2), hand-drawn diagrams, and a PowerPoint presentation of different energy efficient cars sourced from YouTube clips. She conducts an in-class experiment with vinegar and baking powder to demonstrate energy production to the whole class. The experiment simulates what happens inside a household battery. After the demonstration she proceeds to dismantle the small battery-powered toy car wearing protective clothing. Gina uses a webcam to project what is inside the battery onto an interactive whiteboard. Students see what makes the toy work (see Component 2 in Appendix E) and in focus group discussion afterwards, two students remark: “I really learned how a battery works by looking at the inside” and “I understood how it works when she (Gina) pulled the toy apart and I could see what was inside it. I saw it on the screen”.

**Planning**

Planning is central to creating good learning for students. Full details of Gina’s lesson plans are found in Appendix E. This practice is not one-off, and when asked about records and plans from teaching in other contexts Gina retorts: “It’s what I do. My plans are extremely detailed and time-consuming”. Guidance and planning for learning is an activity that stems from her view that teaching is bound by what is in syllabus documents, and she expresses her process in this way:

> It’s governed a bit like the ‘rule of thirds’ … learning is not a free-for-all … if you are doing project-based work it’s not just picking anything to study, you are bound by official documents and you have to cover what the students have to learn.

Gina’s planning process is based upon prior reading of the topic ensuring that she is well-versed in the accuracy of the subject matter, and here she explains her thinking:
Even when the knowledge is problematic … I see myself as a guide, or a planner on the side. You have got to know what you are talking about otherwise you may as well have untrained people doing the job.

In addition to plans on paper, or on her laptop, Gina likes to use mind maps\textsuperscript{42}, to guide and connect content, and suggests that this gives students different ways to access information.

**Connections through language and conversation**

The pedagogical theme of connections through language and conversation to content in syllabus outcomes are made in both Gina’s planning documents, and in her classroom teaching. When asked about this observation, she explains: “What I plan is [taken] from what the documents say I have to do”. Throughout the toy dismantling exercise, students build their scientific knowledge by making lists of topic words associated with her actions, for example: *systems, energy crisis, potential energy, friction, solar, chemicals, electricity,* and *magnesium*. During the observation period, students were encouraged to keep track of new words and to make lists on paper pinned to the walls of the classroom. They began to use the new words in group conversation and while writing up their Science investigations in pairs. In interview, Gina reveals her belief that connections to discipline knowledge for students become more clearly understood when encouraging them to use specialist vocabulary, and how making lists of new words is one way to foster it:

Students have to know the subject but I need to know it better. Some teachers see tech as a quick fix … it’s not a silver bullet. You have to know the words … the language, and you have to do a lot of thinking.

Students raise the subject of climate change in whole class discussions, and how in their daily lives they also contribute to pollution. One student’s comment was typical: “Batteries and what’s in batteries contributes to landfill, and this in turn leaks into the water tables of

\textsuperscript{42} Mind maps are often used by teachers and usually involve a diagram used to visually detail information.
cities, causing pollution”. The importance of the world’s energy challenge is recognised, and in focus group discussion another student recalls his new knowledge:

I remember so many things … like how many batteries are used each year in Australia … it was 345 million. I am going to use [batteries] less now. They fill up rubbish dumps and white stuff comes out into the subsoil which is bad for the environment.

Connections to Science through language and conversation are enhanced in Gina’s classroom through her knowledge of technology integration.

5.6.2 Theory driven practice

Theory drives Gina’s classroom practice. Overt articulation of education theory from various sources, in interviews and observation, supports her claims of its significance. In particular, the theories of Dewey, Vygotsky, Bruner and Piaget are important. The postgraduate Certificate in Gifted Education, which Gina completed soon after her teaching career began, sustains her view of theory: “Education theory is pertinent, and it has a role in differentiation and enabling all kids to access deeper and higher order learning”. The clarity of her learning message is firmly based on theoretical beliefs about social constructivism, the emphasis on a framework like Quality Teaching (QT) and a particular questioning environment.

Constructivist teaching

Gina models what she wants the students to do and consciously builds the environment in the classroom in order for students to understand new concepts: “I am not the knower. I use a constructivist approach. My students work in a learning community to build meaning of the world, out of the learning experiences they engage in”. She adds to this view of constructivist learning, and also what it’s not, in this way:
The students are engaged, they are on task, they are in task and they are, in this case, learning Science for a purpose. The students in my class want to come to school to learn … you don’t tell them … they have to experience it … regurgitating facts is not learning … filling in black-line masters or worksheets is not learning\textsuperscript{43}.

The pedagogical theme of constructivist teaching is prominent in observation. For example, when the battery is dismantled, students draw diagrams of their prototype car and label its parts and energy sources. The diagrams serve as the basis for a movie made in a later lesson. Using ‘trial and error’ methods, students test wheel-type possibilities, chassis size and whether using a balloon or a rubber-band will make the car move further. Gina sets parameters for them to achieve: “It is desirable for the car to travel more than three metres within a one metre track”. Road tests are carried out on a flat surface on nearby tables and each group measures, then records, the distance the car travels.

In focus group discussion, students share the criteria they used to determine what makes a successful ‘clean energy’ car. Two comments are emblematic of sentiments overheard in observation: “If the wheels are round and evenly spaced on the axle the car goes much further” and “If we blow up the balloon really big … then it has more power … more energy to push it further along”. Students write up the process in workbooks and what is articulated by another student in the classroom triangulates with the lesson intention: “I had lots of ideas about how I could make a fast car with a balloon, but eventually I used some rubber-bands to power the car and it went further”.

The mix of old and new technology in this aspect of Gina’s knowledge of technology integration is taken up in Section 5.6.3.

\textsuperscript{43} This reference to in task is a term from the work of the Fair Go Team (2006.) School Is For Me: Pathways to Student Engagement. Sydney: Priority Schools Funding Program, NSW Department of Education and Training.
Teaching for quality

Gina takes the notion of constructivist teaching and cross-checks her practice against the dimensions and elements of a particular pedagogical framework that teachers in this education jurisdiction have used since 2003. The Quality Teaching framework (QT) is based on the original work of ‘authentic instruction’ from the University of Wisconsin’s Centre for Organization and Restructuring of Schools (Newmann, 1996), and more recently, the model of ‘productive pedagogies’ from Australian research known as the Queensland School Reform Longitudinal Study (2002). Gina uses four questions from QT to inform her conception of technology integration, and in interview she states them:

What do I want the students to learn? Why will that learning matter to students?
What do I want the students to produce? How well do I expect them to do it? I really believe you have to do all the QT stuff.

She reiterates the questions over the observation period and demonstrates how her learning plans connect to the students’ world so they are able to construct knowledge for themselves. Technology underpinned by three dimensions and 18 elements of QT is a way of making effective learning possible in Gina’s classroom. The unit planning document in Appendix E explicitly states the QT questions, and each response details the big ideas, links to the Science syllabus, knowledge of climate change and the world’s energy crisis, as well as the production of a multi-modal text and assessment with marking guidelines.

Building a questioning environment

The notion of consciously building a questioning environment and Gina’s repeated statements to students of “questions are more important than answers” were learned early in her life. Not only is the belief continually articulated, “Ask me a billion questions”, Gina also fosters the students’ active involvement in questioning by asking questions while they work. She explains: “You have to create the right schemas in students’ minds”. At Marcus,
while the students build their ‘clean energy’ cars, she initiates the task with a statement, then follows it with two questions, for example: “Batteries are useful and we use 345 million of them each year. How many batteries might you have at your home in various devices? Is there a problem with that?” Observation shows her answering students’ questions with other questions:

Why couldn’t you use something else to power your remote-controlled car? How are we disposing of batteries at home? Where does this rubbish go? Can we use other energy sources to power our devices? What about power from the sun?

Gina insists that teachers need to ask the right questions to arouse students’ curiosity and starting off with an overarching inquiry question is essential:

Our job is not to produce people who know facts and figures. I have to get them to ask good questions that will solve the world’s problems. If they are not asking questions … they are not going to find the answers.

The example of “Ori’s Home” in one of her ‘handmade’ picture books stemmed from student curiosity. This text arose out of the study of rainforests in a Stage 2 class at Hickson. Gina describes how one student was mesmerised by the ‘cuteness’ of a photo of an orangutan in nappies that they found on the internet. Gina used the photo as a trigger for a dilemma and a series of questions about deforestation, which were developed into the story of “Ori’s Home”. Many of the students’ questions are answered in the picture book:

The facts were that the orangutan (Ori) needed nappies after the death of its mother. The book promotes awareness of how rainforest destruction in many parts of the world is happening to make way for palm oil trees. Students hadn’t questioned why the poor thing had nappies. They asked me lots of questions as we began talking, and we looked up things on the web, and I made the book as a response.
The relentless questioning of students about their learning is observed at Marcus. In interview Gina references this practice to Bloom’s taxonomy (Anderson & Krathwohl, 2001). In the classroom she is observed praising one student for asking a good question. She then answers the student’s question with another question. Gina gives the student extra time to think, while other students try to speed up the response. She stops them, and asks them to respect that this student is thinking, and thinking takes time. Afterwards, in interview Gina explains:

Bloom’s taxonomy is really useful here … these students are really starting to think more about their questions … now they are thinking a few steps ahead. I gave [Sally] more time to show that she could eventually come up with a thoughtful understanding.

In focus group discussions this practice is confirmed by the student in question: “At first I didn’t know what to say … so many questions … but she really made me think. I got to the understanding without being told”. At the conclusion of the observation period, Stage 2 students at Marcus show more thought in both the number and quality of questions they are asking in the classroom. The idea of questioning to develop thinking corresponds to Resnick’s Creative Thinking Spiral (2008). This is a way to scaffold and model creative thinking, and is a conversation that is returned to in Chapter 8.

5.6.3 Creativity

Gina was the recipient of a Microsoft Information and Communications Technology Scholarship in 2007. This award gave her the opportunity to explore 21st Century learning in five schools in the US and Canada. In the report of the study tour scholarship, Gina cites creativity as the key for successful 21st Century futures. She adds: “Evolution in schools needs to come in four forms: creative curriculum, creative teachers, creative administration and creative classrooms”. Fostering opportunities for creativity appear limitless when
technology is integrated into learning in Gina’s classroom. In interview, discussion of how this idea links to building new technologies manifests as “bias in software programs”. She explains: “It is the way programs are designed that serves the producer’s purpose and that, generally, is not an education purpose”. If students are to be creators using existing technology and not consumers, the focus in schools according to Gina “should be on building new software”. It is her view that there are technology limitations in what students are currently given to work with in schools. This is a challenging idea that stems from her belief that primary school students should know “the backend stuff”, in particular, computer language like html, and how to program computers. These ideas are discussed in more detail in Chapter 8. The conception of creation in Gina’s knowledge of technology integration is supported by her belief that “technology tools allow students to create” and “producing creative students is my number one goal as a teacher”. This aim is supported by the pedagogical themes of narratives in action, creating learning products and performance.

**Narratives in action**

Gina’s ‘handmade’ books are examples of narratives in action. The stories are stimulated by syllabus outcomes and student questions, and then recounted in picture book format to illustrate particular subject matter. For example: the “Egg-citing Egg Man” is a story about building community, and how “Dr Dumpty” was able to do that in his job in the circus. Gina explains that, in addition to the prescribed syllabus content, it is her role to make the narrative fit the learning outcomes: “Narrative is especially important when teaching students from non-English speaking backgrounds (NESB). They need to see the link between learning outcomes and language. Narratives are a good method of realising that with NESB students because they relate to story”. The proportion of students from non-English speaking backgrounds was high at Gina’s previous school (Hickson) and this is where she believes she developed her story-telling skills.
The pedagogical theme of narratives in action is explored further when Gina details her personal interest in computer games:

I like the really good ones, those with substantial stories, like the Lego stories, Age of Empires and Sim City. Extending the story is something I like to do … computer games blur the lines between home and school. You play characters in a game and can change into someone else.

She carries her gaming passion into the classroom when asking students to write: “the back story of a computer game to build literacy skills”. There is a deep process of narrative building when playing computer games and the experience of first-hand immersion in a scenario that is powerful: “I have seen kids at Hickson produce rich stories using computer games … they write really well … they seem to be more motivated by it. Technology is the hook”. In interview, Gina refers to academic James Gee, whose books include *What video games have to teach us about learning and literacy* (2003). She cites this work as a key reference point for her curiosity in new technology literacies. In focus group discussion at Marcus, two students’ comments add support to Gina’s view of their significance: “I really like playing computer games, they are really cool, they engage me … especially in Maths” and “My favourite game is this journalism game my sister has. I write stories, and I feel like a real journalist when I play the game … it helps me write and it also improves my spelling. I love it”.

**Creating learning products**

Video recording is at the top of Gina’s list of creation tools and she quotes: “Flipping the Classroom” and the work of the Kahn Academy as examples of why video is her favourite technology. Teachers in many parts of the world increasingly discuss how ‘flipping’ or the

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44 Kahn Academy is a video library with thousands of free online resources for students and teachers. [https://www.khanacademy.org/](https://www.khanacademy.org/)
‘flipped classroom’ transforms teaching practice. The idea has much in common with blended learning (Mazur, 1990) and is about teachers recording lessons live using screen capture software, and then posting the lessons online for students to access in their own time. For some teachers it means they have more time in a 1:1 sense for students in the classroom, while for others it means they can’t just stand and talk for long periods of time, presenting endless content to students (Bergmann & Sams, 2012). Many teachers who have embraced the ‘flipped’ notion see themselves as learning coaches. Gina explains this preference: “Video recording is top of my register … it gives kids something to go back to … the idea of producing a video not just for the sake of themselves, but for other students … to a real audience”. Sometimes she records a short explanation of a concept that is shown in the classroom. This wasn’t seen in observation, but is referred to in interview: “It’s a feature in my permanent classroom. Recorded video material is made available for students to view in their own time, via the class blog or wiki”.

At the conclusion of the Science unit at Marcus, Gina shows students some video examples made by her Stage 2 class at Hickson. This group also made ‘clean energy’ cars and communicated their results in short video documentaries. Storyboarding and creating this type of response as a documentary, commences during the final lesson at Marcus. Gina returns to the school and supports Christina, assisting groups of students in editing their final products over the following fortnight. Video production by students reinforces the significance that ‘what students create’ is what matters in learning. Stage 2 students use flip cameras to photograph the cars they have made. They upload images onto computers, and commence writing scripts and recording voiceovers which are then edited into PowerPoint, ready for presentation to the whole class. Christina is excited by the prospect of capturing evidence of the Science unit: “It means that as a class we have a permanent record to return to, and parents can review what was done … we’ll all remember”. This pedagogical theme
of creating products for learning is tied to audience, and the notion of technology making learning public, explored in the following section.

**Performance**

When learning is made public through performance, Gina observes a lift in the quality of the outcome. She says: “Happiness is when students hear their own voice; it lifts their performance and the quality of their writing. It’s also the idea of thinking and writing for a public purpose, but it always needs a context”. Students like to comment on other students’ work in a blog or wiki, and when using this medium often take more time to write, giving better quality responses, because they are viewed by others, or made public.

Papert (1993) refers to turning the activity of writing, using devices that students like to use such as computers or digital cameras, into “hard fun” (p.30). This occurs in Gina’s classroom when students storyboard, capture, write about and make videos of their work, as she explains:

> If kids aren’t given opportunity to be creative and perform what they know, then how are they going to solve important problems? Victor Chang [eminent Australian heart surgeon] made models and showed his peers when he was growing up – that creativity helped him become a pioneering doctor. These days we can add the video dimension and capture, and show, what is produced by students.

At Barkwood, Gina supports another Stage 2 teacher to integrate technology while teaching a new unit of work on Australian bush animals. Gina and the teacher co-teach the lesson. Students use two collaborative technology applications, Popplet and Linoit45, to determine what they already know about the topic. Observation of the lesson demonstrates how apps designed to display ideas as online ‘sticky notes’ are useful, to add and grow knowledge in

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45 Popplet and Linoit are both apps, one is for sharing ideas and the other is an online web sticky note service.
concert with peers in a classroom setting. Gina explains her approach and how this links to the value of technology in making learning public:

These apps encourage thinking, and I care about thinking and switching kids’ brains on so they can show their peers what they know. Using this type of app means students can see what others are thinking immediately, as they write up their thoughts on a digital wall on the laptop screen. This seems to trigger more really good ideas.

Simultaneously, as laptop ‘sticky notes’ are displayed on the interactive whiteboard, the teacher can gauge what the students know. Work from the lesson is saved for future reference.

5.6.4 Real world application

The notion of school and life being separate entities is not something Gina agrees with. If it evolves that way then it’s proof that “learning is no longer important to students”. This sentiment captures the importance of Gina’s belief in technology integration and how it enables real world application:

I consciously try to integrate knowledge and various technology tools support me to do that. I must connect what they are learning to the real world as much as possible. The questions don’t stay in the books they read, or on the internet. I always ask “what did you learn?”

This conception is drawn together with the pedagogical themes of preparation for life, student voice and ownership.

Preparation for life

Measurement systems that enhance education in schools are important and, in this education jurisdiction, standardised testing regimes dictate many assessment practices in primary
classrooms (Quinnell, 2011). Gina ponders on whether her approach to education, which doesn’t involve exposing students to worksheet-based learning, places her students at some disadvantage. This thought is articulated in interview: “Should I give my students exposure to the ‘real world’ where worksheets and NAPLAN\(^{46}\) reign? Am I disadvantaging my kids because I don’t do that? Maybe they need practise?” In the report of her scholarship study tour, she mentions the example of King Middle School in Portland, Maine where “students use technology to support all their learning. The students are involved in rich, open-ended, real life ‘expeditions’ and are encouraged to take risks and imagine solutions to real life problems, and test their hypotheses” (NSW DET, 2007, p.14). When questioned about this statement in interview, she explains: “It stems from the line between school and real life being blurred and involves students as apprentice creators … citizens of the real world”.

Since the introduction of ‘expeditionary learning’ at the school, King Middle School results on standardised test scores have shifted from being in the bottom third of the state to the top one-third of the state (NSW DET, 2007, p.15). Gina believes examples of foundational approaches to learning like these are enabled through technology integration and, as such, promote deeper learning and preparation for life beyond school.

**Student voice**

Accessing and valuing the voice of young people in what they are learning at school is being given precedence in education (Bragg, 2010). In interview, it is technology and its ubiquitous availability in schools that Gina believes supports students to have a ‘voice’:

Technology gives reluctant learners a voice, the student who is not confident or who is not engaged can suddenly be good at something – when they develop their ideas, they can produce something using technology. It doesn’t always have to involve technology, but more often it does. The product can then be praised by the teacher.

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\(^{46}\) NAPLAN refers to the Australian government’s National Assessment Plan for Literacy and Numeracy.
Technology as a lever for ‘student voice’ was part of her fascination with Scratch (see glossary) and the establishment of a Scratch community at Hickson. Students learn important Science and engineering concepts using Scratch while they make something that is in their imagination a reality. Gina describes how students develop a personal interest in seeing their project become a reality, and the final products elicit feedback from peers and teachers. At Marcus, in focus group discussions, this idea is seen when two students confirm the teacher’s interest in what they produce: “She likes our car and listens to why we chose a particular type of wheel” and “I have seen model cars like this in magazines but I didn’t think I could ever make one”. Gina says her approach to teaching is quite different: “I let go of control. Students have a voice in my classroom – the action of letting go empowers the students. I nurture them and make sure they are on the right path”. Completion is important and encouraging students to persist and therefore complete work is valued.

Ownership

Students having control and ownership over their work is important in Gina’s classroom. This priority is linked to the pivotal role of technology and how ownership supports students to find their voice. She explains: “There are many positive things to be said about getting laptops into the hands of students”. Not only do technology devices reduce the logistical challenge of space in the classroom, they aid ownership and collaboration. She clarifies this effect: “It is so much easier to get into groups and work on a document collaboratively using Google docs with a portable laptop, as opposed to working around a desktop computer where one student is typing”. In another classroom at Barkwood Primary School, where Gina supports a Stage 2 teacher with technology integration, the theme of ownership is observed in action when students commence using Claymation. One student says:

47 Claymation is one of many forms of stop motion animation.
I feel like the work is mine when I can use what the teacher shows us … all the little animation clips. I really like it. [Gina] came to our class last week too. I want to make my own animation now.

There is an argument that if students have ownership over their work, then the work is meaningful to them and they are more likely to remember it (Richardson, 2008). Observation of this classroom shows students creating mind maps (see glossary) after the animation discussion led by Gina, while another student makes notes in a word document. A student at a desktop computer is looking up a website, while two others work with plasticine materials on a plastic mat on the classroom floor, in preparation for storyboarding their movie. When asked about this lesson in interview, Gina argues her approach stems from a principle: “Learning at school must be challenging, interesting and personal … it gives students ownership. Technology gives them a chance to collaborate. Access and playing with lots of stuff allows their strengths to be valued”.

5.6.5 Professional identity

Gina’s initial role as a classroom teacher has evolved in a short period of time to include more professional responsibility. Her move from the classroom, to the role of assistant principal, to PSP consultant, to school principal is testament to her employer’s recognition of her considerable talent as an exemplary educator. She also expresses a desire to “return to the classroom” and her new position of teaching school principal will combine that wish with responsibility for pedagogical leadership. These professional duties are conceptualised in Gina’s construction of technology integration as dependent on professional identity, built upon the pedagogical themes of teacher roles and learning communities.

Teacher roles

Expanding the multiple roles that teachers naturally take on when teaching in a school provides opportunity for professional growth. The role of technology consultant gives Gina
license to work alongside education colleagues beyond her own classroom. In interview she describes:

It is an explicit role. You see when I move from one site to another I respond to what each teacher prefers. At Barkwood I had to set up an old computer with a screen. I was more of a ‘guide on the side’ in that classroom. In the second and third lessons using Popplet, and then Claymation (see glossary) at Alice Primary, I was in the role of expert. The teachers wanted me to teach them how to use these tools, as well as their students.

Observation confirms different approaches to technology professional support in three classrooms in the two schools. Building professional relationships with each teacher is done without threat and with a sense of humour. Gina sees her approach in these terms: “I like working with teachers, you create rapport on the fly and gauge very quickly where they are at with technology integration”. She couples her hands-on role with a concern for the profession’s responsibility to accept technology in education settings, and continues:

Teachers and schools should get over technology as a new thing, instead they should use it as a tool to integrate everything they do … it’s like having oil pastels in your classroom … just another option to support how students learn … it’s not the focus of learning.

There is some suggestion of her frustration with how slow education systems have been to require teachers to be ‘tech savvy’:

I did my first technology presentation on podcasts to teachers in schools in 2006. Now it’s 2011 and I am still being asked to do the same presentation. I get annoyed that there is too much talk, and that we still have to convince teachers that technology is worthwhile. It hasn’t moved very far … it’s still getting there.
The idea of modelling practice and shifting teachers’ ideas about classroom control is critical in her conception of how systems should support professional learning for technology integration. Gina gives teachers many options on how to approach technology integration:

Teachers are very worried and have strong concerns. Perhaps there is a problem in their teaching practice to start with? I might start by asking them about how they believe they control students. Technology is blamed as the issue … maybe it requires teachers to be too liberal? They have to shift their sense of control.

Notions of having to know more than students dominate some teachers’ perceptions of what it means to teach (Dewey, 1938; Hayes et al, 2006). This is not Gina’s experience of technology integration, and in interview she explains:

Teachers do not need to know about every single tool available to them. They need to understand the concept of Web 2.0 and that there are a plethora of tools to access, such as blogs, wikis and podcasts at a minimum.

There is also value in turning students’ technology knowledge into a real strength in the classroom, and she says: “When teachers say they don’t use technology because students know more than them it’s a cop out. Teachers must help students make connections so that unconnected things link together”.

Learning communities

Closely aligned to the theme of teacher roles in technology integration are learning communities. Gina describes her conception of the classroom as a learning community as: “A community of learners which includes the teacher”. She gives reasons for why technology conversation beyond process is important: “Teachers must be willing to learn and know how texts work in technology mediums, and know what makes an effective text. Technologies have literacies themselves, which will increasingly need to be addressed”. The reality of the PSP consultancy position suggests there is still ground to be covered by Gina in
finding effective means for technology-focused teacher professional learning. Often, the focus on technology tools and processes means there is less opportunity to talk intensely with teachers about learning and, to affirm their professionalism within a context of continuous learning community. She laments: “I sometimes miss the deep discussion about what works that comes from ongoing contact with the one class, or the one group of teachers”.

Teachers in learning communities within some school structures have opportunities to play with technology and network with other technology users (Thomas & Brown, 2011). Gina, like many other teachers, regularly cultivates this need through a professional learning network (PLN) using social media tools like Twitter and Yammer. In interview Gina argues: “Teachers should be able to play around with technology, have a PLN … technology knowledge must be supported and enhanced. Who do I go to if I can’t do something? It gets a bit lonely sometimes. My PLN helps me a lot”. Not a new idea, the PLN in the technology context supports informal learning based around common technology ideas and interests (Downes, 2003; Siemens, 2005).

The importance of a willingness to learn by both the individual teacher, and more broadly the education system, is a repeated theme in Gina’s conception of technology integration. Professional identity affirmed through support for teacher roles and learning communities are the preferred means to enhance teacher knowledge of technology integration. The concept of students learning in community in the classroom using technology, and therefore constituting their own learning community is situated within Gina’s understanding of this pedagogical theme.

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48 Twitter is an online social networking and microblogging service that enables its users to send and read text-based messages of up to 140 characters, known as “tweets”.
5.7 What is fresh?

This case illustrates more fresh ways to understand another teacher’s knowledge of technology integration. The conceptions of purposeful teaching, theory-driven practice, creativity, real world application and professional identity are phenomena that distinguish Gina’s practice. Each pedagogical theme in this conception of her knowledge of technology integration adds unique and some common understandings, and provides further possibilities for what can be shared in other teachers’ classrooms. Establishing a clear purpose for including a particular technology in classroom learning precedes teacher planning, and allows for practice that opens up connections that a teacher is able to make through language and conversation. Furthermore, constructivist teaching based on education theory and teaching for quality, using a particular pedagogical framework where the focus is on building a questioning environment, assists students in Gina’s classroom to think about what they are learning. Students’ films made using various hardware are also key products that enable students and the teacher to publicly demonstrate learning. Creating narratives through construction of contextualised storybooks, and telling stories to understand subject matter content are common in both Gabby and Gina’s classrooms. If schools develop this teacher skill set and combine professional support in technology integration with teacher-partners who are technology savvy, as Gina was able to demonstrate in her consultancy role, then teachers will be inclined to take risks with technology integration in the classroom. Further discussion of What is fresh? is taken up in Chapter 8. Now it’s time to step inside another classroom with a teacher whose students are in Stage 3. The case of Nina follows.
Chapter 6: The Case of Nina

With apologies to E E Cummings

You take your laptop with you (and place it on the desk)

I am never without mine (always in this classroom)

I work you work, my students; and what is done using QUEST we will share together

Learning (for your learning is important)

I want to prepare you for life (for the world beyond school)

It’s in this classroom that values are central

And whatever you do

make a difference

Here is the essence; technology means working with ideas

It's no secret (I wish more teachers would embrace it)

(Here is the crux of the problem and the problem of the crux)

I cannot play the game, the game is not my game

it is over now

You take your laptop with you (and place it on the desk).

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49 The poems of E E Cummings were studied in the observation week. This version is an adaptation of the well-known poem “I carry your heart with me” (1952).
6.1 Introduction

This chapter features Nina, who teaches gifted and talented students in a Stage 3 class at Starton Primary School50. The opening poem captures Nina’s classroom and philosophy of technology integration. In her classroom, each student works on a laptop giving them access to iMovie, Garageband, Audacity51 and a suite of Adobe software programs, and they also use digital cameras. A class wiki, iWeb52, and desktop sharing are the main organisational tools for teacher and student work files and communication.

6.2 Starton Primary School

The school was established in 1961 and is located in the north-west of Sydney. Starton offers tuition to approximately 657 students from Kindergarten to Year 6. There are approximately 31 full-time members of staff, most of whom are female, and the class sizes range between 21-30 students. The school is positioned in a leafy suburb where the socio-economic background is “mainly middle class”. No student at the school identifies as coming from an Indigenous background. However, 39% come from language backgrounds other than English, and most of these students speak Hebrew or Cantonese/Mandarin (Annual School Report, 2011). In interview, Nina describes the school this way:

We're in a well-off area … kids have lots of great opportunities outside of school.

We have a large group of students from South Africa. On the whole, the kids do very well in things like NAPLAN and International Competitions and Assessments for

50 The policy document which determines how public schools should meet the needs of students deemed ‘gifted and talented’, is located at: https://www.det.nsw.edu.au/policies/curriculum/schools/gats/PD20040051.shtml

51 iMovie is a proprietary video editing software application sold by Apple which allows users to edit their own movies. Garageband is also made by Apple, and is a software application that allows users to create music or podcasts. Audacity is audio editor for recording, slicing, and mixing audio. All three software programs are frequently used with laptops in education contexts.

52 iWeb is a feature of Mac laptops that allows users to create and design websites and blogs without coding. Desktop sharing is a function on a laptop that allows the user to be at a computer and connect to a remote computer in a different location.
School exams. We also had three kids go to national competitions for swimming, and between them they won 11 medals and broke 2 records. It’s a pretty special school I think.

The school’s education philosophy targets ‘gifted and talented’ students, as well as technology and cultural opportunities for all students. Nina plays a key role in teaching ‘gifted and talented’ students in the school. The school has a specialist enrichment program, the “Kingston Unit for Gifted and Talented Students” offers a four-year extension course for students in Mathematics, higher level thinking skills and problem solving, e-learning projects including Robotics and Animation, and mentoring, utilising experts in Engineering, Algebra, Law, Biogenetics and Astronomy (Annual School Report, 2011).

Resources, programs and extra-curricular cultural opportunities include the teaching of French, Italian, Mandarin and Hebrew, and school music programs, all of which draw enthusiastic parental support. In 2010, the school received funds from the Federal Government’s Building Education Revolution (BER) for the construction of a new library, an administration block and three additional classrooms. The school has a connected classroom (see glossary), and an intranet, with resources and sites available to students from the networked computers in the library and in classrooms. Most teachers’ classrooms, not including Nina’s, have an interactive whiteboard and there are plans to install this technology in every classroom throughout the school.

There is an atmosphere of community and support between students and staff, and the motto displayed prominently in the school foyer is “Learn to live”. Students’ achievements and awards are also showcased, and outside, the well-tended school grounds include large playground spaces and a community garden. Nina states her views about the provision of rich learning opportunities in the school: “Music, sport, technology … they’re very lucky kids. There are wonderful excursions and camps, there is the gifted unit. The community is very involved and supportive – but they also expect remarkable things from their school”.

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6.3 The classroom

It is a 1:1 classroom, and the Year 6 laptop program adds to the variety of technology programs that students at the school have access to, from Kindergarten onwards. The first computer mediated classroom was established by Nina at Starton in 2000 and the school is a designated “Apple School of Excellence” because of its recognised technology focus. Her 28 students in Year 6 are equal numbers of male and females, and most have schooled together since Year 3. Nina talks frequently in interview about the importance of community in the school. She believes this phenomenon is supported by continuous class grouping of students right across the whole school and makes the following comment in reference to her previous Year 6 class:

It's interesting that they were a class for four years in a row. Not many children spend so much time together. It builds a remarkable community. They’ve kept very close this year, even after starting high school. Four of them from last year have joined my robotics team, and come back to my classroom for meetings, and to work on programming.

Two boys in Nina’s class have just returned from competing in the NSW Mathematics Olympiad for secondary students. They are ranked in the top 2% of the state, and “some of the Year 6 students achieved 100% in the Year 10 papers”. Nina adds: “The class has mainly ‘gifted’ students, most of who fall into the profoundly gifted range”. When Year 6 students leave Starton, the majority go to selective or independent schools in other parts of the city

Each day Nina uses a large pull-down projector screen as a pedagogical tool to display each student’s laptop screen, using the remote desktop sharing function on her laptop. From this position, she can monitor from four to nine laptop screens at a time. The students share and

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53 In NSW, gifted and talent students are identified according to education policy, accessed here https://www.det.nsw.edu.au/policies/curriculum/schools/gats/PD20040051.shtml. ‘Independent’ or ‘private’ schools are fee-paying schools which receive money from the Federal Government, and ‘selective’ schools are a stream within public education that requires entry via academic placement tests.
swap ideas on what they are doing, and if the screen shows that’s not what they are doing, Nina brings the students back on task. When asked about this observation of the technology, one student explains this feature in the following way: “The remote desktop is good because if someone is doing a particularly good piece of work the teacher can show that person’s work on the projector screen. It’s really helpful”. Another student recognises its classroom management purpose: “It means we can be shown doing stuff … like sending photos and other distracting stuff … stuff we are not meant to be doing”. In Nina’s mind, this function is part of her system. She says in interview: “I am trying to create learning behaviours, and technology enables efficient learning – I have one system consisting of the remote desktop, the wiki pages and the iWeb”.

The comfortable carpeted classroom is dotted with small clusters of tables, and includes a withdrawal space with four desktop computers. Carefully arranged long bench seats are placed around the perimeter of the room. These were purchased by Nina, and the students regularly use them for laptop work, in preference to sitting at a desk. Also, Nina says: “I procured all 28 laptops from a nearby private school for $500”. She rarely sits at her ‘teacher desk’ which is furnished with a desktop computer, preferring to see that location as another shared space for students. Observations show that students like to work with computers in this classroom, and a comment made by a student in focus group discussions is typical: “Laptops enable us to do new stuff, like digital portfolios, web pages, podcasts, programming … it’s really developed our interest in learning”. Another student confirms this:

At the start of the year we weren’t used to technology – it’s better now we can do more. Miss … has helped us become better and better … having a teacher who really knows how to use technology has extended our knowledge.

Nina moves around the classroom with her laptop perched on one hand, and regularly sits down to work with students, either on the benches, or at a desk. It is quiet and highly work-
focused each day. For two hours each week, Nina teaches with a specialised Mathematics teacher from a nearby high school. Lesson documentation shows coverage of specific parts of secondary school Mathematics syllabuses, such as Mathematics patterns, investigations and creative responses to problem solving. Students have already moved beyond most of the Board of Studies NSW K-6 syllabus outcomes, and Nina extends her students using ideas from syllabus content from other school systems. Some examples of this in observations include a range of UK English Tests, “Thinking Adventures”, “Kidspiration”, interactive online “Gizmos” in Mathematics and Science, and “Positive Tracking”. Nina’s professional background lays the groundwork for her approach to technology integration and it is outlined below.

6.4 Professional background

Nina set up the server in the school when she established the computer mediated classroom. Her role as the current Year Coordinator means she has responsibility for the choir, peer support and the Middle Years Experience, which focuses on technology and linkages to nearby high schools. From the moment she stepped into Starton as a beginning teacher, Nina was recognised as a technology leader. With the support of her previous principal, she pioneered the first 1:1 classroom in NSW public schools. This approach attracted the attention of high level bureaucrats, Ministers of Education and the Australian media, who continually visited her classroom over a two year period. After this time, again with the encouragement of her school principal, Nina returned to full-time study and completed her PhD in education and learning design. Nina was re-employed at Starton three years later to implement her study findings. The question of ‘how children learn’ fascinated her.

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Motivated to find an answer, she used her recent teaching experience as a catalyst for her doctoral study. Nina describes the decision in interview:

I realised I didn’t know how to answer the question when I finished my initial teacher education, but my PhD changed all that. I support Dewey’s vision of learning but he didn’t have a mechanism to bring about that vision … technology is the medium that can do that.

Of her own early schooling, Nina recalls a particularly influential primary school teacher: “Miss Brown asked lots of good questions”. The questions, she says, made her feel valued and it was with this teacher she could share her world view:

I didn’t see what other kids saw, she valued me, she liked the world and so did I … we had these exercises where we had to cut up triangles of paper and mine was different to the other kids, but she validated my response.

Also influential was her childhood home environment, where computers were ever present. In interview, she is keen to point out that she doesn’t use much technology at home now. She says: “I’m pretty picky about technology. I don’t own a digital camera, nor do I use blogs, Twitter or Facebook and I don’t have the latest iPhone. I’m a people person outside school”. She sees technology as part of her professional identity, and any support she required in ‘technology trouble-shooting’ comes from a computing colleague external to the school, with whom she shares the same skill level. Teachers from her school draw heavily on Nina’s technology expertise, and she frequently makes herself available to assist colleagues. After all, in interview when this observation is mentioned, she expresses doubts:

Teachers who choose not to use technology cause me distress … it’s our tool of trade. It’s not appropriate that [other teachers] dodge technology for so long. In medicine, and in law, people didn’t get a choice when hospitals and firms moved to
new ways of managing files and doing their work … teachers risk being left behind
if they don’t embrace technology.

The following section details the data of Nina’s perceptions of technology integration in light
of the TPACK framework.

6.5 A representation of Nina’s perceptions of technology integration

The lessons observed primarily focused on literacy. In the case study week, this included
lessons on poetry and the novel, as well as numeracy, peer support and one physical
education session. Of particular interest is the time devoted to QUEST, an acronym for an
open-ended pedagogical sequence that stands for Question, Uncover, Explain (or Explore)
and Share Together (the concept is fully explored in Section 6.6.1). In essence, QUEST
aligns closely to the TPACK framework, as it integrates student exploration of subject matter
based on questions that are guided and enhanced by further questions (the PCK and the CK
in TPACK). Subject matter is ‘checked’ by students, and may go beyond the teacher’s own
subject matter knowledge. Subject matter is efficiently researched using technology (in this
instance guided by Nina’s TCK) and is then presented in the Share Together component by
students, using laptops. The students’ technology skills are enriched by Nina’s extraordinary
technology knowledge (both TK and TPK), reflected in interview when she said: “I love the
search aspect of technology, I like programming, and I like the back-end. I like
understanding how it works”. This knowledge actively supports Nina’s conception of
technology integration as the most efficient way to bring about unique learning affordances
for students (OECD, 2013; Papert, 1993; Resnick, 2012). The QUEST framework
culminates and embodies TPACK as an effective approach to technology learning by design
(Shulman, 1986; Moar & Roberts, 2011). When given this proposition about similarities
between QUEST and TPACK, Nina argues: “TPACK is a bit neutral, there are all the things
that we as teachers bring to it … our particular values and our purpose … I would describe
TPACK as an orderly framework, it doesn’t acknowledge the unexpected”. This issue is taken up further in cross-case analysis, in Chapter 8. The main conceptions of Nina’s knowledge of technology integration are set out below.

### 6.6 The main conceptions

In this Stage 3 classroom, conceptions of technology integration fall into five distinct areas. Each conception was developed from groupings of pedagogical themes that emerged from the data analysis. Pedagogical themes comprise diverse teaching strategies and student learning processes. The five conceptions are:

1. Praxis: QUEST, theory-based with a focus on active construction and relentless probing and questioning;
2. Metacognitive learning through technology: technology philosophy, pace of learning and robust subject matter;
3. Creativity: values of joy and celebration and preparation for life;
4. Community of learners: shared ownership and self regulation in learning; and
5. Redefining the game: personal context and conflicting system demands.

The following sections of the case study note each conception of technology integration and the pedagogical themes with reference to teacher and student interviews, classroom observations of students and document analysis. The first conception, praxis, is outlined next with specific data describing the conception provided. The conception is supported by detailed data for each pedagogical theme.

#### 6.6.1 Praxis

When teachers take a praxis approach to their teaching practice it is very influential (Bernstein, 1983; Friere, 1972; Grundy, 1987; Kemmis & McTaggart, 2000; Kemmis & Smith, 2008). Here the distinction made by Carr and Kemmis (1986) is relevant for Nina’s classroom:
Praxis is not simply action based on reflection. It is action which embodies certain qualities. These include a commitment to human wellbeing and the search for truth, and respect for others. It is the action of people who are free, who are able to act for themselves. Moreover, praxis is always risky. It requires that a person ‘makes a wise and prudent practical judgement about how to act in this situation’ (p.190).

These highly complex ideas play out for students through frequent opportunities to act with freedom and autonomy in their daily classroom experiences. This praxis conception is supported by the pedagogical themes of QUEST, theory-based with a focus on active construction, and relentless probing and questioning.

**QUEST**

In the classroom, QUEST is the framework that enacts praxis in Nina’s conceptualisation of technology integration. She explains it this way:

Q is the Question part … this acknowledges what you want to know about, what has caught your interest, what you would like to understand, and what you would like to know more about. U is for Uncover … this is about acknowledging that our community has insight into the subject being studied, there are things people have already found out, and students need to uncover what is already known, who has been involved and then uncover what they can look at … is there something more they can reveal and show? E is for Explain … requires students to think about the subject in a clever and insightful way to explain and demonstrate what it is that they know and understand; and the S and T are for Share Together. This is when we sit down with all of the QUEST groups, and what has been learned is explained and shared with others. You can go on your own QUEST, but then the experience is shared together with peers. This is the heart of what I came to understand about the type of education children are entitled to.
Students use QUEST to study subjects they are interested in from recess until lunch-time each day, for two to three weeks, in three to four week cycles across the school term. QUEST ratifies “real learning for students”. Nina adds more detail: “I’ve tested my own theories about learning and I’ve found that my theories, my values, do not fit with the broader curriculum. I therefore use my own approach, and the PhD gave me a good foundation”.

Laptops are the most potent tools to carry out QUEST work, and provide students with necessary risk-taking opportunities in learning. Nina explains in interview: “Computers enable powerful work with ideas. They mediate relationships, and the QUEST approach puts [the students] in precarious learning situations where they have to find solutions and solve problems”. In addition to the work of Dewey and Piaget, Nina is heavily influenced by the work of Papert. One chapter in her doctoral thesis is devoted to research design based on Papert’s five-step approach to educational research, as the methodological foundation of investigation into how children learn (Papert, 1973). Observations of Nina’s students during the data collection phase allow close examination of QUEST in action. Students cover many different subjects using QUEST, and recent topics listed in focus group discussion include: Dangerous additives: what do they put in our foods? Google vs Yahoo: which is better? and Flowers: What gives them colour?. One student articulates this approach to learning, and what he says triangulates with Nina’s intention: “We are free to do whatever we want. When we work in a group there are lots of viewpoints. QUEST lets us study any subject and uncover it”. Another student speaks about her QUEST on flowers, reinforcing what was said: “I love working this way … we mix up our groups, not just our friends, this time we might make a photo booth in iMovie”. Nina uses QUEST regardless of the nature of the student five-step approach to educational research, as the methodological foundation of investigation into how children learn (Papert, 1973). Observations of Nina’s students during the data collection phase allow close examination of QUEST in action. Students cover many different subjects using QUEST, and recent topics listed in focus group discussion include: Dangerous additives: what do they put in our foods? Google vs Yahoo: which is better? and Flowers: What gives them colour?. One student articulates this approach to learning, and what he says triangulates with Nina’s intention: “We are free to do whatever we want. When we work in a group there are lots of viewpoints. QUEST lets us study any subject and uncover it”. Another student speaks about her QUEST on flowers, reinforcing what was said: “I love working this way … we mix up our groups, not just our friends, this time we might make a photo booth in iMovie”. Nina uses QUEST regardless of the nature of the student

55 This approach involves “selecting a theory of education, developing this theory’s consequences for the intellectual growth of children, implementing the conditions, equipping the research and running the experiment and determining its success or failure”. (McCredie, 2007, p.37).
groups she teaches at Starton. She readily embraces Papert’s learning ideas, and her classroom mirrors his vision.

**Theory-based with a focus on active construction**

Theory underpins QUEST and in Nina’s doctoral thesis it states: “Learning theory is a biologically based generative theory of learning that draws insight from neuroscience and evolutionary epistemology” (Schaverien & Cosgrove in McCredie, 2007, p.14). Such theory considers learning as evolved adaptation, and is derived from the work of Edeleman (1992, 1993) and Plotkin (1994) who test ideas based on their value. Such a view of learning is detailed in the thesis, and it has three central characteristics: “It is driven by values, it is a process of generating and testing those values, and lastly, it is developmental” (McCredie, 2007, 15). Nina compares and contrasts her approach to learning, with the school’s approach, and with that of her teaching colleagues. Her outlook is reflected here:

Powerful research insights from the late twentieth and early twenty-first century have highlighted young children’s status as humanity’s pre-eminent learners as a result of their privileged position in their communities and the phenomenal early growth of their brains.

(McCredie, 2007, p.15)

Nina’s view of learning theory drives her design of education contexts and pedagogies that accommodate the ways she believes children learn best. This links to her practice of constant probing and questioning.

**Relentless probing and questioning**

In the classroom, the sense of being ‘pre-eminent learners’ is consistently revealed through the work of QUEST, and the manner in which Nina continually questions students. She asks them to stop work and then ‘throws out a challenge’. This pedagogical theme is closely aligned to the QUEST framework and is observed on a daily basis. It is rationalised by Nina
in interview as another effective way to achieve technology integration and involves the use of “Thinking Adventures”. In interview, Nina explains:

I enjoy them … I want the students to think about cause and effect for the immediate, the short term and the long term … what are the implications, these daily ‘adventures’ challenge the mind and what other people might have thought about before.

Such tasks require students to consider complex questions or scenarios from different points of view, and arrive at win/lose, compromise, cooperate, or withdraw outcomes. Students quickly consider solutions that seem to best fit the situation, and they justify their choice in a group debrief. Detailed in the following section is the important conception of learning how to learn more about learning.

6.6.2 Metacognitive learning through technology

In his famous book *Future Shock* (1970), futurist Alvin Toffler writes about how “the illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn” (p.14). In Nina’s classroom, this idea is advanced further. Knowledge of technology integration in this conception is substantiated by the pedagogical themes of technology philosophy, pace of learning and robust subject matter.

*Technology philosophy*

In interview, Nina often refers to the work of two technology philosophers, Ihde (1990) and Bronowski (1974). Their insights lay open a way of recognising and appreciating how people interact technologically with their environment. Observations of adaptation and the potential of technology to mediate learning are reflected in shifts and changes in Nina’s pedagogical style during each learning session. She rationalises this behaviour when it is drawn to her attention: “What I want to achieve with a particular group of students stems
from modelling learning and being a good learner myself. I even say to my students … watch me learn”.

Some education research examines the notion of whether teachers in 21st Century classrooms should be ‘facilitators of learning’, or ‘guides on the side’ (Jukes, Crockett & McCain, 2010). In earlier accounts, McWilliam (2009) cites the notion of ‘meddler in the middle’ in technology contexts. When questioned about this idea in interview, Nina believes she does not conform to any of the models, instead: “I see myself as mentoring the students through their own learning … I am just a bit further along on my journey of learning”. This point was made in the context of teaching mainstream students, and how the ability of the class group didn’t alter her technology philosophy. Observation in the classroom suggests there are aspects of all three models in her behaviour. Nonetheless, it is students in focus group discussions who articulate agreement in how they understand Nina’s technology philosophy:

Miss … will give us a base to work from, but there is room to figure out things for ourselves, and if someone in the class knows how to do something they will put it on the wiki (see glossary). If we don’t know how to do something Miss … will have a bit of a lesson and show us how something is done and how awesome it is.

It is not only Nina’s perception of the ability of technology to pave the way for learning, it stems from her belief that “teachers must give students a say in what they want to focus on in their learning”. In interview, Nina says: “Technology is the mechanism …. It’s the most powerful way to work with ideas”. She adds: “Technology enables students to learn more because it’s efficient … it lets students learn more about their learning … to really look at it … you can’t learn about learning without learning about something”.

Nina appreciates technology is for the individual, and links this to notions of ownership and engagement in learning, and to the idea of learning being a “generative act” (Schaverien & Cosgrove in McCredie, 2007, p.13). Each student working with a laptop is the means to
achieve “more fluid technology integration”. Moreover, in interview Nina is critical: “The interactive whiteboard stole the future of what technology could be in schools, it just ‘technologised’ what many teachers already did”. She remarks further, “This technology serves to reinforce didactic pedagogy. It’s only a tool for the teacher”. The comments were made in reference to the significant commitment by her employer, the NSW Department of Education and Communities (NSW DEC), to support the implementation of interactive whiteboards in public schools.

Pace of learning

Recent education research confirms Nina’s concerns about interactive whiteboards and their role in modern classrooms as another form of ‘high-powered overhead projector’ (Higgins, 2005; Schrum, 2011; Schuck & Kearney, 2007). Tied to Nina’s technology philosophy is the perception that content is covered more efficiently when technology is integrated. She explains this in interview: “The pace of learning must be monitored, never underestimate what you can get done in two minutes”. Most students in focus group discussions nod in agreement, and one Year 6 boy states: “You get more work done using a computer … it’s so much faster”.

Observations show how keeping up, with frequent reminders of time, are priorities when discussing ‘qualities of a good leader’ in a Peer Support session. Here, one student is seen scribing whole class responses on a laptop, which are displayed simultaneously in the class wiki on the projector screen. Pairs of students use the responses as the basis for creating a fully edited interview in a 10 minute time frame. Most students complete the task, and the quality is impressive. Nina retorts during the process, “good to go” and the students respond “all good” when they finish. Reminders of time and how much time is left in each learning session are persistent classroom structures.
Robust subject matter

For many years, education research on “quality teaching” has suggested teachers need to know their subject matter well (Hayes et al, 2006; Newman, 1996; Shulman, 2000). This view of the importance of subject matter knowledge is prioritised in the TPACK framework of Mishra & Koehler (2006). Nina has a particular view of content integration, and she says: “I am not a fan of integration ... subject matter should be thought about in terms of themes within subjects”. When students explore subjects using QUEST they are not considered in an integrated perspective. This is congruent with Nina’s view about using technology to study ideas. She says in interview: “It’s the most efficient way to do that exploration. They know how to learn but don’t necessarily understand why different methods of learning work for different subject matter”. Observations show Nina checking documentation prior to the start of the school day. When asked about this, she says:

I still make sure I tick all of the [syllabus] boxes. Content can be covered more deeply using technology, so that students relate to the subject in a very different way. In this way they learn more about their learning.

Technology enables flexible access to content, and teachers pick up substantial information as they need it (Solomon & Schrum, 2007). Nina views the laptop as her “modern-day storeroom”. In interview, she notes: “In the past, I would grab what is useful out of the storeroom or the textbook room. Now I grab content off the internet … off websites”. An example of the “storeroom” idea in action is observed on Remembrance Day when Nina talks to students about the significance of the day just prior to recess. As she speaks, she quickly pulls down the projector screen, and accesses an internet link to watch the closing parts of the ceremony, via livestream telecast from the Australian War Memorial in Canberra. Technology is immediate and available; previously, this activity would have

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56 Remembrance Day is held each year in Commonwealth countries on the 11 November. Schools in Australia mark the occasion at 11am on this day, by standing to attention in the classroom, or at an assembly to pay respect to Australian soldiers killed in battle in WW1.
involved looking up the library catalogue, finding suitable content, making a booking in the library, and leaving the classroom. This is no longer the case.

Creativity in this classroom is a priority. The third conception is underpinned by pedagogical themes of the values of joy and celebration, and preparation of students for life. Both themes are detailed in the next section of the case study.

6.6. Creativity

In this classroom there is a total focus on learning. It is observed in what Nina plans, and in what she articulates to students. Pedagogically, it involves modelling the roles and values of “good learning” and this is about “being creative”. In interview, she states:

I have noticed that I am different to other teachers. I seem to be very imaginative with technology … I see what is there and then I go, OK well … we can use that and oh, that’s fabulous and this can fit in with this, or how can I do that?

Teachers like Nina re-purpose technology for their own educational or pedagogical end to benefit student learning (Mishra & Koehler, 2006). Observations show feedback on learning is continually given to students, and there is intensity about learning every moment of the day. It is valued and made visible in novel and poetry lessons, and through work in QUEST in the Share Together component. Students produce and share their learning in podcasts, 3D games and sketches, movies, complex slide shows using Keynote, Scratch projects and digital stories. In interview, Nina states: “QUEST is about reporting on concepts creatively and then powerfully demonstrating what you have learned”. She reasons further: “I want to be creative and I want the students to totally let their imaginations go”. Increasingly, in some education literature the significance of creativity is discussed “around an attention to a quality of personal ‘challenge’ for young learners and to the making of certain kinds of...

57 Keynote is a presentation tool available in Mac computer software. Scratch is a programming language that enables students to create digital projects including interactive stories, animations, games, music, and art.
subjectivity” (Sefton-Green et al, 2011, p.1). In interviews, Nina speaks at length about her concerns around creativity: “I have to protect students’ innate creativity and their learning ability from conforming to the school system’s values”.

In addition to QUEST, her classroom also features social studies project work in the form of Asia Pacific Projects (APPs). Examples of APPs focusing on countries in the Asia-Pacific Region are displayed on the classroom walls, and include support materials developed by students in their iWeb pages. In interview, she says: “It’s all about opportunities for student to produce work that will also set them up for life”. In the observation week, groups of students contribute to storyboarding, and then make a short film about ‘the school they would like to attend’ titled “Breaking the Silence”. It is shown at a major student-led conference with other schools from across NSW. This conception of creativity in student-centred approaches to technology integration is supported by the pedagogical themes of the values of joy and celebration, and preparation for life.

*Values of joy and celebration*

In classroom observations, Nina takes time to explain her values to students prior to commencing particular tasks. When asked about this behaviour, she says: “My focus is on a sense of celebration, excitement and joy. These are the most important values I hold, and I focus on my students being spectacular … I want them to know this”. This type of comment is not uncommon. For example, in the context of Peer Support training, she says to the class: “I value this task because it will give you time to think about what a good leader should be, and what values good leaders should possess … when you are working with the Year 1 students tomorrow”. In interview, this perception is reinforced again: “Teaching is about values, everything is about values, and you must honour and recognise how your students see the world. It’s my values that shape the learning process”.

58 Nina and her students belong to the “Coalition of Knowledge Building Schools” led by Professor Susan Groundwater-Smith, accessed at [http://www.ckbschools.org/Coalition_Home.html](http://www.ckbschools.org/Coalition_Home.html)
The overt displays of joy in seeing students learn are highlighted in prolific exclamations throughout the day, as she regularly says to students: “How fabulous”, “What joy”, “what glorious super-child has done that” and “We must celebrate what you have learned”.

Students in focus group discussions also express ideas about values and the importance of the value placed on learning. They know that what Nina values are different to their learning experiences with other teachers. Comments from three students in focus group discussions directly address this point: “Technology in [this] … class has really developed our interest in valuing learning”; “It’s made us interested in what we do”, and “So different to other teachers … it’s a chance to explore different ways of learning and giving us a head start on how to learn with technology”. Nina confirms the students’ perception when in interview she says: “They value learning using technology in their classroom, they understand what they are using it for and any frustrations they experience are far outweighed by its positive effects”.

**Preparation for life**

Nina is conscious of preparing students for life beyond primary school. She remarks: “It is my duty to monitor time in every lesson as part of preparing students for high school”. This belief was revealed in classroom observation. When asked about this conscious strategy, she states:

> Often I get frustrated when one level of school (in this case primary school) is used as a stepping stone to the next level of schooling (secondary school). Different levels of school have their own intrinsic value and need to be true to themselves.

She adds further detail in another interview:

> Schools need to understand and teach students that life isn’t school … training in the school mode is not adequate training for life because life is not like the classroom setting. I want to challenge them, throw curve balls at them because that’s what life
does. I don’t want to them to be school learners and absorb that way of thinking … rigid, straightforward, non-creative.

In focus group discussions students articulated their sense of how they were being prepared, and this view is representative: “At the start of the year we weren’t used to technology, we are better now, Miss … has helped us. She is preparing us for life beyond school … for high school … it really helps”. There was a sense that it was ‘OK not to know things in life’ but what is more important is how to find out.

6.6.4 Community of learners

Conversations on the importance of building learning communities in classrooms are found in education research (Brophy, Alleman & Knighton, 2010; Watkins, 2005). There is a twist on the idea in this Stage 3 class, as building a community of learners is bolstered by 1:1 technology. In interview, Nina says the class resisted at first: “At the start of the year they really struggled with my approach. Now we are a community, we do things all together and that changes my role as a teacher”. The conception of a community of learners is central to Nina’s knowledge of technology integration, and is underpinned by two pedagogical themes of shared ownership, and self-regulation in learning.

Shared ownership

Technology integration, for Nina, is built on the premise of each student “working on a laptop, having good technology skills and accessing remote desktop sharing”. In interview, Nina confirms this perception and uses it as an opportunity to critique other technology tools:

The laptop is about giving students ownership, in a very real way, of their own learning … the IWB on the other hand is still about the teacher. If I use the remote desktop, I can access what they are doing and they can access each other.
In observations, 1:1 technology clearly enables content to be shared, analysed and responded to, in community. QUEST is centred on individual, paired or group responses that are shared in community. In focus group discussions, one student’s view reflects a common perception: “I like QUESTing and then coming together as a class community … we have to find out stuff. It’s up to us to find out”. A few students also point out that computers could take away a sense of ownership: “We are asked to take responsibility, especially as we are going to high school but sometimes computers take the responsibility away from us”. Another student explains how this may occur: “There are lots and lots of temptations … so that’s distracting. You have to be really disciplined. Loading files takes time, sometimes it’s just easier to write on paper”. There is unanimous recognition at the conclusion of this focus group discussion that students like the variety of what they do more than anything else.

One observed symbol of shared ownership, which gives the distinct feeling that this class is still very young at heart, manifests in daily gatherings and discussions around a “Harry Potter Board”. This small, freestanding whiteboard is covered in spells and potion mixes written in black marker pen. Each day, groups of students discuss, and change the magical combinations. It is a hive of activity, laughter and fun before school, at recess and at lunchtime.

**Self-regulation in learning**

Self-regulation is first mentioned in interview when Nina speaks about her technology role in the school, and then in reference to classroom layout. She explains: “I don’t have my own desk, I have a learning space with a table and a computer, and students are free to use it. I would really like big tables in the whole room”. Long, bench spaces to carry out work are also observable manifestations:

I don’t set limits on what is my space, they use the benches, we share files on the server. I’m not the boss. Other teachers have trouble with this way of operating
because it’s more equal. But I do play the teacher card when I need to … to set
boundaries and limitations when the need arises

The idea of the ‘small efforts of many rather than large efforts of the few’ is a homily Nina
often used in interview. She adds:

We are a community … we design ideas and we do things together. My classroom
works very much from a model of distributed leadership in terms of ideas and
learning, so the distinction between teacher and student in my classroom is non-
hierarchical.

Observations confirm this way of working. Students sit in various learning spaces in the
classroom, and often go outside to work. In focus group discussion, this Year 6 student
acknowledges: “We have a lot of freedom to choose where to work, I don’t feel restricted, it
feels like a community”.

The perception of not having to know everything is important and this notion is facilitated
through encouraging students to take the lead. In interview, Nina says: “The teacher’s
computer is the mothership, and then there is the whole fleet behind me on the same mission,
but sometimes they are the ‘scouts out front’ beyond the mothership”. This idea is linked to
Nina’s admission that in some subject areas she does not feel confident, and Science is a case
in point:

Some of my students know more than me so I might use something like Gizmos.
Students will ask me if they can’t do something before trying something else … I
may not know … I say to them, keep going and don’t presume I can get you over
that speed bump … I want you to get over it.

Gizmos and Science study arose in the context of favourite technology lessons, in focus
group discussions with students. Notwithstanding, there is also frustration:
I think it’s bad that we are always staring at the laptop screen and it would be more helpful if we did things outside, and in the Gizmos exercise I would have liked to have done the experiment in reality, rather than the computer doing everything.

This comment led to other cautionary remarks from students about the: “Amount of work we do in different subjects”, and that “Sometimes it is really hard to work out how to do something”. This appears quite problematic, and another student vocalises her concern: “It’s difficult to keep track of everything, although the spotlight tool on Macs help with locating missing work”. Nina is mindful of what she expects of the class, and often during the day she allows them to give voice to their concerns. In interview, she says: “You must honour and value how they see the world. Some of the students are quite anxious about taking the lead and I want them to know that it’s OK if you don’t know a lot about something”.

Observations of her movements around the classroom show her listening to their grievances. She recognises that even as ‘gifted students’, they have limitations, and perhaps are not quite ready to self regulate in the way she requires, all of the time.

### 6.6.5 Redefining the game

It became apparent quite early in observation week that there is conflict between what Nina does in her classroom, and what the school and the education system at large requires. In the very first interview, she expressed this observation of her practice: “I find tension between what I am required to do and what I am doing in my classroom, but also a recognition that if you want to bring about change you have to play the game”. This conception of Nina’s knowledge of technology integration is about redefining the ‘education’ game and compromised pedagogical themes of personal context and conflicting system demands.
**Personal context**

Nina isn’t comfortable with the notion of being an identified ‘exemplary teacher’. Instead, she says: “I see myself as a pioneer … you question, you challenge and you change. It’s about pushing boundaries”. She adds further explicit detail in interview:

In many ways, I don’t fit the picture, which is, marking work and returning it to students. As a teacher your teaching approach is shaped by the values you have and your personal context … it’s your learning, your knowledge and your background.

Observations confirmed this statement. Each day, Nina intently watches what students do as they complete various tasks. She explains: “I am satisfied when I observe what they are doing, rather than having to mark everything they do”. As mentioned earlier, Nina’s research with primary school children involved studying how they understand learning using a city-building simulation game. The doctoral thesis is titled “Children as e-designers: How do they understand learning?” (McCredie, 2007) and the study findings are the levers she uses to achieve learning in the classroom.

**Conflicting system demands**

When teachers are employed in public schools in Australia, they agree to follow mandated syllabus and system requirements, and in so doing, employ a variety of rich pedagogical strategies in classrooms (Munns, et al, 2013). Nina uses her firm beliefs about learning to drive pedagogy. In interview, she agrees with this observation and she speaks about what current school education systems require:

There is incongruence between what you are meant to cover and what I think students should be learning … I get really sad, as even though we have brought about a lot of changes we are still not where I want to be.

This comment is supported by extensive commentary on concerns with existing models of schooling, and Nina says:
There is a problem if their brain gets stuck in the school model of thinking. I’m almost trying to protect their way of thinking in childhood, without it being hijacked by the school way of thinking. If we want students to be spectacular, we need them to think creatively.

She is confident in her approach to learning at all times, and in interview states: “I don’t know if what I do is what other teachers are doing … it’s just that I couldn’t do what I do without the laptops”. She adds, “I think about learning, rather than formal lesson preparation”. Nina doesn’t belong to professional teaching associations and sees this as a kind of gesture, a “side activity, not the main game”. She sees problems with current school curriculum, pedagogy and assessment in that it “inhibits learning”, and because of her beliefs about its tight construction she has a special pact with the new school principal. In interview she describes the deal:

I have made an agreement to teach literacy and numeracy in the morning, then QUEST after recess each day. The afternoons are often sport or relief from face-to-face teaching sessions. The required curriculum is covered to make way for ‘real learning’.

The previous school principal “picked me for this school and he said you ‘go for it’ and I will back you and any complaints or issues … they have to get through me”. Nina’s commitment to bring about significant educational reform is palpable throughout most interviews. The notion of current school practices “hijacking learning” is raised again in another interview, when she says: “The problem is that the current model clashes with my values. Learning is hijacked by the superficial values of the school. The model is laid out for you”. There was deep desire from Nina about schools expecting teachers to use technology, as she said in interview: “There shouldn’t be a choice, other professions are expected to use digitised records or state of the art technology … like in hospitals for doctors and nurses … it should be part of how our profession operates too”.

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6.7 What is fresh?

The case of Nina enables fresh ways to scrutinise this teacher’s knowledge of technology integration through conceptions of praxis, metacognitive learning through technology, creativity, community of learners, and redefining the game. Positive changes in teachers’ knowledge of technology integration will happen, according to Nina, “if teachers immerse themselves in the context”. When questioned in interview, she sees that what she does may not be easily shared: “It will happen if trust is built within a particular context … this is the only way to really understand what is going on in my classroom”. Strong beliefs, combined with alignment of theory and pedagogical values in her conception of knowledge of technology integration, provide challenges for what might be replicable for other teachers. This notion also may not sit comfortably alongside how education systems sometimes envisage successful technology integration. Purposeful inquiry approaches – like that of QUEST, as an example of project-based learning – may enable teachers to access a structured process, that allows students more freedom and self-regulation in determining what matters to them. Like Gabby and Gina, Nina’s technology knowledge enables opportunities for creativity in a range of task responses using both written, audio and film formats. Contextual accommodations uncovered in all of the classrooms of the teachers studied so far reveal personal, community, and sometimes conflicting professional demands. Discussion of Nina’s vision for future classrooms is important and is further detailed in Chapter 8. The fourth case follows. This is the case of Kitty, who teaches students in Stages 4-5, all of whom are in the first five years of secondary education.
Chapter 7: The Case of Kitty

Figure 5: Shows a wordle which creates a picture of Kitty’s classroom.

Wordle is an app which generates “word clouds” from text that users provide. The clouds give greater prominence to words that appear more frequently in the source text.
7.1 Introduction

This chapter highlights Kitty, a Visual Arts teacher at Farner Secondary School in the southwestern suburbs of Sydney. The wordle on the previous page comprises text from conceptions of Kitty’s knowledge of technology integration, from one set of final data sheets. Kitty teaches multi-stage digital media projects, as well as Stage 5 students in elective Visual Arts\(^{60}\). She was Head Teacher Visual Arts until recently, when she agreed to be Head Teacher Technology, with responsibility for working across the whole school supporting teachers with technology integration in all subject areas. Students in Years 9, 10, and 11 at Farner have DER laptops (see glossary). In the classroom, Kitty uses up to three computers at any one time, in addition to teacher- and student-created blogs and wikis, various apps and an interactive whiteboard. Her students also access flip cameras, iPhones, iPads, the SRN\(^{61}\), online test generators, software programs and a full suite of the latest filmmaking equipment.

7.2 Farner Secondary School

Farner was established in 1955 and has more than 1100 students in Years 7 to 12. There are approximately 105 full-time teachers. The stated aim of the school is “to produce informed, confident and caring individuals” (Annual School Report, 2011, p.4). The school encourages a wide variety of vocational educational programs and works closely with technical training organisations in the local community. Farner has an extensive program in literacy and numeracy support, with specialist executive teachers. Extra financial aid for the school is made possible under Federal Government initiatives because of its low socio-economic status (SES) classification. This is compounded by the fact that the school serves students

\(^{60}\) Students in multi-stage digital media projects are in Stage 4, Years 7-10. Students in Stage 5 are in Year 11, the second last year of secondary school education. Stage 6 is Year 12 and the final year of school.

\(^{61}\) SRN refers to Student Response Network, an application developed by a local teacher which is an evolved form of Audience Response Network, whereby students actively "live poll" in the classroom, in response to information and questions about content.
from “mainly migrant working classes”, where 92% come from LOTE or Language backgrounds Other Than English (Annual School Report, 2011, p.5). In interview, Kitty explains:

Many of the students’ parents work in low skill labour markets or are unemployed. Because of their migrant backgrounds, previous qualifications often do not apply, and parents cannot always afford to re-train, or attend education facilities. Many do overnight shift work, which impacts upon the support for students within their family. Students are often the only English speaker in the family, and struggle to take responsibility for things, like posting the mail.

Farner has a well-established intensive English centre for more than 220 refugee students, who after graduation move into the main high school. The school’s motto is To live is to learn, with its education philosophy strongly focused on pastoral care for refugee/migrant students from Syria, Afghanistan, Lebanon, Sudan, the South-Pacific, Vietnam, China and Cambodia. The school’s CARE program targets “Community, Achievement, Respect, and the Environment and is focused on the need for each student to achieve their academic, sporting and social potential”, and this positive milieu is evident in its award and welfare systems (Annual School Report, 2011, p.6).

In 2012, the school launched “Focus on Reading”. The program, according to Kitty, arises from: “Analysis of NAPLAN (see glossary) in Years 7 and 9, and our School Certificate and Higher School Certificate\(^\text{62}\) results, which indicate that reading is the area of most need for our overall student cohort”. The school is also using National Partnerships funding from the Federal Government to directly improve the literacy, numeracy and technology skills of Farner students. Another initiative is the offer of a non-ATAR HSC alternative called “Work

\(^{62}\) The School Certificate (SC) a credential for students in Year 10, and this has now been replaced by the Record of School Achievement. The Higher School Certificate (HSC) is a nationally and internationally recognised qualification for students who successfully complete secondary education in NSW
More than 70 Year 11 students are choosing courses in floristry, bricklaying or mechanics, for instance.

Across Farner there is wifi access, and computer labs are located in each subject faculty, although the age and working order of the hardware varies. Kitty comments in interview: “The old computers are not good enough, and don’t seduce teachers into wanting to use technology with students”. Faculty staffrooms often have only one computer on which teachers can work. Kitty says: “The school is considering an iPad trial, and executive staff is experimenting with a highly successful ‘Meet ‘n’ Greet’ activity at the commencement of each school day to further enthuse staff”. Farner received funds from the Federal Government’s Building Education Revolution (BER) fund for new built spaces, including additional technology classrooms that are now completed and occupied. Three connected classrooms (see glossary) and a school intranet with digital resources for learning are available to students from networked computers in the library.

In interview, Kitty gives insight into the school’s strong community connections:

Farner offers the students a safe, happy environment, where welfare needs are a priority. Because of their varied and disrupted backgrounds, which include fleeing countries, living in refugee camps, little or no schooling, deaths of family members, or just settling in an unfamiliar country and language … many of our students need a stable and consistent learning environment. It can take some time settling in before learning is maximised. Research suggests it can take up to seven years to fully acquire a new language; many of our students move right through high school with a language disadvantage.

ATAR is the Australian Tertiary Admission Rank and is calculated solely for use by institutions to rank and select school leavers for admission to tertiary courses.

‘Meet ‘n’ Greet’ is about improving school culture and getting students to school on time. It is detailed later in the case in Section 7.6.5.
The school employs a Community Liaison Officer with an Arabic background, who runs the Farner Parent Café for 20-30 parents each week. Kitty is building a community website with these parents. This is how she describes it:

> The parent community is very supportive of the school. However, English barriers present as difficulties and also some unrealistic expectations from parents still persist. For example, most parents expect that their children will go to university. In reality, the majority of Year 12 students go to jobs, or on to vocational training … approximately 30% of our students go onto tertiary studies.

Recently, another parent group began working on a community garden with small plots and farms for lease. This initiative is for settled migrants and newly arrived refugees in the community, and will expand to include a market garden and will be connected to agriculture courses taught by a local Technical and Further Education College.

### 7.3 The classroom/s

Kitty teaches 22 students in an elective Year 11 Visual Arts class, for five hours of art history and art practice each fortnight. Often the tasks she assigns the class run for seven weeks. This classroom is replete with groups of high tables, wet areas and a storeroom, as well as a state-of-the-art darkroom. Students also use a large open classroom in a demountable space that has an interactive whiteboard, where they work on individual laptops completing assessment tasks. In the multi-stage digital media projects, students are in Years 7-10 and spend from 15-18 hours each week working on film projects. Entry to this class is by Expressions of Interest (EOI) that are advertised on the school’s website each term. In the application process students indicate a proposed project, make links to relevant syllabus content and state outcomes they intend pursuing. In interview, Kitty says:

> The EOI is intended to mimic the real arts grant application process. They apply to come. I’ll have up to four projects at once, involving no more than 20 students
overall, who come from subject areas across the whole school. For example, in History I am currently producing a video with a mainly Year 9 group who are interviewing a famous Australian from the past. Another group in English are enacting and filming a scene from a play.

Observations show Kitty’s involvement in other digital projects, generated by a demand within the school community. These take the form of information videos, or electronic presentations on components of school programs. She is also involved in projects that come from regional or state education offices, such as the Schools Spectacular and the World’s Biggest Classroom65. In any one year, Kitty constructs up to 80 individual short films and participates in the making of at least another 20 films for other reasons. She explains:

Because I teach alongside other teachers in my role as Head Teacher Technology, it involves co-teaching in the connected classroom. I move around a lot in the school, to support teachers with DER strategies in their classrooms, and this might include making films.

Over the observation week, Kitty co-teaches with a colleague, in a Year 9 History classroom with 26 students, on the topic of Gallipoli, using the SRN (see glossary). This commitment extends to modelling practice in several lessons. She accompanied this class on an excursion to the Australian National War Memorial in Canberra to make a short film about WWI soldiers. Her unique professional background is central to all aspects of her work at Farner, and it is outlined in the following section.

7.4 Professional background

Kitty has been teaching at the school for 21 years. In interview, she remarks, “I love teaching at Farner” and adds:

65 Schools Spectacular is an annual entertainment showcase for more than 3500 students from NSW DEC public schools. It is recorded, and broadcast on national TV. The World’s Biggest Classroom is a series of three multi-media exhibitions of the work of 900 students and teachers from 53 public schools.
There is great satisfaction in working in this environment, I could probably work in an easier school, a girls’ school, or one that is more comfortable, but I need a lot of stimulation. Each year the students change, so your teaching approach is always going to be slightly different.

She is a qualified filmmaker and made her first film, “The Trombone”, at home on Super 8 film when she was 15. She describes how: “In 1975 my family was the first in the street to own a colour TV. It was this new technology that provoked my interest in the visual form of film”. Kitty left school in Year 10 to start an independent film production company, which she ran for two years. Eventually deciding to complete secondary school education, she formalised her filmmaking and gained education qualifications, enabling her to teach in schools.

Kitty believes she wasn’t well prepared for teaching. In interview, she says: “I didn’t have training in all art media. I had to learn a lot in my first five years on the job”. She regularly enters major film competitions like Tropfest, and “my students do too, and sometimes we win”.66 The school is not an easy place to teach, and Kitty takes students whom other teachers “won’t teach”. During the week several ‘extra’ students join Kitty’s classes. She accommodates these students in a generous, patient manner and when asked in interview about this, she explains:

I concentrated early on in teaching students with behavioural difficulties. I did a postgraduate diploma. Maybe coming from a family of 16 children you develop a thick skin, and have to get on with everyone. I am pretty grounded in the person that I am.

For the past 20 years she has run specialised training courses for teachers in video production at a major urban university, during the annual summer holidays. Kitty sits on syllabus

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66 Tropfest is an internationally recognised short film festival that encourages up and coming filmmakers to submit. It also has a section for school students, access here [http://tropfest.com/au/](http://tropfest.com/au/)
committees, and is a highly regarded speaker at high profile art events in the state. At home, she has a production studio and darkroom, and describes herself as: “An extensive user of social networking, including Yammer, Twitter and Facebook” (see glossary). She expresses her preference for mobile technologies as the most useful type of technology, in addition to the video-recorder, microphone and still camera. Kitty adds: “The IWB, on the other hand, is not my favourite technology, although I acknowledge primary school teachers do amazing things with them”.

The following section briefly outlines Kitty’s perceptions of technology integration in light of the TPACK framework.

7.5 A representation of Kitty’s perceptions of technology integration

Observation of lessons centred on Kitty’s Year 11 elective Visual Arts, art history and art practice sessions, as well as several multi-stage digital media project groups including the making of a promotional video for competition, and a Year 9 History class using the SRN (see glossary). Kitty draws on the term TPACK on a number of occasions. In interview, she says:

> It is a useful way to describe my deliberate attempts to consider technology, pedagogy and subject matter in teaching practice. I have developed TPACK because I love what I do. Can you imagine going to work every day … having a fantastic time and doing projects that you believe in?”

The critical vehicle that enacts the TPACK framework in Kitty’s classroom is the making of films with students, using technology tools and applications, on various topics arising from syllabus content. The film product allows integration of wide-ranging subject matter (the PK and the CK combining as PCK), and this is enabled through Kitty’s skill – or fluency – in the film medium, and enactment of her rich knowledge of technology (the TK). The open-ended
pedagogical interaction she displays arises out of her flexible approach to teaching practice that stems from deep knowledge of the Visual Arts (TCK) in its various forms. This understanding allows manipulation of various technology devices, programs and creative applications for engaging and motivating students in the subject matter they are learning. In effect, Kitty brings TPACK into play every time she teaches (Mishra & Koehler, 2006). The main conceptions of Kitty’s knowledge of technology integration are detailed below.

7.6 The main conceptions

Conceptions of Kitty’s knowledge of technology integration in her Stage 4 and Stage 5 classrooms fall into five distinct areas. Each conception was developed from groupings of pedagogical themes that emerged from the data analysis. Pedagogical themes comprise diverse teaching strategies and student learning processes. The five conceptions are:

1. Flexibility: planning and organization, self regulation and differentiation;
2. Experiential learning: authentic experience and developing subject matter knowledge;
3. Creativity: aesthetic significance and learning made public;
4. Preparation for a life of learning: risk-taking and self-efficacy; and
5. Whole school culture: professional responsibility and enacting a role.

The following sections of the case study note each conception of technology integration and the pedagogical themes with reference to teacher and student interviews, classroom observations of students and document analysis. The first conception, flexibility, is outlined next with specific data describing the conception provided. The conception is supported by detailed data for each of the maintaining pedagogical themes.

7.6.1 Flexibility

Fostering flexibility in using laptop devices is important. The ‘3 by 3 rule’ is an observable example of how Kitty structures this approach to student learning. Her interview reveals how
this rule is applied as a pedagogical response to the daily realities of classrooms and technology at Farner:

It means students are either 1) working online using their laptops and the internet, 2) offline using their laptops with OneNote\textsuperscript{67} or SMART Notebook 10\textsuperscript{68}, or 3) by hand, on paper in a workbook. This work is done either as 1) an individual, 2) in a pair or 3) in small groups.

The rule is known to students and in focus group discussion, one Year 11 student’s view of it is agreed to by several others, and triangulates with Kitty’s intention:

It’s more productive, quieter and less disruptive when we have options in the way we work when we use technology. It is easier to work when we use technology and it’s faster, because I can now touch type what the teacher says.

Kitty believes that the culture of Farner means teachers need to flexible:

There are sets of procedures for students to expect, depending on whether it’s the school or the classroom setting. In fact often it’s the students who come up with school rules, things like flirting and the level of intimacy in the playground. Students at the school also have a big say in setting rules for the way their classroom operates. 3 by 3 is an example of that.

The conception of flexibility is supported by the pedagogical themes of planning and organisation, self-regulation and differentiation.

\textit{Planning and organisation}

Early in the observation week, Kitty establishes that planning and managing learning is a significant aspect of teachers’ work, and explains in interview: “You facilitate learning …

\textsuperscript{67} OneNote is a Microsoft application for free-form information gathering and multi-user collaboration.

\textsuperscript{68} SMART Notebook 10 is the lesson creation software used on the interactive whiteboard.
you don’t direct learning”. Each 40 minute lesson commences with the distribution of a small ‘red slip’ of paper to every student. The paper states the lesson’s learning objective, and success parameters, providing an explicit learning prompt for the diverse learners in her room. Every ‘red slip’ makes up a series of learning sequences, which usually run for about four weeks in a subject:

I use the ‘red slip’ to establish the purpose of the lesson, and what the students will do and learn, and what will indicate that they have achieved this. The technique allows for explicit instructions, it allows for the daydreamers, and those who do not ‘orally’ learn. It also allows for latecomers.

The students like this organiser, and one Year 11 student’s remark sparks conversation in focus group discussion: “I like the red slip. I can see the lesson structure in front of me”.

Other students give more specific comments, such as this one which captures typical beliefs: “The red slip really keeps you on track”.

It is obvious that students in Kitty’s classes like using technology daily and having their own laptop. They use words like “great”, “really cool” and “fun” as common descriptors of their learning tools. Kitty explains: “I hold workshops to get students excited about using and working with their new laptops”. In addition, blogs are key pedagogical organisers (Hunter, 2010). A statement in focus group discussion sums up one Year 11 student’s feelings about using blogs: “It’s good to have the structure of our learning on the blog too, and it really saves on handling piles of printed sheets”. Kitty uses various subject blogs for learning and assessment, explaining:

If I put a test within a blog it means I can cover more content and ascertain the students’ learning better. The tests I feature on the blog have links to content that supports students understanding of big concepts in a subject.

A copy of text on a typical ‘red slip’ is found in Appendix F. This slip is from the History class where Kitty was modelling her practice to the students’ usual classroom teacher.
Self-regulation

Kitty believes blogs are stable, accessible learning environments for students that encourage self-regulation. In some web applications she says: “User accounts expire and it means work is lost and not accessible, whereas a blog, once it is set up, is readily accessible from school or home”. In interview, she explains further:

Blogs are a means to measure what is going on in the classroom, and they reflect practice and learning. I use them as a pedagogical tool to assess prior learning and for classroom management. If I combine them with Testmoz\textsuperscript{70}, the dashboard acts as a type of learning management system too.

The Hall of Fame is a memorable example. This particular blog is observed in operation, and how it serves as a method of self-regulation in token reinforcement for “good behaviour and great work” is immediately obvious. In focus group discussions with students in the multi-stage digital media projects, one Year 8 student mentions that he wants to appear in the Hall of Fame blog. Kitty explains its purpose:

I set this blog up so students can make it to the Hall of Fame when they do wonderful things. I try to rotate it so that everyone has their ‘five minutes’, and it has also brought in the parents. Students show parents their learning, and their achievements.

Self-regulation using blogs also develops appropriate online behaviour, class rules and quality posting. In interview, Kitty suggests: “Students draft their posts, then self-correct, and it means the quality of the work generated online is better than face-to-face interaction. It’s also because they are public”. This public aspect of technology integration is taken up further in Section 7.6.3. The notion links to Kitty’s comments about how “all students,

\textsuperscript{70} Testmoz is a free online test generator. Its dashboard is simple to use and presents information in a way that is easy to read. Learning management systems are software applications that administer, document and track online events. Testmoz can be accessed at http://testmoz.com/
including students with LOTE backgrounds, are ‘digital natives’ and are very advanced in their understanding of technology, even when their English is not strong”. Some education research suggests that this is one of the significant advantages of blogs as a medium for improving reading and writing (Gilbert & Hoepper, 2010; Richardson, 2010). Students are encouraged to choose how they learn content. Kitty confirms this belief: “They can choose the medium for their work, and if they feel embarrassed because of the way they speak, they can do a podcast or a slide show”.

**Differentiation**

The pedagogical theme of differentiation manifests in the multi-stage grouping, in digital media projects. Kitty explains: “In projects, they have an opportunity to work with older or younger students and they learn from each other”. Observation of a Year 7/8 group supports this claim. Students involved in the project identified the school’s need to promote its image in the wider community. A suitable video competition is sourced and written into their EOI, and they settle on the “Great School’s Show Off” as a suitable event. A full storyboard of video footage is flagged for inclusion and the group proceeds to shoot video footage around the school over four days. They edit the film, enter it in the competition, and then upload it to the school’s website. In focus group discussion, one student from the project reflects: “We like to make movies, and we get to work with kids in other years. It is the images and pictures that tell bigger stories in a promo, rather than teachers just talking about our school”. Kitty also sees this activity as an opportunity to report to the wider community in her region, and adds:

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71 The final product from “Team LOL”, the Year 7 and 8 digital media group, is available on the school’s website.
It’s important to differentiate Farner from other schools in the area. I got help from the ESL\textsuperscript{72} teacher when I saw what these students were proposing. I also approached the finance committee for pre- and post-production costs of this particular promo.

Kitty concludes the DER laptops have pushed some teachers at Farner to differentiate learning for students in more overt ways. In interview, she specifies: “It means work in classrooms is now more student-centred, and many teachers work on individual education plans. Students don’t yet have enough choice in what they do in the plans, but this is a step forward”. In interview, Kitty shares her belief that choice extends to differentiation of curriculum and assessment for students:

> The school has started to post assessment tasks on the web. I feel that tasks across a grade in a subject don’t have to be identical … the outcomes need to be the same but not the task, depending on the students’ level of learning. Differentiating the curriculum for all students, including our gifted and talented students, is important.

Closely tied to the pedagogical theme of differentiation in Kitty’s conception of flexibility in technology integration is experiential learning. The conception is explored below.

### 7.6.2 Experiential learning

One definition of experiential learning suggests “it is the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 4). In Kitty’s classroom, film is the medium that enables experiential learning. She says: “Being able to make films is the thing I love most. I bring this passion into the meta context of my work as a Visual Arts teacher”. It is not the only medium, but a very important one in Kitty’s classroom. In interview, when questioned about this observation of her practice, she is clear: “What the student is doing is important, and it’s a concrete experience. This is the key … learning by doing”. She adds more explanation:

\textsuperscript{72} ESL refers to English as a Second Language.
Digital technology is the perfect medium for learning. Students learn through active engagement … recapping, replaying, preparing for acting, reviewing. The product of a film brings learning together for them. They can see it, and look at their learning again later.

This conception of Kitty’s knowledge of technology integration is delivered and observed through learning the conventions of filmmaking in multi-stage digital media projects, when using the SRN (see glossary), and when making film to explore History topics and famous Impressionist artists in Visual Arts classes. The pedagogical themes of authentic experience and developing subject matter knowledge underpin experiential learning.

**Authentic experience**

In multi-stage digital media projects, it is theory first, followed by illustration, and then protocols, and “after that it’s lights-camera-action”. Kitty refers to this structure as “inside learning”, involving a set of shooting protocols and conventions learned inside the classroom. This mirrors procedures real filmmakers follow on set. For example, in one observation session a board at the front of the classroom displays the shooting protocol, and features the following commands: “1st position please, quiet on set, roll camera, camera rolling … 1, 2, 3, mark it with a clapperboard, action”. Students familiarise themselves with film techniques incorporating the codes, signs and symbols which are particular to the film medium. Kitty uses a range of short films, YouTube clips and extracts of feature films to support student learning of these filmmaking conventions. One key resource she uses is a DVD set called “Film As Text”. In interview, when asked about this choice she reveals: “The film I love to show students most is ‘Living in Oblivion’ – this is a film about making a film, and it teaches kids the shooting protocol beautifully and … comically”. She expands her reasoning:
Students must learn the conventions first and they only understand this by being involved in the whole process. They learn that the type of music in film is a code, to tune the audience into a mood, or that the type of shot reinforces the feeling a character is experiencing. For example, there are high shots, low shots, and diagonal shots.

In her Year 11 class, the importance of authentic experience prevails. Kitty outlines this belief in interview: “It all fits very nicely with everything I teach. It’s really Vygotsky’s Zone of Proximal Development and key constructivist notions. He talked about how instruction is only good when it proceeds ahead of development”. She delivers this idea with an additional quip about how it’s also important to disrupt protocol: “By teaching students film protocols … you encourage them to break them, and they can’t break them until they know exactly what the rules are”.

**Developing subject matter knowledge**

In the Year 9 History class where she co-teaches, students research the historical context, and the SRN (see glossary) is used to reinforce historical knowledge (see sample ‘red slip’ in Appendix F). In interview, Kitty is firm in her belief that this approach allows students to remember facts and succeed at learning. She recounts that when trialling the SRN the previous year, it gave her the “proudest teaching moment ever”, and added:

> It was dynamic and exciting, the kids were with me. The whole class was on fire. I was on fire. The teacher whose class it was watched what happened, and said to me afterwards … you have just got through about four weeks of content in a single period.

In the History class observed, a series of questions is presented to students based on work they have investigated during class time. In this instance, questions arising from a set of Gallipoli posters are given to students in advance, and then in a fixed period of time they
respond to the questions using the SRN. Students choose from multiple choice answers, short
text responses and Yes/No feedback. Reinforcement is given instantaneously, and students
compete with one another to gain the best result. If the result is poor, they repeat the test up
to three times and only the best result is recorded. Kitty confirms her belief that the SRN
develops subject matter knowledge again after this classroom observation. The technology
enables efficient learning, which she says: “Aids better understanding of content, and also
helps teachers to examine their practice”.

When each of the digital media project groups step through a particular filmmaking process,
they research content, plan pre-production, think about the film techniques that might best
convey ideas, film the sequences, and then do post-production work. Kitty describes how
after following this procedure “they know their subject matter really well”. The example she
gives to illustrate the point is from a multi-stage project group from the previous year. The
group, although very problematic for other teachers, is a high support class of new
immigrant students. She manages to sustain their interest in Ned Kelly, by making a film:

When they were making the film, they had to interview relatives of the historic
figure and get into character. Students unpacked the story from the mother’s point of
view. The depth of knowledge they developed was incredible. I wanted them to
know that Australia has a hero who is criminal and a bushranger. They did vast
amounts of research, and used all sorts of camera shots applying the correct
conventions. Even now, when I see this group around the school, they remember
facts about his life.

Kitty links knowing subject matter to “supporting students from the back”. Her belief centres
on providing guidelines and creating a learning environment that allows students to arrive at
their own understandings:
The process of continuous dialogue in making a film means students will learn the subject well. It’s not just about subject and content, but about using a range of technologies to keep them engaged and supported, to discover new ways of looking at content. As a teacher, you must create that deep desire for knowledge and understanding in students.

Often students in the multi-stage digital media projects are reluctant to explore subject matter in mainstream classes, and prefer to use the medium of film to explore content they would otherwise be less interested in. This notion is triangulated in focus group discussions when a Year 10 student, whose view is typical, explains: “It makes learning more fun, and you make it factual by putting facts into the film content and by including special effects. It’s more interesting this way, and it’s fun for people to listen and watch”. Commentary also highlights the positive effect and sense of ownership making films has on classroom management. Several students mention: “There is less noise and less disruption to learning in project work”, and they believe they “are more productive”, and subjects are “easier”. It is argued by some students in the same conversation that if concepts are not well understood then it’s possible to explore content in different ways using: “Digital games, the internet or other software applications”.

In Kitty’s classroom, so much more content can be investigated through the process of filmmaking. She states in interview: “Films are a brilliant way to teach subject matter in Visual Arts. I use the same process as I use in the media groups. Films bridge the gap for students between context and culture”. Kitty expands further: “All digital technologies are a key way to build literacy, for example, videography, photography, and digital slide shows and of course filmmaking”. A Year 11 student, who is making a film as a response to a prescribed art history assessment task, says: “I love filmmaking, it is such a beautiful thing – it’s an art when you can capture an artist you are studying on film”. Closely tied to this pedagogical theme in the conception of experiential learning is the importance of creativity.
7.6.3 Creativity

Students using technology to create and make films supports a range of Kitty’s learning objectives. She reiterates: “Technology can recap learning; you save it, play it back, remember and listen. All students can more easily develop their verbal skills … they are learning through this process”. The conception of technology integration involving a flexible pedagogical approach is also mentioned in this theme. Kitty says: “Deviation off the set path is central to the creative path, and technology provides a means to do that”.

Kitty uses films made by students in past digital media projects as a way to illustrate creative possibilities to new groups. She suggests they allow drawing on different creative techniques to do with ‘shot size’:

They love to see themselves on film, or what other students have done, and they always think they can do way better. They seem to want to understand the film technique more, if they can criticise what another group actually did.

Observation of an art making session in the Year 11 class shows students choosing a suitable medium for creating mid-term major works. In the centre of each table group are bonsai trees, belonging to Kitty. When questioned about this feature, she explains that bonsai is a personal hobby, and in the classroom she uses them as:

... living sculptures for inspiration. They give the students a strong aesthetic focus. If they are stuck for an idea they can photograph the bonsai using a digital camera, they might make a screen shot of it, project it onto a wall and then begin their drawing or painting work. Artists are like collectors, and they work with form, so that is what I have done with the trees.

Some of the trees are extremely old and valuable. For all that, students respectfully carry them from place to place, looking at them while doing their art work. She stops to show them how to draw something on a large canvas, while projecting the bonsai image on a laptop.
Students experiment with the idea, using pen and paint and large sheets of paper. The pedagogical themes of aesthetic significance and learning made public are important considerations in the conception of creativity in technology integration.

**Aesthetic significance**

The term “aesthetic” reveals itself in this context as both an adjective and a noun. Concern for beauty or appearance is important to Kitty, as is the set of principles that underline or guide her conception of aesthetic significance. The value of the visual nature of film and its aesthetic is enacted through Kitty’s knowledge of technology integration. Lund (1988) predicts this value may play an “increasingly important role in school education in the next century” (p. 44). There is congruence between Kitty’s ‘inside life’ as a Visual Arts teacher and her ‘outside life’ as a filmmaker. Preoccupation with the aesthetic manifests in making films with students, the software applications she introduces to them, and her preference for photographic mediums and bonsai.

The nature of a school subject like Visual Arts automatically incorporates the aesthetics of visual form. Kitty asserts that technology’s visual form: “Makes teaching easier because of its recordable nature, and therefore the inherent openness allows manipulation for artistic purposes”. This theme surfaces in several ways. Students’ present assessable work using a range of technology applications and one noteworthy example is Prezi. Students experiment with the tool overnight, and the following day come to class with elaborate and beautifully displayed mid-term major works demonstrating their use of Prezi. In interview, she expresses surprise that so many students immediately responded to creative uses of the software: “The aesthetic is valued in something like Prezi because students really need to think about the audience viewing their work”.

73 Prezi is a cloud based zooming presentation software, access examples here [http://prezi.com/explore/](http://prezi.com/explore/)
Many students agree with this assessment, and in focus group discussion reveal: “It’s a good alternative to PowerPoint, easier to use and it’s more fluid. I really like the look that it gives my art work”. In Visual Arts, technology assists structuring what they know about various Australian artists. In one example, the blog created for “The Angry Penguins” is mentioned:

I remember more when I use something like Prezi because it looks nice, and you have to use headings and structure the information so it flows. You don’t put everything on display. Ms … showed us how to use it, and now we show her more things it can do. It’s really memorable to watch, compared to someone reading off a worksheet or some paper.

Students in Kitty’s classrooms describe valuing the aesthetic of the visual form that technology opens up for them as learners, as “most teenagers are visual these days”.

**Learning made public**

Closely linked to aesthetic significance is the idea that publication, and making what students produce public, means it can be viewed, read over, and edited. In interview, Kitty repeats a long-held view that: “Because technology exposes the students’ work publicly, the quality is better. The performance aspect of technology has produced a new writing convention”. Observations and interview reveal that students seem to like seeing what other students create, and whether it’s writing or creating films, there is enormous interest from students outside the classroom context in the final product from the multi-stage digital media projects. One example which supports this assertion is the high number of ‘hits’ recorded for the promotional video, within minutes of it ‘going live’ on the school’s website. When asked about the importance of peer acknowledgement as a driver for learning, this Year 7 student comments: “By the time we finish the film, other students have already seen us filming

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74 The Angry Penguins were modernist Australian painters from the 1940s who included Arthur Boyd, Sidney Nolan, Max Harris, John Perceval, Albert Tucker and Joy Hester.
around the school. They think they might be in it, and they want to see what we have come up with. It’s really fun”.

Kitty notices in the Year 9 History class, that when she first uses a blog to record and structure this group’s learning, she would ‘hear’ from students who never ask questions or make comments in class: “I now hear from the quieter students, their written responses are more considered. [The responses] seem deeper because they have time to think, and they know other people (including me and their teacher) will be reading the work”. Some education literature (Andrews, 2010; Kist, 2010; Hunter, 2010) confirms this aspect of blog usage in schools. The idea of being a self-conscious learner in the classroom is not new.

Both Kitty and the class’ usual teacher agree that for many students who are new language speakers: “A heavy or broken accent is unheard when students post online, or send an email. This [use of technology] encourages and builds confidence in using English. Technology is a way to hook migrant students in”.

The conception of technology integration as preparation for life follows on from creativity, and is detailed below.

7.6.4 Preparation for a life of learning

It was John Dewey (1934) who famously said: “Education is not preparation for life; education is life itself” (p.12). In interview, Kitty parallels this well-known quote when she says: “I am preparing students for life beyond school … for life. Visual Arts may be the only subject where some students experience success in their learning, and can walk out of school with a sense of how the world is”. This conception in her knowledge of technology integration as preparation for a life of learning is pursued daily, both inside and outside the classroom. It is the way education happens. In observation, this message is overtly given to students through conversation, and the manner in which Kitty underwrites the conception with the pedagogical themes of risk-taking and self efficacy. Each theme is explored below.
Risk-taking

Tied to the idea of preparing students for a life of learning is the notion of risk-taking. This theme unfolds in Kitty’s practice of learning alongside students. Throughout interview sessions Kitty returns to this theme repeatedly, and it’s couched in terms of how important it is for “teachers to take risks, so that students will also be encouraged to take risks”. She adds: “It’s the life I want for my learners”. This philosophy extends to enacting her knowledge of technology, as students see her constantly trialling different technology hardware and software. In observation, early one morning before school starts, Kitty uses the school’s connected classroom to join a conversation with education colleagues from across the region. This group is trialling and experimenting with new software applications. It is at this meeting that Kitty first sees Prezi (see glossary), and she follows up the same day, sharing the application with her Year 11 Visual Arts class (see previous section in 7.6.3).

She gives another example of the value of risk-taking in interview: “Students take risks in digital media projects. It requires structure … loose time, and if they are not conscious of this, the project will not be realised”. The students agree, and seem to understand her expectations and ways of working. In focus group discussions, students in another digital media project expressed this understanding: “We do so many cool things … animation, making short films … we can try different things and if it doesn’t work out we can re-do it, until it’s just right. It’s OK”.

Sustained importance is given to the pedagogical theme of risk-taking. In interview, Kitty asserts that:

> When teachers take risks they will be more successful at teaching. You must have excitement and passion about the job and the subject you teach. I adopt a role, and

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75 The teacher professional learning session is “Brekkie with a Techie”, accessed here [http://hccweb2.org/bt/?page_id=66](http://hccweb2.org/bt/?page_id=66)
pretend that I am not frightened. I am confident. I am happy and I want to be here.

The students know we are going to do something important together. I am not afraid of making a mistake. I have realistic expectations and I hold high expectations of what I want from the students.

Risk-taking links to not being afraid of failure. Kitty sees a characteristic present among her teaching colleagues, and she remarks: “There is a fear of failure, which means the same tasks are used year after year. I’m more critical of myself”. She implores her colleagues:

Trust your students with technology … it makes them lead their own learning, rather than being dependent on the teacher but it’s done within boundaries … you want them to use it wisely … it’s not for filming the fight at lunchtime.

Kitty facilitates their technology exploration, shows them and then stands back, and now she says: “They do what I can’t do … they become co-producers”. There is opportunity for students to move from a sense of failure to success, when teachers work alongside them.

**Self-efficacy**

Modelling self-efficacy as preparation for a life of learning is a conscious decision. Kitty says: “If you open up a crack in the door young people will run through it. I know some teachers are very nervous about this approach”. The previous pedagogical theme of risk-taking has an impact on an individual’s self-efficacy. Students who are self-regulated learners believe that opportunities to take on challenging tasks, practise their learning, develop a deep understanding of subject matter, and exert effort will give rise to academic success; self-regulated learners usually exhibit a high sense of self-efficacy (Bandura, 1989).

In focus group discussions, both Year 9 and Year 11 students explain how being in Kitty’s class has led to greater feelings of autonomy. For example, this Year 9 explains: “If we work with others there are more ideas, I like it. I’d feel too nervous otherwise”. Another student in Year 11 succinctly captures Kitty’s intention: “In this class we are taught how to use
technology, we have more time, more freedom, more contact and we can make mistakes. Now I can do stuff I have never done before”.

In many respects, it is as if technology is a mirror, or model for personal practice. Kitty believes teachers need to have realistic expectations about students’ use of technology, as: “Not all chat students have online in the classroom is about work ... give them more freedom”. In interview she describes this vicarious experience:

I like them to behave like professional students. Film projects enable that … to work in a team and disagree with one another … try different possibilities … that’s what happens in life. I don’t interfere. Dictating the outcomes lowers the bar. You go on a journey with your students … have fun … explore … investigate … take risks.

When modelling self-efficacy using technology, Kitty acknowledges: “There are good days and bad days in teaching … you don’t take it personally. Doing the same thing every day doesn’t mean students learn or become independent”.

Conceptions of Kitty’s knowledge of technology integration are felt in her impact on whole school culture. This final conception is detailed below.

7.6.5 Whole school culture

Throughout history, and in education contexts in particular, the importance of a school’s educational leadership and its role in shaping school culture cannot be underestimated (Fullan, 2011; Hargraves, 2007). At Farner, Kitty’s designated role on the school’s executive as Head Teacher Technology means leading technology innovation in the school. Kitty describes the position:

The subtext of my position is responsibility for up-skilling teachers in their use and competence in technology hardware and software, as well as trialling new technology devices on the market. For example, the iPad, the SRN, flip cameras and
new photographic equipment. I play a central role in the distribution and maintenance of DER laptops for students in Years 9-12.

It is her belief that the DER is instrumental in pushing teachers to change their approach to practice. The conception of whole school culture in Kitty’s knowledge of technology integration is built upon the pedagogical themes of professional responsibility and enacting a role. Both themes are detailed in the following sections of the chapter.

**Professional responsibility**

Kitty’s school principal is highly supportive. He encourages and actively enables her professional responsibility for leading technology innovation in a variety of forums. One example of the level of support observed is “Meet ‘n’ Greet”. The activity involves five members of the school executive, led by Kitty and the principal, standing at the front gates of the school each weekday morning from 8.15am. This team personally greets students as they enter the school grounds, and if they are out of uniform they return home to change (provided there is enough time; if not, they change into correct uniforms/shoes provided at the gate). iPads are used to mark names off class rolls as students arrive. Kitty explains the rationale behind “Meet ‘n’ Greet” in interview:

> It’s about greeting students, as they start their day, with a smile. On Fridays it’s accompanied by breakfast. It is a lovely way to get to know the students. It’s about fostering pride in the school. In the first week, 30 uniform slips and 30 detentions were issued, in the second week it had come down to 8, and now this week it has come down to 1 or 2. We’ll see how it goes.

The aim of this action is to improve school culture and communication; it’s also about lateness and compliance. Kitty points out: “The idea of Meet ‘n’ Greet fits with expectations of using technology for administration and programming, which is all part of our
professional responsibility … I see it also [technology] as time saving devices for classroom learning”.

Many teachers at the school don’t always think about using technology for teaching and learning. The principal has impressed upon her the idea of “you are only as strong as your weakest teacher”. She explains:

I do a lot of training of weaker teachers … I have failed some. It’s about unpacking what good teachers do. It’s about being consciously competent\textsuperscript{76}. If your students are failing, that’s your professional responsibility … you need to think … may be I haven’t taught them well. Have I given scaffolds, models, structures, skills or knowledge to build their competence?

Gathering data on students’ performance assists teachers to examine their practice, and Kitty says that this, too, is part of professional responsibility. She says: “You can’t blame the kids, if over a five-year period you have only had one student in Band 4. You need to reflect and take responsibility for what you are doing\textsuperscript{77}.”

\textit{Enacting a role}

Positional power in the school means Kitty is seen to enact a particular role. The title of Head Teacher Technology allows teachers to ask for support for technology integration. She elaborates:

It’s easier to ask for technology support, rather than asking for help with your teaching … it’s a good doorway which has been opened where I can work with teachers, and even if they are confident they train me and I can co-teach … it’s about not being the best … we are all at varying points in our development.

\textsuperscript{76} At this point in the interview she mentioned the work of Christine Richmond and her model of what good teachers do, accessed \url{http://www.christinerichmond.net.au/Christine_Richmond/Christines_books.html}

\textsuperscript{77} In Stage 6 students are awarded a band placement of achievement in the Higher School Certificate (HSC), the lowest Band is 1, and the highest Band 6.
The leadership role in technology means Kitty can see what goes on in other teachers’ classrooms. Her team of ‘ICT Champions’ is growing at the school and she says: “Teachers volunteer to become a champion in technology, and they ask me to support them in the classroom, to design units of work, watch lessons … I am inundated with requests”. This is observed in the Year 9 History classroom using the SRN (see glossary) for the Gallipoli studies, as described in section 7.6.2.

It is Kitty’s belief that teachers are more willing to present their teaching weakness to her when it’s framed as “difficulties in technology integration”. The request for technology support becomes a type of shared lever to ‘up-skill’ colleagues in classroom practice. In interview she says:

I have the sexy tools to do it, however it’s underpinned by really confident teaching practices. It’s much easier to ask for help to integrate technology, than ask another teacher about classroom management, programming, literacy, teaching strategies and other quality teaching elements.78

Kitty recognises that she is different to other teachers in the school; she tends to use her appearance as a kind of visual code, her style of dressing will indicate the activities she plans for the day. She explains: “Teachers wear costumes … they take how I am dressed as cue for how we will be learning. Maybe as a Visual Arts teacher I push the costume idea a bit further?”

Kitty also sees herself as a “highly competitive teacher” in her technology role, and adds: “Competition is the vehicle for me to achieve personal goals for the school, and the region”. Most significant are the goals she has for the students she teaches, and she explains:

I know how to get the bottom kids up. They get Band 1s in other subjects … in my subject they get 3s or 4s. I want to get the best from them. You have to like kids …

78 From the Quality Teaching Framework - see glossary.
love them to death. I care about the community’s perception of the teaching profession. I like to be a good example and I want the kids work to be of a high standard.

Kitty gives an example of a student from the previous year: “One Stage 6 student I taught in Visual Arts got a Band 4 and a Band 1 in all of his other subjects. He was not producing anything in art to begin with, and then we went together into the darkroom and made photograms. That changed everything”. Students in focus group discussions concur with her aspirational role and readily acknowledge the fact. One Year 11 student expressed it in these terms: “We know we will do well in this class”.

7.5 What is fresh?

The fourth case reveals rich ideas for fresh ways to motivate less ‘tech savvy’ teachers to think about technology integration. The case contains another example of non-threatening, technology professional learning through a model of co-teaching. This model is successful when less confident teachers volunteer to work alongside an innovative practitioner – whose role in the school might be deemed Head Teacher Technology. Inspiring specialist teachers in secondary school contexts who work alongside the usual classroom teacher find that hesitant teachers are more willing to experiment with technology integration, rather than ask for support to improve their teaching. The notion of co-teaching is less threatening, and not at all different to Gina’s consultancy role in various primary school settings.

Like Gabby, Gina and Nina, Kitty sees pedagogical value in providing opportunities for students to perform publicly. She recognises that her video publishing skills to support students are a gift, and not all teachers have them nor should they be required to develop them. What these teachers do, according to Kitty in her final interview, is: “Share what we know with our peers”. Some education jurisdictions that are now beginning to focus on up-

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79 A photogram is a photographic image like shadow. It’s produced without a camera, usually by placing an object on or near a piece of film or light-sensitive paper and exposing it to light.
skilling classroom teachers in video production, using simple software programs, suggest
schools are better at understanding the importance of fostering creativity and imagination in
the lives of young people in schools.

Data in the previous chapters has shown that each of the teachers adopted a classroom
pedagogy that they believed would prepare their students for life, both within and beyond
school. Chapter 8 now turns to a detailed discussion of the commonalities and differences in
their pedagogies. This discussion leads to an understanding of what is fresh in their
approaches to teaching and learning in technology rich classroom environments, and returns
the thesis to its central research question.
Chapter 8: A *fresh equation* for technology integration

The *fresh equation* of this chapter’s title is revealed through analysis of commonalities and differences in each teacher’s knowledge of technology integration. The original TPACK framework developed by Mishra and Koehler (2006) detailed in Chapter 2 articulates the components of technology integration: content knowledge, pedagogical knowledge, pedagogical content knowledge, technology knowledge, technology content knowledge, and technological pedagogical knowledge. These form a particular knowledge understanding that is described in the seventh component as: “TPACK or technological pedagogical and content knowledge” (p.1026-1031). While the framework has brought important insights to what we know about technology integration in education settings, this chapter proposes that analysis of this thesis’ new data brings critical *fresh* insights to the TPACK framework.

The previous four chapters describe particular conceptions of four exemplary teachers’ knowledge of technology integration in the classrooms of Australian school students in Stages 1-5. Each case featured data analysed into pedagogical themes, comprising diverse teaching strategies and student learning processes. Groups of defining conceptions, and pedagogical themes of each teacher’s knowledge of technology integration, emerged through analysis and these are summarised in Table 8. This chapter explores commonalities and differences across the teachers’ approaches and shows how the conceptions and themes reveal innovative knowledge of technology integration. This exploration addresses the study’s central research question posed in Chapter 3. To this end, a *fresh equation* for technology integration in ‘exemplary’ teachers’ classroom practices is proposed.

To recapitulate, the aim of this study was to understand the dynamic relationships between technology, pedagogy and content and the interactions between these knowledge components. The central research question was:
How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?

The following sub-questions informed the central question:

How does the conceptualisation of teachers’ knowledge of technology integration form a ‘fresh’ understanding for technology implementation in teaching and learning?

What is the emergent form of ‘new knowledge’ about technology integration that can be shared more widely across school contexts?

Table 2 below presents a summary of the conceptions and pedagogical themes for each teacher’s knowledge of technology integration from the previous four chapters.

<table>
<thead>
<tr>
<th>Gabby</th>
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</thead>
<tbody>
<tr>
<td>Learning made public through performance</td>
<td>Creativity</td>
<td>Differentiation and negotiation</td>
<td>Play and fun</td>
<td>Extended learning time</td>
</tr>
<tr>
<td>Better quality outcomes</td>
<td>Continuous co-creation of products</td>
<td>Experimentation</td>
<td>Dressing up</td>
<td>Imagination</td>
</tr>
<tr>
<td>Audience</td>
<td>Peer support</td>
<td>Going with the flow</td>
<td>Story telling</td>
<td>Length of session time</td>
</tr>
<tr>
<td>Active engagement</td>
<td>Modelled and guided practice</td>
<td>Unfinishedness</td>
<td>Mathematical thinking</td>
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<table>
<thead>
<tr>
<th>Gina</th>
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<tbody>
<tr>
<td>Purposeful teaching</td>
<td>Theory-driven practice</td>
<td>Creativity</td>
<td>Real world application</td>
<td>Professional identity</td>
</tr>
<tr>
<td>Purpose</td>
<td>Constructivist teaching</td>
<td>Narratives in action</td>
<td>Preparation for life</td>
<td>Teacher roles</td>
</tr>
<tr>
<td>Planning</td>
<td>Teaching for quality</td>
<td>Creating learning products</td>
<td>Student voice</td>
<td>Learning communities</td>
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<tr>
<td>Connections through language and conversation</td>
<td>Building a questioning environment</td>
<td>Performance</td>
<td>Ownership</td>
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</table>
Common to all of the teachers in the study is their understanding of learning driven by theory. The teachers take risks with the technology they use, all are confident, and they exhibit trust in their students as thinkers and learners. They know and value students as learners, and believe the ‘voice’ of students is important. Technology is the learning enabler. There is a focus on the pedagogical values of creativity, making multi-media products is common, and participating in play, imagination and fun are familiar behaviours that engage students in high quality learning. In these case study classrooms, there is a strong emphasis on what students produce and perform as preparation for their lives beyond school. All four
teachers also see themselves as ‘expert learners’. These commonalities are explored in details below.

Each school context was distinctive, and there was adaptation or accommodation by each teacher to the school setting. For instance, patterns in the analysis showed that the pedagogical approach in every classroom varied, as did the technology tools and pathways that created learning. What was interesting was that the teachers believed their outcomes were similar. Kitty proposed: “I think we might have adopted different pedagogies but we end up in the same place”. For some of the teachers, context was more about professional identity and different timetable considerations. For others, it meant the potential technology provided for schools to change and renew practice across the entire school community.

The teachers demonstrated all seven components of the TPACK framework in their approach to technology integration. However, as Nina concluded: “TPACK comes naturally to us, but it doesn’t capture our values”. In the same conversation, Gina added: “the TPACK framework is neutral and does not portray what we bring to it … the spark and the passion … the socio-economic context … TPACK doesn’t go far enough”. Kitty decided: “TPACK doesn’t acknowledge the unexpected … teaching and learning is our hobby”. Gabby nodded in agreement as she also shared the same perception.

The conceptions and pedagogical themes in Table 2 were validated and further refined during the cross-case process, producing clear similarities and points of divergence, and these are presented in final form in Table 3 below.
Table 3: Conceptions and pedagogical themes of exemplary teachers’ knowledge of technology integration.

What emerged are five conceptions of technology integration supported by a total of 22 pedagogical themes. Table 3 provides an organising principle for the chapter that follows, with each conception and supporting themes reflected in major headings and sub-headings. To clarify, the five conceptions emerging from the study are: theory-driven technology practice; creativity for learning through technology; public learning through technology; life preparation using technology; and contextual accommodations using technology.
preparation using technology; and contextual accommodations using technology. The chapter now turns to the “T”, the opening conception in the fresh equation.

8.1 Theory driven practice + technology = theory driven technology practice

This first conception reveals how the teachers’ technology philosophy in the classroom affects practice, and it is supported by three themes: technology drives construction of learning, technology enhances purposeful teaching and technology focuses planning. Through the implementation of these themes, the teachers also transform student learning from a focus on the teacher’s actions, to its impact on student learning processes; such that: technology enriches subject matter, technology promotes reflective learning, technology shifts conversations and thinking, and technology engages students in authentic ways. Considered together, these seven themes illustrate theory-driven technology practice. Each element is now considered in priority order.

*Technology drives construction of learning*

Constructivist teaching is based on constructivist learning theories (Bruner, 1960; Curwood, 2011; Dewey, 1916; Piaget, 1954; Solomon & Schrum, 2007; Vygotsky, 1978). Such philosophy, shared by the teachers in the study, values constructivist teaching as “transactional knowledge” (Denzin & Lincoln, 2011, p.92), and is based on the idea that what you know as a teacher must be applied to support students to make sense of their world. All four teachers favoured highly student-centred modes of learning, where technology was the vehicle that enabled both teachers and students to make meaning of their world. For example, technology was used to project the dismantled images of the battery that Gina used to begin the unit of work on energy and systems, and this illustrated to students that what is used in production has implications for its waste disposal.
Having established the construction of learning as a central part of her practice, Nina’s QUEST framework allowed students to seek out answers to questions or problems they wanted to explore. Similarly, inquiry-based approaches to learning are made effective in Nina’s classroom, using technology like laptops and the internet to search and record information, and QUEST work was always presented back to the class using various multimedia modes. While project-based approaches to learning (PBL) sometimes referred to as self-directed learning (SDL) are not necessarily new, they are increasingly cited as important learning skills for equipping students to live well in the 21st century (ACARA, 2012; Chen, 2010; Hargreaves, 2011; Krauss & Boss, 2013; Mishra et al, 2013; Solomon & Schrum, 2007; Thomas, 1999). The King Middle School in Portland, Maine has embedded such ideas in their expeditionary approach to learning. What was interesting in Nina’s classroom was her deep knowledge of theory, and that the learning constructed arose directly from her own doctoral research (McCredie, 2007). Nina’s principal at the time gave support to implementing her thesis findings. The approach used stemmed from “generative theory” (Schaverien & Cosgrove, 1999). QUEST aligned to the students’ developmental stage, and not to their chronological age. In Nina’s classroom, there were no limitations or constraints placed on what students studied or wanted to question, build or structure, and such an approach supports what developmental theory has known for some time (Piaget in Gruner & Voneche, 1977; Papert, 1993). Teachers sometimes underestimate how capable students are as learners, and therefore, including open-ended or project-based learning (PBL) may enable students to move beyond stage or syllabus outcomes. New problem-focused projects reviewed in a recent report Decoding Learning (Luckin et al, 2012) details the example of Savannah, as a case in point. The notion of finding out or inquiring into a topic using QUEST is taken a step further; here learners are supported by a mobile game, to act as lions.

80 The school’s website can be accessed here http://king.portlandschools.org/files/ourschool/ourschool.htm
The ‘expeditions’ are in-depth and interdisciplinary in nature and require students to engage in research, use the community in authentic ways, and represent their knowledge with products which are presented to an audience.
in a grassland simulation, in order to further improve their understanding of the topic of animal behaviour.

Like Nina, Gina’s recent postgraduate study propelled classroom practice. Also, Kitty’s theoretical understandings linked to her broad artistic community and to her formidable technical skills as a filmmaker, and Gabby’s recent professional learning enhanced her knowledge of story-telling from a position of theory (Egan, 2005, 2010). Technology compelled the construction of learning in these classrooms, and enhanced purposeful teaching. It is to this pedagogical theme the analysis now turns.

**Technology enhances purposeful teaching**

In Gabby’s classroom, students are encouraged to experiment with language. They play and practise using words, not only when they write elaborate narratives but also when they read and perform the same narratives in front of peers. Students practise their work over and over using digital microphones, and through drafting and re-drafting written and recorded texts.

There is a long history of technology being used to support learners practising their skills and knowledge, but what remains central is the “foundation of knowledge gained and how it can be used in other contexts” (Luckin et al, 2012, p.36). The notion of “practising until fluency is reached is seen as key to becoming expert” (p. 37). The sense of purpose in developing students’ skills with words in narratives was acknowledged by other teachers in Gabby’s school, in conference presentations and in books published by the students in her classes. Writing samples were used to guide future written tasks and often ‘new words’ surfaced in different story contexts as students progressed through the year.

Purposeful teaching for Gina was supported by deliberate engagement with the Quality Teaching (QT) framework (see glossary), which was also frequently referred to by the other teachers. Gina’s QT practice is most explicit in classroom planning documentation and she situates QT in each step of the planning process. The four QT questions were critical (see
Appendix E) as she used them to focus learning on the “element of deep knowledge and the dimension of significance” (NSW DET, 2007, p.16). Deep knowledge was about how content was presented in a lesson, and was evident when either the teacher or students provided information, reasoning or arguments that addressed the complexity of a key concept or idea. For example, Gina’s students knew something about climate change. Their knowledge deepened when they articulated clear links to battery consumption, landfill and how much the world needed to seek alternate energy sources. In the dimension of significance in QT “background and cultural knowledge, knowledge integration, inclusivity, connectedness and narrative are present” (NSW DET, 2007, p.16). At each juncture, Gina considered knowledge components in the significance dimension when she gave students opportunity to answer questions, make connection and express narratives in the handmade picture books.

Technology and the choice of digital tools to match the learning purpose were common across cases. If the ‘no tech or low tech’ option was the ‘right tool’, then it was used. Technology was another classroom resource, and the sense of teaching innovation being driven purely by technology innovation itself was not a trademark of any of the teachers in the study (Luckin et al, 2012). They preferred a variety of technology and aimed for proficiency (Ottenbreit-Leftwich, Glazewski & Newby, 2010). For example, Gina’s technology use included laptops, iPads, iPhones, digital cameras, and software applications. On the other hand, Nina’s tool of choice was the laptop supported by software applications and desktop sharing. Gina was cautious about laptops on a whole classroom basis as she believed it promoted individual work with the teacher out-the-front and was akin to working separately at a desk in your own workbook (Learning Cultures Consulting Inc, 2006). Nina’s practice was anything but isolated. Students could work on their own if that was their preference. The use of iWeb and remote desktop functions ensured significant sharing and
collaboration. Both Gina and Nina were highly critical of interactive whiteboards and didn’t use them, whereas in Gabby and Kitty’s classrooms they were used often.

It is important to acknowledge here that there has been some criticism of teachers’ use of interactive whiteboards in schools, in that they may encourage didactic teaching (Roblyer & Doering, 2013). This was not so in Gabby or Kitty’s classrooms. Here, the interactive whiteboard was for students’ use and experimentation (Mitchell et al, 2010; Schuck & Kearney, 2007; Smith, Hardman & Higgins, 2006; Swan, Kratcoski, Schenker & van’t Hooft, in press). Practices such as those of Gabby and Kitty suggests that if the teacher’s pedagogical purpose is not clear, then placing students at the centre of technology use or choosing ‘no tech or low tech’ options are appropriate. Another example of this aspect and what it means was the ‘low tech red slip’ Kitty used to focus planning. The theme of planning is the next part of the analysis.

**Technology focuses planning**

Three planning actions in Kitty’s classroom supported students’ work with technology. For example, the ‘3 x 3 rule’ for laptop work meant students had clear expectations about bringing the device to school each day. Several studies (Collins & Halverson, 2009; Cuban, 2001; Curwood, 2011; Peneul, 2006) reveal that the ‘I forgot my laptop’ catch cry is a frequent problem for teachers. Students who do not have laptops disrupt others, and it is often for this reason that some teachers are less inclined to embrace technology, for fear of its implications for classroom management (Learning Cultures Consulting Inc, 2006). The literature argues that positive uses of laptops outweigh the negatives (Howell, 2012; Law, Pelgrum & Plomp, 2008; Papert, 1973, 1980) and this belief is held by all four teachers in this study. Students in Kitty’s classes participated in the development of the ‘3 x 3 rule’ when laptops were first introduced to Farner in 2008, and they rarely came to class without them. The second action that directed Kitty’s planning was the ‘red slip’, which is also an example of a ‘no tech or low tech’, or a ‘paper-based back up tool’. The slip was handed to
students when they entered the classroom. It outlined lesson directions and took into account late arrivals, students who came to class without a laptop and needed to catch up without disturbing peers, and it meant that Kitty was not interrupted if she was working with particular students. The ‘red slip’ directed students to the third planning action – the class blog. This tool is used for lesson structure and is a place for further classroom instruction, content links and set tasks.

Blogs are useful technology tools for teachers as they provide a skeleton on which to hang rich subject matter, and help to structure classroom learning (Churchill, 2009; Hunter, 2010; Polly, Mims, Shepard & Inan, 2010; Richardson, 2010). Blogs can also be important planning tools. The flexibility they provide for planning is important and when teachers consider technology integration in the classroom, then planning actions like these are helpful (Solomon & Schrum, 2007; Thomas & Brown, 2011). None of the other teachers used the same combination of planning supports; although in Nina’s classroom a short free-standing whiteboard (not interactive) was used to plan a structure for the day, and its content made available to students via the class blog. In Gabby’s classroom, the plan for the day was discussed with students, and in Gina’s classroom detailed lesson plans were kept on a personal laptop. Now, in her role as principal in a new school, Gina writes a weekly blog for parents, and she uses a blog to capture lesson outlines for students in her Year 6 class. At this point in the first conception, the pedagogical themes that follow begin a transition to how the teachers’ technology decisions impacted on student learning processes. Technology and its enrichment of subject matter is the focus of the next theme.

**Technology enriches subject matter**

Studies suggest that opportunities for technology to enrich learning content are endless in schools (Barron et al, 2003; Bos & Lee, 2012; Mishra et al, 2013). This finding was common in all four cases. However, what happened in Kitty’s classroom demonstrated that access to current content from a class blog was more engaging when combined with other
technologies. The Year 9 History lesson not only required knowing aspects of the history of Gallipoli, it required self-testing of students’ understandings; the whole class was able to test their topic knowledge using the SRN (see glossary). Mobile technology meant Kitty quickly saw who had grasped the lesson content, and thus it served as a useful assessment tool. The teacher, whose regular class it was, remarked on the pace of the lesson. In addition, when one of Kitty’s digital media project groups from the previous year made a film about Ned Kelly using various mobile technologies, it was their recall of the subject matter more than a year later that surprised her most. Such technology enrichment of subject matter is supported in UK research (Blake & Edwards, 2012) with a group of preservice teachers discussing the teaching of History. One teacher in the study remarked: “accessing historical concepts using technology links students to their ideas and creativity … the constructed and contestable nature of historical inquiry” (p.85). The work of The Deep-Play Research Group at Michigan State University takes this further, suggesting that “creative work emerges within deep knowledge of the discipline” (Mishra et al., 2013, p.10). On the other hand, it could be argued that because technology like an SRN enables “Yes/No” responses, it was only useful for superficial recall activity. Though, the constructive effects on learning of other mobile technologies, like tablet devices, netbooks and laptops for instance, have been known for some time (Kearney, Schuck, Burden & Aubusson, 2012b; Luckin et al, 2012; Swan et al, 2005). In the case of the Gallipoli lesson, the SRN supported a History teacher new to technology, to see – in a non-threatening way – a highly engaging technology lesson in action.

Nina and Gina’s approaches to technology enriching subject matter were interesting. Ready access to content using the internet, for example, meant Nina was quickly able to gather resources for learning from her “modern day storeroom”. When students explored subject matter using a PBL approach, like QUEST or in an Asia Pacific Project (APP), they used content readily accessible on laptops. Used in this way, laptops are efficient tools for
teaching students how to ‘search’. It was Papert, in the late 1970s, who first recognised “the power of the computer for masterful student learning” and that “learning to use a computer can change the way they use everything else” (Papert, 1993, p. vii). This kind of preparation was evident in sets of statistics Gina used in mind maps (see glossary) she created with the students’ input. It is arguably the case that the possibilities for teachers to access rich and current content for planning lessons are infinite using the internet, especially given that approximately 2.4 billion people across the world accessed the internet each day (Internet World Stats, accessed 29 January 2013).

In Gabby’s classroom, learning mathematical content was enhanced using student created Notebook files for both online and student-created mathematical games. Video game advocates like Gee (2003, 2005) and others (de Fretas & Marhag, 2011; Prensky, 2001a) have campaigned for schools to consider the possibilities for games in learning in both literacy and mathematical problem solving. Again, it was Papert (1980) and his work in Logo that acknowledged the ability of young children to write code, and program computers. In Gabby’s classroom, for example, when they studied the topic of mass, students produced podcasts about weight and size and then constructed games using Notebook software. Such game-based tasks were useful to gauge their grasp of the concept, especially when assessing their learning (Eck, 2006; Oblinger, 2005). More recently, Mishra, Koehler and Henriksen’s (2011) work has extended the content aspect of TPACK to include cognitive skills, or a set of what is referred to as “trans-disciplinary habits of mind”, and they assert that “great thinkers in the past enjoyed unbounded ways of thinking that stand in contrast to how our education system today is structured” (Mishra et al, 2012b, p.19). In earlier work with the Deep-Play Group, Mishra and Hendrickson (2012a) suggested that rote solutions to problems do not help students to engage in deep and reasoned mathematical thinking which connects perceptions and action to deeper abstract ideas. Gabby’s intention in conducting her Mathematics Day at the beach aligns with what is detailed in this new work, and in the
learning approaches noted by Robinson (2003). Making meaning out of technology integration, and how it enhances reflective learning for students and for teachers is the theme examined in the following section.

**Technology promotes reflective learning**

Nina’s practice was supported by deep knowledge of technology theory from particular philosophical traditions, Bronowski (1974) and Ihde (1990). She sees herself as a more experienced learner; having studied learning, being an older learner and in a position to apply what she knows, draw on it and take her students further along their learning path. Reflective learning was a deliberate act, and it is technology (in this case, laptops) that allowed Nina’s students to find out, look at what they found, make decisions about what their research meant, and share what they knew and understood with others. Nina referred to this as “the skill of metacognition, enacting or knowing about knowing comprised of planning, monitoring and evaluating” (Metcalfe & Shimamura, 1994, p.22). Laptops facilitated students working more powerfully and expeditiously with ideas (Papert 1973, 1980, 1990, 1991, 1993, 1997). Nina strongly identified with Papert’s (1980) vision. Papert is recognised as having provided a means to understand and apply Piaget’s experiments in concrete and formal thinking in child development (Resnick, 2012). Nina’s classroom in many ways mirrored Papert’s insight into how young children learn best. For example, Nina’s students used Scratch computing and attended the robotics club – they were very successful at national competitions. Their level of freedom to explore what they were curious about in the world was clearly observed in the research. Research from The Digital Media and Research Hub (Ito, 2013) referred to examples like this as “connected learning, that is, learning driven by peers, academic performance and tied to in-school recognition” (p.8).

Nina’s classroom was fast paced, highly democratic, technology rich, and students had a say in what they learned. When questioned about her approach with this ‘gifted class’, Nina was quick to point out that regardless of students’ cognitive abilities, she approached teaching all
students in the same way. In Gabby’s, Gina’s and Kitty’s classrooms, the ideas of metacognition as a vehicle to drive reflective learning were not as explicit; it was more about giving students freedom to create sustained responses to learning. It is possible to speculate that the nature of Nina’s ‘gifted’ class made the difference.

In many countries, there is a call for teachers, students and school systems (Jerald, 2009) to have a greater say in what is learned in classrooms, both in terms of curriculum content and in developing thinking skills. Facer (2011) suggests a significant disruption to this pattern may come “during the next decade in the form of challenges to the legitimacy of adults to take decisions on the part of children” (p. 39). Other examples exist, in strategies like those detailed in international (DfE, 2010; US Department of Education, 2010a) and national education policies (DWEER, 2008, 2010; MCEETYA, 2009). The role of technology in shifting conversations and thinking dominated both Gina’s and Nina’s classrooms and the analysis now turns to this theme.

**Technology shifts conversations and thinking**

In contrast to Gabby’s use of new words as a measure of purposeful teaching, Gina’s practice required students to build lists of discipline-specific words on charts around the classroom. Her emphasis on knowing subject and its *metalanguage* was paramount. An example of this was Gina’s deliberate collection of scientific technical vocabulary appropriate to the topic of energy, as shown in her lesson plans. For Gina, the notion that technology and what students can access from the classroom extended beyond subject matter knowledge and its associated language (Shulman, 1986). Similarly, teachers who foregrounded particular words, sentences, text features, and discourses in *The Queensland School Reform Longitudinal Study* (2002) were found to have classrooms that “were of higher intellectual quality than those where the language did not change or was unsophisticated” (Hayes et al, 2006, p.45). Referred to as *metalanguage* in the findings, it is another element in the QT framework that places importance on language, grammar and
technical vocabulary being given prominence in the classroom (Newmann, 1996; NSW DET, 2003). Dictionaries and thesauruses have always been classroom staples; fast access from mobile devices, for example, on an iPhone or an iPad, means students can find, build banks of words, record them and use them again in texts. In Kitty’s classroom, students used artistic terminology in presentation and group work, and when making films in multi-media projects their repertoire of genre-specific terminology was pronounced.

Closely linked to shifting student conversation, through the teachers’ use of metalanguage supported by technological devices, was the importance teachers placed on questioning. For instance, in Nina’s classroom probing and questioning of students was relentless. This strategy was supported by ‘verbal challenges’ in the form of questions while working on QUEST, or when undertaking Thinking Adventures. Polanyi (1966) writes about the concepts of knowledge and knowing in what he refers to as the “tacit dimension”. His premise is “we know more than we can tell” (p.7). More recently, this point is taken up by Thomas and Brown (2011) in what they refer to as “a new culture of learning”, where the asking of questions is more important than the answers. They suggest teachers need to shift from the limited “ask a question … find an answer” to “every answer serving as a starting point and inviting us to ask more and better questions” (Thomas & Brown, 2011, p.74). This notion was echoed some years ago by Mike Summers, CEO of Dell computers (Wagner, 2008), when he said: “People who’ve learned to ask great questions and have learned to be inquisitive are the ones who move fastest in our environment because they solve the biggest problems in ways that have the most impact on innovation” (p.20).

It was Gina’s parents who fostered her questioning from an early age. Whereas her approach to asking questions was not as unyielding as Nina’s, it was still about creating a schema in the child’s mind that aroused curiosity in the world. In addition to the handmade books, Gina would invite students to think further, actually giving them ‘thinking time’; if they struggled to explain something new they had encountered, she would persist with questioning them.
until their thinking shifted. Resnick (2006) too, in his “playful learning”, sees interactive technology like Cricket81, not unlike Papert’s Logo, as a means to foster independent questions and to create new inventions borne out of students’ questions about the world. If students do this, their thinking goes beyond the discipline and can span disciplines (Mishra et al, 2013). The final theme examined in the conception of theory driven technology practice is the ability of technology to engage students in authentic ways.

**Technology engages students in authentic ways**

Nina’s classroom engaged students in authentic learning modes. She made the decision to structure her pedagogy using technology, and used an approach to learning that gave students freedom to learn in a more real manner. Some teachers may consider this risky. Nonetheless, Nina’s approach was supported by the school principal, parents and students. They trusted her judgment – and she recognised not all teachers have the autonomy to conduct learning in the same way. When teachers make decisions like this, the Carr & Kemmis (1986) definition of praxis is useful: “Action that embodies particular qualities” (p.190). It was a type of authenticity drawn from her belief that what students do with technology engaged and motivated them to want to explore their world … to learn how to learn (Luckin et al, 2012). This was not necessarily the perception articulated by the other teachers. Their beliefs were more pragmatic. For example, Kitty expressed a belief that if you want students to know about something they have to experience it – that is, you learn about filmmaking by becoming a filmmaker. Technology associated with producing films, such as digital cameras, microphones, software programs, editing equipment as well as clapper boards and storyboards, fulfil what Kitty called the “concrete experience”. This fits with what Craft (2011b) suggests is “pedagogy that fosters high participation and high possibilities, expects, encourages and rewards high learner engagement” (p.130). In Kitty’s

81 Cricket is an app for a cross-platform audio software library, accessed at [http://www.crickettechnology.com/](http://www.crickettechnology.com/)
view, engagement arises from knowing film conventions and protocols, just as a filmmaker
would on a film set. Digital media projects are popular at Kitty’s school. It became clear in
the research that students like to learn this way, and each term Kitty has to turn many
students away from her elective classes. She does this gently through another professional
process using Expressions of Interest (EOI). This again, is an authentic, real world process.
In both Gina’s and Gabby’s classrooms, students were also highly engaged in authentic
learning, and didn’t want to leave when the bell rang. For students in these classrooms
learning was fun, part of the second conception of teachers’ knowledge of technology
integration, and the “C” for Creativity in the fresh equation. This conception is turned to
next.

8.2 Creativity for learning + technology = creativity for learning through technology

Creativity was a potent common force in the classrooms of Gabby, Gina, Nina and Kitty. In
a well-known TED talk familiar to the teachers, Sir Ken Robinson (2006) said: “My
contention is that creativity now is as important in education as literacy, and we should treat
it with the same status”. It was Howard Gardner’s (2007) research that proposed the
“creative mind” as one of five necessary minds for the future; such ideas had been flagged
previously in popular texts about the future of education (Florida, 2002; Pink, 2006). New
education research from Mishra and Hendrickson and The Deep Play research group
(2012b), among other key players, argued that “creativity is essential in education” (p.20).
This conception in the study was demonstrated through five elements: technology boosts
creativity, technology creates opportunities for production, technology unleashes playful
moments, technology support values and technology differentiates learning. In the first

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82 TED is an acronym that stands for Technology, Entertainment, Design and is a non-profit that is devoted to
“Ideas Worth Spreading”, accessed at http://www.ted.com/pages/about
pedagogical theme, it is what the teacher did that in turn affected student learning processes in the other four themes. The role of technology in boosting creativity is now considered.

**Technology boosts creativity**

In Gabby’s classroom, the emphasis was on hands on activities and her belief that unless students were making “beautiful products”, they were not learning. Parallel to this belief are ideas around *creative learning* that draw on Jeffrey and Craft’s (2006) earlier definition in Chapter 2. Interactive whiteboard technology sparked Gabby’s creative edge. Her interaction with it was always about what students did with it; in many ways, it was her ‘electronic crayon box’. Students operated it independently, in conjunction with scanners, digital microphones and Notebook software. In the classroom Gabby often said: “Get those creative juices flowing”. Students knew exactly what she meant. Not only was the classroom a visual feast of technology-created artefacts, parents in the school wanted their child to have at least one year of primary education in Gabby’s class (this point was noted in study field notes). Craft (2011b) identifies several challenges for teachers in schools who focus learning in this way, namely: the economic rationale, the elision between creativity and culture, conservative education policies, creative partnerships with schools, and how to assess creativity. For Gabby, her approach was principal approved, widely disseminated and publicly applauded, and she, like Nina, recognised this was not always the case.

The idea of technology boosting creativity was taken up in the report Gina wrote after her study tour. The report focused on what she deemed “successful 21st Century futures” (NSWDET, 2009, p.28). The production of creative students was a long held priority for Gina. Her professional background as a programmer led her to develop an overt concern with school-age students learning “the backend stuff”, for example, programming language at primary school (OECD, 2013). She stated a view that teachers needed to capitalise on young children’s innate creativity, and for her, this meant encouraging less passive consumption of what software companies produced. Her belief correlates with what Papert
(1999) referred to as “hard fun” and the fact that all children liked challenging things to do. The computer language Logo being a case in point. The sense of “hard fun” also resonated with Nina. In interview, she directly associated good learning with creativity, and giving students time to let their imagination lead them. Space for creativity and imagination is important in classrooms, akin to what Nixon and Comber (2011) refer to as essential elements in curriculum design, and long before that, it was Einstein who said, “Knowledge is limited. Imagination encircles the world” (Taylor, 2002, p.2). Physical space was also a critical element of learning design, and will be returned to later in the chapter. Nina’s students worked with laptops on long benches, around a central table and outside in the school garden. The other teachers had similarly flexible ideas about unbounded physical space.

The value of being able to make or produce something using technology was critical for Kitty in the secondary school context. This was coupled with her belief that deviation off a set path using technology only served to accentuate creativity. For instance, it was possible to elicit recordable responses from her students while they experimented with shot sizes using a digital camera, or when using bonsai as a photographic subject to begin a new project. Thomas and Brown (2011) suggest “when we build we do more than create content. Thanks to new technologies, we also create context by building within a particular environment, often providing links or creating connections and juxtapositions to give meaning to the content” (p.94). This act of seeing the fine detail in Kitty’s classrooms correlates with what has been referred to as “the move from looking to seeing” (Root-Bernstein, in Mishra, 2012b). Students created products, in particular the making of films, in all four teachers’ classrooms, and it is to that theme of production that the analysis now turns.
Technology creates opportunities for production

In a new report of 210 technology innovations from the United Kingdom, “Learning through Making” was identified as one of eight key themes (Luckin et al, 2012, p.24). In research almost 30 years ago before that, Simonton (1984) found creative success is linked to the sheer quantity of productive output: “The more ideas you have, the more likely you are to have a truly valuable creative insight; the more you produce, the likelier you are to creatively succeed” (p.14). This echoes how technology creates opportunities for production in the case study classrooms, and is strongly aligned to Gina’s view of creativity. Technology was most effective when students created something to share, so that it could be discussed and reflected upon. A good example of this was when Gina showed her new class a video of solar cars made by a previous group. When questioned about her tactic, she advocated video recording as “top of the technology list”, and she mentioned the ‘flipped classroom’. This concept relies upon homework traditionally done at home being completed in class where “each class starts with a few minutes of discussion about a video students have viewed the night before” (Bergmann & Sams, 2012, p.13). The ‘flipping idea’ from the Kahn Academy is built on blended learning principles, and the idea of restructuring classroom time. Under normal circumstances, Gina would have required students to view the video the night before, take notes, and then come to class with questions. Video used in this way “helps students learn and revise, and it means for some teachers they can’t just be content delivery agents” (Bergmann & Sams, 2012, p.15).

Gina extended her preference for video production further, when she modelled how to record content for students in various podcasts and short films. Similar practices existed in the classrooms of Gabby, Nina and Kitty. Arguments for this kind of production in classrooms abound in the literature: using technology to make videos means better learning for busy

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83 Kahn Academy is a video library with thousands of free online resources for students and teachers, accessed at [https://www.khanacademy.org/](https://www.khanacademy.org/)
students, struggling students and those who excel, and it gives more student-teacher interaction (Bergmann & Sams, 2012; Horizon Report, 2012; Mazur, 1990; Tenneson & McGlasson, 2006). What was clear from the case study observations was that video production was time-consuming for teachers and students. Invariably, films had to be completed outside of class/school time. Yet, in these classrooms there was undoubtedly more to gain than lose. Another important gain in these classrooms was playfulness, and this theme is examined next.

**Technology unleashes playful moments**

In his book, *Homo Ludens* (1971), Huizinga argued that play created culture, and for this reason play was not something that we do, “it is who we are … and the structure of play makes the player’s agency central to the learning” (p.17). The data showed that what made play influential and provided agency to students was the opportunity for experimentation, something Gabby gave voice to, and it was in the early years of schooling that more evidence of play in the study emerged. It could be argued; however, that like the students, the teachers in the study played too. For example, Gina’s students played when they constructed cars, Nina’s when they responded to Thinking Challenges, and Kitty’s, when students recorded ‘film takes’ on set. Thomas and Brown (2011) state that “whatever one accomplishes through play, the activity is never about a particular goal … it’s about finding the next challenge and becoming fully immersed in the state of play” (p. 99). Technology unleashed these playful moments by creating a base from which to structure, guide and realise the desire to learn, and in so doing, provided certain legitimacy and a vehicle for immersive, and often experimental experiences. Perhaps this is what Craft (2011b) states is the “exploratory drive that is nourished by digital contexts common in the lives of children and young people” (p.73). What was seen also aligns with what Mackey (2009) terms “thick play”, and her idea that children must be encouraged to “linger in a particular fictional world,
savouring, repeating, extending and embellishing the imaginative contact with that world, often in complex, irregular and inexplicit ways” (p.92).

This kind of “thick play” was apparent in Gabby’s classroom most of the time; the music lesson with Charles stood out as an excellent example. What occurred in the lesson resonated with what Mackey (2009) refers to as “big worlds” activity, as this complex learning event was an adaptation and extension of the fairy tale “Hansel and Gretel”. It began with storytelling. It had scripted music, and handmade musical instruments, as well as dialogue, background scenes scanned onto the interactive whiteboard, and dramatic action. In addition, each week Gabby held ‘play time’ in class, for students to report news stories by bringing them to life through dressing up and performance. Students filmed each other using digital cameras, and played the material back in class; some wanted to revisit the recordings at lunchtime or after school. Play in schools, especially in primary schools, is being given less time (Gardner, 2007; Palmer, 2006; Weigel, James & Gardner, 2009), and this issue is returned to at the end of the chapter. When the teachers played in these classrooms, they expressed their delight in that they “got paid to do this job”. Gabby made exotic Notebooks; Gina completed picture books; Nina acted in scenes for the Breaking the Silence movie; and Kitty was active on the film set and became part of the crowd interviewed in the promotional video.

When educators play more, or think more about play or “playfulness” as defined by Craft (2011b) they are “faced with two dilemmas, one at the level of principle and the other at level of practice” (p.85). This refers to the question of who is in charge, and therefore who is in command. This matter is returned to at the end of the chapter. In examining creativity, imagination in these contexts was core, and worked as a common way of “opening up” thinking (Egan, 2005, 2010; Janks & Comber, 2006) for both teachers and students alike. This notion is closely associated with McWilliam’s (2011) ideas on intuition, inspiration, ingenuity and insight, as ‘core businesses’ for schools. Connecting play and imagination, as
seen in these classrooms, may, according to Thomas and Brown (2011), be the “single most important step in unleashing the new culture of learning” (p. 118). Another vital component of creativity for learning through technology was how it was sustained by particular values held by teachers in the study, and this is the subject of analysis in the next section.

**Technology supports values**

A widely distributed post WWII schooling pamphlet, *Story of a School*, detailed values in “illustrations that showed creativity in action” (Burke, 2011, p. 423). Although published for the English and Welsh education market in the late 1940s and early 1950s, from Burke’s description, there are parallels with current calls for how education jurisdictions might prepare children for the future. Today, the role of school design and digital tools are prominent. To fast-forward that vision into the Australian context, the latest National Curriculum paper, *Shape of the Curriculum: Technologies* (2012), focuses attention on technology and its central role as an education goal for young Australians (MCCETYA, 2008a). Emphasising technology as a vital force in students’ lives, this new paper makes links to “literacy, numeracy, information and communication technology capability, critical and creative thinking, personal and social capability, ethical behaviour and intercultural understanding” (ACARA, 2012, p.4). Technology supports values in education policy documentation across the globe (ACARA, 2012; DfE, 2010; US Department of Education, 2010a). On the other hand, how technology props up what is valued in Nina and Kitty’s classrooms, does not always appear in official documentation; it is more subtle.

For Nina, what was manifested was joy and celebration, as shown when students trained for peer support. Technology was the vessel used for discussion and collation of understandings on ‘leadership’. Nina’s learning values shaped her constructivist teaching principles, as detailed in the first conception. Students, when questioned about what Nina valued, understood that learning mattered in their classroom. She devoted time to praising achievement and persistence in problem solving, calling out “what joy!” and other
celebratory comments on more than one occasion. The action summoned Dewey’s (1916) idea of ‘intrinsic valuing’, and more recently Pink (2009), who says it’s more about autonomy, mastery and purpose. In the National Framework for Values Education in Australian Schools (DEEWR, 2005) nine elements are detailed, none of which address Nina’s focus on joy or celebration.

Nevertheless, “integrity” or “doing your best” aligns to what Nina wanted for her students. The notion of joy aligns to the “high affective dimensions” of engagement in research from the *Fair Go Projects* (Munns et al, 2006, 2013). Earlier, Pink (2005), implored audiences around the world with his call to consider, “left brain activities that powered the information age are no longer sufficient, right brain qualities of inventiveness, empathy, joyfulness and meaning will now determine who flourishes and who flounders” (p.3).

In Kitty’s classrooms, the values of aesthetic significance fit alongside her formal training as a visual arts practitioner and filmmaker, and arise “from current models of creativity in art education practice” (Constantino, 2011, p.159). Technology affected the visual form, and gave Kitty endless possibilities in art practice (Prensky, 2001; Tapscott, 2009). Other education specialists cite “attention to visual literacy as increasingly necessary in technology rich landscapes” (Craft, 2011b, p.109). Kitty modelled new software applications such as Prezi to students; subsequently they would experiment with the apps (see glossary) at home or in class, and often returned with better versions than they were shown. Technology provided a positive, quiet space in which text, audio and the visual collided, and in this case linked to the teacher’s considerable aesthetic commitment. There was also a sense that students in Kitty’s senior classes had chosen to study visual arts with a practitioner who improved their technology skills. The last theme in the second conception is captured in differentiating learning, and it is detailed below.
Technology differentiates learning

Across all four classrooms, learning differentiation is linked to the pace of learning. It was conspicuous, and reached fever-pitch in Nina’s context. Pace is cited in education literature as one of the key affordances of technology integration, and the way it enables differentiated instruction in schools is well-documented (Freidman, 2005; Hedberg, 2006; Schuck & Kearney, 2007). Use of laptops meant students could work on different tasks at their own pace, and Nina exploited this advantage by setting short timeframes and high expectations for task completion. Students moved swiftly from one task to the next, reported back and then went onto new work. Such positive technology effects are supported in reports that listened to what students wanted from their school experience (Farris-Berg, 2005; Green & Hannon, 2007; Moyle & Owen, 2008). Other literature takes the plan a step further and sees it as means for personalised learning (Hargreaves, 2004; Leadbeater, 2009). Elsewhere, other educators believe this is the route to achievement of differentiated instruction (Fullan, 2009; Hopkins, 2007).

In Kitty’s classrooms, differentiation linked to pace in a particular way. It gave impetus to cross-stage grouping of students in digital media projects. Making films with students from different years promoted social, as well as academic benefits. Distribution of laptops at Farner assisted teachers to better differentiate learning for students, and a growing body of evidence cites the potential of digital tools like iPads, and other digital tools, to more successfully create differentiated learning environments (Finger et al 2007; Howell, 2012; Lane, 2012).

For Gabby, the potential for technology to differentiate instruction was enlivened by negotiation, and through processes of ‘going with the flow’ and allowing students to have ‘incomplete tasks’ or ‘work in progress’ to continually inspire creativity. She called it “unfinishedness”. Choice was a key feature here, and technology served to broaden how students worked differently. At different times they chose the scanner combined with the
interactive whiteboard, or the desktop computer with Notebook software. There is comment about the notion of ‘flow’ and ‘getting into flow’ as hallmarks of successful technology integration in education literature (Landhausser & Keller, 2012; Shernoff, Csíkszentmihályi, Schneider & Shernoff, 2003). The term comes from ‘positive psychology’, and refers to “intense concentration in the moment, giving the person a sense of agency and loss of self consciousness” (Csíkszentmihályi, 1975, p. 26). In more recent exposition, reference is made to Montessori Education, and historically, education theorists as long ago as Dewey discussed flow (Csíkszentmihályi, 1990). In many ways this distinguished what went on in Gabby’s classroom, in stark contrast to other teachers in the school. She spoke about “letting go” and “giving students control” as her approach to differentiation; it worked, and meant and she was able to step back and see how students used technology without teacher intervention. Craft (2012) presents a summary of narratives that may be useful to explain Gabby’s approach; there are two dominant discourses one sees “childhood as computerised” and therefore empowered, and the other, views children as “at risk” requiring protection where play is private (p. 176-7). Such ideas about empowerment of children versus ideas of ‘at risk’ are taken up further in Chapter 9. Attached to differentiation are opportunities to make learning public through technology integration, and this is the “P” for Public learning in the *fresh equation* and is examined in the conception below.

**8.3 Public learning + technology = public learning through technology**

The third conception was supported by two pedagogical themes: technology scaffolds performance and technology enhances outcomes. Both themes positively impact student learning processes. The public dimension of technology is controversial and there are concerns globally that young people know about safe online behaviours, and understand that all you do online leaves a ‘digital footprint’ (Robyler & Doering, 2013). Furthermore, Craft (2012) supports this idea of public, and then argues for:
Lyman et al.’s (2004) ‘cultural production’ notion, which acknowledges opportunities through digital media for children and young people to make public co-representations of experience which are then challenged, evolved, manipulated online by others … such cultural co-production makes audible children’s voices in a more political sense. (p. 181).

What came through strongly in this conception of the teachers’ knowledge of technology integration in the study, was the propensity of technology-enabled learning environments to scaffold performance by making it public. The conception was more covert in Nina’s practice, probably as a consequence of the nature of the group. Her students received considerable public attention for the films, robots and 3-D models they created. Both the teachers’ pedagogy and student learning processes illustrate making learning public through technology, and constitute the “P” for Public in the new algorithm, the first theme is now considered.

*Technology scaffolds performance*

Gina used apps when she worked with teachers in other school settings, and she chose programs that deliberately exposed students’ work to one another. Working this way was another aspect of creativity, and confirmed Gina’s fundamental belief that if students viewed learning done by peers, this supported and enhanced what everyone learned. If learning was screened, for example, on a projector or in an online program, all students stood to benefit. This belief fitted with what occurred in other classrooms in the study. The theme was not performative (Ball, 2003) in essence, although pushed to its logical conclusion, what the teachers wanted was better and deeper learning for all students, and to tap the potential of many minds working together. These attributes are not easily testable through rubrics of standardised assessment. In recent discussion, Mishra (2012a) raises the importance of “in-
disciplined thinking”, and cites the software application, Kinect\textsuperscript{84}, developed at the University of Washington-Bothell, that is used to teach students the functions of distance, velocity and acceleration in real time: “Students in the 5\textsuperscript{th} grade were able to understand this concept without any previous instruction” (p.16). Gina’s students’ understanding of energy transfer was impressive, as were Nina’s students’ performances in national academic and arts-based competitions, and their explanations of complex ideas in QUEST projects were similarly remarkable.

Kitty’s long experience as a senior teacher confirmed her observation that technology had improved student learning outcomes over time. This was borne out in the final examination results achieved by her students, in comparison to students of other teachers in the school, who used little or no technology in learning. Another ingredient in the performance theme was how her students used social media, like blogs, to give themselves a voice. Some were shy; while others believed it disguised their ethnic background and meant their accent was not on display. Studies of student engagement with social media abound (Bragg, 2010; Hunter, 2010; Richardson, 2010) and align to the public aspects of blogging, in particular to the teachers’ perceptions of the usefulness, or otherwise, of this technology.

There was pressure to produce something worthwhile in senior school contexts, as students knew others would view it, and this pressure was equally apparent in the early years of schooling. Immediacy, pace, the notion of learning being made public and performativity (Ball, 2003) are linked here and considered together raise concerns for some educators (Newton, 2012; Purcell et al, 2012). For some students, little effort led to something interesting and stimulating being made available to others, and this suggested possible tensions between performativity and mastery, or performativity and creativity. This is a concern raised by Craft and Jeffery (2008). Outward displays of learning created by using

\textsuperscript{84}Kinect is a motion sensing input device developed by Microsoft.
Technology provided visual records or documentation for Gabby’s students, which could be viewed by others, including parents. However, because students valued the visual medium, what they produced as final products or work-in-progress was better. Such belief was based on what Gabby noticed across more than 20 years in the classroom. Kitty had also taught for this long, and she, too, believed that what students produced today in her classrooms was better than when she first started teaching. To reach the conclusion that it was all a consequence of technology integration would need further study. The proposition that when students’ work has public audience it enhances outcomes is detailed below.

**Technology enhances outcomes**

The work that Gabby’s students produced was held up as exceptional both within the school and beyond. Her students gained an impressive level of technology mastery from an early age, and what they did confirmed the notion of the tech-savvy child (Facer, 2011; Martin & Ellis, 2011; OECD, 2008a; Prensky, 2001). Support from peers was central to growth in technology skill, and students would more often ask each other for assistance, than ask the teacher. There is an argument that if teachers harness students’ natural technology interest, and see it as positive and not a threat, it may free up class time for other things. Martinez (2000) took this approach in what she terms “participatory learning”, in the project *GenerationYes*. Here, students work alongside their teachers as technology leaders, collaborators and mentors. Students in these contexts are agents of change, rather than objects of change. The idea, again, falls within a perception some educators have of childhood as being about risk and others viewing children as empowered (Craft, 2011; Frechette, 2006; Livingstone, 2009; Newburn, 1996). What the teachers in this study demonstrate is that it’s possible to prepare students to succeed at school in authentic ways, with technology enhancing the outcomes, and this is a view hailed by educators such as Barrett (2000), Solomon and Schrum (2007), and Tuttle (2004). They argued some time ago that teachers’ technology use (for example, of electronic portfolios in schools) was a means
to bring about changes in school outcomes. What these studies identified was important. If peer or collegial audiences are nurtured effectively, they, too, can boost outcomes using technology. The belief can be extended to the professional tensions around raising standards, testing and school rankings, and where measuring creativity – or not – falls within such considerations. Thomson (2011) frames this issue in ideas of capacity building for change that often appear in “development discourses citing Bascia and Hargreaves, 2000; Fullan, 1993, McLaughlin et al, 2007 and others” (p.347). Luckin et al (2012) argue that “there is little innovation in technology-supported assessment and possibly this is due to the lack of excitement assessment generates more generally within the education sector” (p.39). Their report cites increasing interest in formative e-assessment among teachers, and gives examples of how ‘off-the-shelf’ technology like Audacity and Movie Maker (see glossary) might be used. Notably, all four teachers in this study used these software programs extensively with students. The possibilities for life preparation using technology are critical, and this is the subject of analysis in the fourth conception.

8.4 Preparation for life + technology = life preparation using technology

In the preface to Alan November’s book Empowering students with technology (2010), he details the case of Yves, a former high school student who broke into the school’s computer lab. Although Yves was a weak student, he explained that if he had a computer, he could do the whole of the school’s programming course in a weekend; he did just that. November touts this example as more than just a failing student being motivated by using computers; it represented a case of a shift in the control of learning, and demonstrated the importance of students learning how to learn. What it also showed was a vision for technology as central to preparing students for life beyond school. Much of the global debate now centres on the well-known, albeit highly contested phrase “21st Century skills” (Darling-Hammond, 2008; Hargraves, 2011; Jerald, 2009). There is a call for teachers to integrate these skills into the
curriculum. This push aligns with the fourth conception revealed in this study, and while it was a less common concern in Gabby’s classroom as she teaches younger students, data revealed that it is supported by several themes: technology operationalises the real world, technology gives voice, technology means ownership and possibility, and technology reveals effectiveness. This conception is the “L” for Life preparation in the fresh equation. The first theme in the conception is detailed below.

**Technology operationalises the real world**

The spirit of this theme involved connecting what students learned to the real world and questioning them about it. Gina touched on providing students with other ‘real experiences’, like preparation for assessment regimes like NAPLAN. This presented a dilemma for her – and indeed, for all teachers in the study – that perhaps her students were disadvantaged because she didn’t teach like other teachers whose classrooms were awash with “drill and preparation activity” (Greene & Melton, 2007). Such sentiments are captured in a cheeky Twitter comment on 6 December 2012 by Shiralee Poed, at a recent Australian education research conference, who said: “Life’s most important lessons generally don’t appear in standardised tests”.

In Nina’s classroom, another aspect of creativity that linked closely to life preparation was her consciousness that, as a primary school teacher, she needed to prepare her students for high school. Nina’s belief was “life isn’t school”, and “if you are just a school learner I will not have succeeded in my mission”. This preoccupation was not dissimilar to the message Kitty gave to her students. She, too, felt a sense of urgency. Kitty’s students were in the later stages of their school lives, and mostly from migrant families, where perhaps there was even greater pressure to succeed at school (Connell, 1982; Ogbu & Davis, 2003). The sense of what the real world expects surfaces in Facer’s (2011) research that supports conditions for what she terms as enabling “future-building schools”. These range across:
governance, local curriculum, mapping students and schools wider education ecology, housing education, transport and environmental policies, assessment for competency not certification, rethinking child protection policy, rethinking teacher education, building school-university collaborations and developing an ethical code for the educational use of digital and bio-technologies (p.128-132).

Some educators tie such education futures to students being more self-directed (Candy, 2004; Mishra et al, 2013) and to theories of transformative learning (Bandura, 1977; Cranton, 1994; King, 2005; Mezirow, 2000). It could also be asserted that transformation in its more current use is the normal condition of meaning making in one’s life (Kress, 2011). In Siemens’ theory of constructivism (2004), he points out that using technology and making connections are linked. If teachers are able to frame how they teach in real world considerations and to dimensions like “significance” in the QT framework, then perhaps education is a step closer to closing the gap between the students’ school lives and what occurs outside (Grant, 2010; Green & Bigum, 1993; Hayes, 2006; Hunter, 2007a; NSW DET, 2003) A further theme in the conception is that technology gives voice, and it is examined in the following section.

**Technology gives voice**

Both Gina and Nina held the view that technology gave students ‘voice’ in overt and covert ways, and each used particular technology to affect that opportunity. For example, they used Scratch, class blogs, desktop sharing and video production in “Breaking the Silence”, a film, which focused on creating a vision of the “school they’d like”. The notion of ‘student voice’ in part returns to an earlier reference to personalised learning, and to previous work of Fielding (2001), Hargreaves (2004) and Thomson and Gunther (2006) who all argued that ‘authentic student voice’ should encourage young people’s active participation in shared decision-making and consequent actions. What occurred in these two classrooms (and to some degree in Gabby’s, and in a more pronounced manner in Kitty’s) came with deliberate
opportunities for students to have control over what they learned. Often, it was technology choices that students made that determined how learning was realised. This was very compelling, and matches McWilliam and Taylor’s (2012) arguments for what they term ‘personally significant learning’. This approach asserts that:

When learning is not personally significant children become vulnerable, and if they think learning is boring and just about preparing for tests and reliant on teachers and parents who tell them what to do, then they are in deep trouble (p.1).

This argument broadens out into wider implications for culture. Still, what this means is that current models of schooling and personally significant learning are at odds with each other (Ashenden, 2012). Technology is a means to enact personally significant learning and to give students voice, as agents of change who work alongside teachers, and in ways in which technology is invisible. Florida (2005) opines that “we should look to life after school, not during it, as a time of creative possibilities” (p.33). According to Craft (2011b), the idea of possibilities is just one of four digital dimensions in children’s lives. Other researchers (Ito, 2009) suggest that if young people are given time to hang out, mess or geek around they will more successfully “indwell”. This term (first developed by Polayni, 1966) refers to an adaptive process, and means a “familiarity with ideas, practices, possibilities and processes that become so ingrained they become second nature and eventually enable individuals to make connections among the tacit dimensions of things” (Thomas & Brown, 2011, p. 84).

Focus allows students to construct their own collective learning communities with their voice and form what has been referred to as “collective indwelling” and “networked imaginations” (Ito et al, 2013). This concept is often evident when students play LAN (Local Area Network) games like World of Warcraft (WOW)\(^{85}\). It was Nina who saw technology integration, the laptop in particular, as the means to create community in the classroom. This

\(^{85}\text{World of Warcraft is a fantasy, multiplayer, online roleplaying game.}\)
was coupled to her beliefs about shared ownership and possibility, both essential to balancing the personal and the collective, and key parts of life preparation using technology. This pedagogical theme is appraised in the next section.

**Technology means ownership and possibility**

Claymation, a form of stop-motion animation, was used by Gina to extend a colleague’s technology skill set. It was students in this teacher’s classroom who commented on how much they liked the program and also, the autonomy it gave to their learning. Gina referred to this as ownership. In positing challenges for creativity and learning over the next 10 years, Craft (2011) identifies *ownership* as important from the perspective of “whose hands is the future in and what role does learner participation and voice play in nurturing creativity?” (p.136). Concerns like those identified by Craft are active in the beliefs of teachers in this study. Students in Nina’s class cite the freedom to find out when ‘QUESTing’, and sharing what they know, as liberating. Yet, there was also student comment about the temptations and distractions of technology, and the need to be disciplined. Facer (2011) refers to perceptions that technology represents “dangerous knowledge” (p.67). For some commentators, technology is responsible for creating more distracted children with shorter attention spans (Greenfield, 2009; Richtel, 2012). What was clear was that even within the parameters of the classrooms, for teachers and students in this study, there were personal preferences in terms of their technology choices.

Kitty viewed using different tools as a matter of risk-taking, and felt that this was central to a sense of ownership, and therefore key to students’ life preparation. Her view was echoed in a major 21st century education report (Jerald, 2009), that listed students’ preparedness to take risks in learning, and therefore take responsibility for personal learning, as one of five critical skills for future employment. Kitty believed it was simple, as she stated: “If students see teachers taking learning risks, and I am talking about technology … then they will too”. In her context, that meant teachers using technology, or asking for professional support with
in-class technology mentoring. This notion tied in with her beliefs about flexibility, particularly in a school like Farner, where teachers needed to be even more supple, and rules like ‘3 x 3’ were examples of how technology integration was achieved. Cremin, Burnard and Craft (2006) present a Stage 1 model of pedagogy and possibility thinking where risk-taking, posing questions, playing, immersion, being imaginative, self-determining and intentioned are important. Although the study was not carried out in digital contexts, it is possible to speculate that what was revealed by Craft’s (2011) work, in light of the teachers in this study, has much in common with ideas of “possibility thinking” (p. 51-8). Other educators (Howell, 2012) maintain that if teachers are serious about equipping themselves with technology skills and practices, then a specific digital pedagogy is required, an issue examined further in the fifth conception. The last theme in this conception is how technology reveals effectiveness, and the next section now turns to this analysis.

**Technology reveals effectiveness**

In the classrooms of Nina and Kitty perceptions of teacher knowledge of technology integration and effectiveness developed around notions of self-efficacy and self-regulation. The domain of self-efficacy owes much to the work of Bandura (1977), and is about belief in one’s ability to succeed in specific situations. Self-regulation stems from social cognitive theory in the educational psychology literature. Students who are self-regulated learners believe that opportunities to take on challenging tasks, practise their learning, develop a deep understanding of subject matter, and exert effort, will give rise to academic success (Perry, Phillips & Hutchinson, 2006). Creative self-efficacy is “an emerging area of research that has received little or no attention in education – this is instrumental in developing and demonstrating creativity” (Lassig, 2009, p. 229).

Creative ability alone is not sufficient for creative performance using the Bandura (1977) construct. For example, in Nina’s classroom, self-regulation was built on such foundations and this paired with her self-described model of “distributed leadership” which she admitted
would not sit well with other teachers. Nina didn’t have a desk, she moved around the classroom with her laptop perched on one hand and the table where her desktop computer sat was accessed by students. She used the metaphor of a “mothership” for her computer with a “whole fleet behind her on the same mission”. However, “sometimes there were scouts out front”. This issue was flagged long ago by Lankshear, Peters and Knobel (1996) who suggested that new technologies, with their effects on compressing time and place, would challenge these spaces of enclosure and therefore the authority of the teacher. There was a heightened awareness from Nina’s students in terms of the amount of work she expected from them and they mentioned in interview how much time they spent at screens in the classroom. Students aired their grievances in class, and Nina was quick to act and change direction. There is a view that when teachers take the concerns of students seriously and have positive relationships, students are less likely to fail (Hayes et al, 2006; Rose, 1995; Yates, McLeod & Arrow, 2003). In a more recent document, a meta-review of knowledge work, Lucas and Claxton (2009) distill a phrase “wider-skills” to encompass a series of interventions over the past 10 years in curriculum and research analyses. These made reference to:

Soft outcomes, or life skills for the 21st century as well as creative learning as falling into these catch-all ideas, and are described in an OECD book that advocates a model of education which encourages students to become “self-regulated” learners. (Dumont et al, 2010, p.14).

Such calls suggest that there are a new set of qualities being demanded of learners and Sefton-Green (2011) refers to these as “intra-personal”. This means “being able to work in teams, to negotiate, to work cooperatively and within communities and to be able to present oneself confidently” (p.317). Bandura (1989) identified this as personal agency, and it was Zimmermann (1990) not long after who urged educators to think about self-directed learning. Recent research, in a middle school in the midwest of the United States (Mishra et
al, 2013), is built upon the notion of self-directed learning (SDL) and how “technology combined with exploratory, learner-directed environments fosters development of learner-directed attitudes and behaviours” (p. 12). Analysis in the final conception in Section 8.5 distils these observations further.

What was also interesting in the classrooms of all teachers in the study is that there were few, if any, behaviour problems. On the odd occasion, it concerned noise level and being mindful of learning taking place in the next classroom. Kitty described these moments as “good days and bad days in teaching”. This fits with findings of research in the *Fair Go Projects* that demonstrated when students are in-task they are less inclined to be “off-task” or misbehave (Munns et al, 2006, 2013). Kitty encouraged this type of self-regulation, or effectiveness using technology and the most memorable example was the *Hall of Fame* blog. It was a classroom management tool at one level, while at the same time reinforcing content and students’ ideas. Since the introduction of blogs at the school, Kitty noticed greater confidence in students’ learning in a range of classrooms (Churchill, 2009). The previous four conceptions are highly dependent on the last conception, contextual accommodations using technology, which is examined below.

**8.5 Contextual accommodations + technology = contextual accommodations using technology**

The fifth conception seals the response to the research question on which this study was premised. It adds the final “C” for Contextual accommodations to the *fresh equation*. Teachers’ knowledge of technology integration is bounded by context. This is played out as a series of accommodations or realities using technology, and what this might mean for teachers and for schools. The conception is underpinned by four themes: technology remains personal and professional, technology changes time, technology nurtures community and technology defines the game.
Technology remains personal and professional

More common in Gina, Nina and Kitty’s classrooms, but also significant in Gabby’s, this theme bestowed opportunities as well as challenges for the teachers. For Gina, the move from computer programming to classroom teacher had changed her professional identity, and this in turn was re-shaped when she took on the roles of assistant principal, consultant, and now, school principal. Her career progression was not without concern. She lamented less time in the classroom and being able to build rapport with the one class. Instead, it was now multiple classrooms and mentoring colleagues in pedagogy. In effect, Gina’s personal passion for technology had become her professional mantle in a very short period of time. In studies of teacher identity, Day and colleagues (2006) found that teachers balance three dimensions in their work, a personal dimension (teachers’ life outside the school), a professional dimension (social and policy expectations of what a good teacher is and teachers’ own educational ideals) and a situational dimension (the direct working environment of the teacher). It is through “the ways these dimensions interact that different professional identities are formed” (p.249).

This balancing act was turned into a proactive position; Gina’s expert technology knowledge informed her practice, and she shared that willingly with teaching colleagues. Indeed, all of the teachers did this – it was a criterion for study participation. Nina didn’t consider herself ‘exemplary’, she preferred the idea of ‘pioneer’, by which she implied that all parts of the personal, professional and situational came into play. As the first teacher in her education jurisdiction to implement a whole laptop classroom, this description was appropriate and aligns with what McGuey and Moore (2007) identify as “common secrets” of inspirational teachers.

At Kitty’s school professional responsibility was personally enacted and leveraged with technology among teaching colleagues. Meet ‘n’ Greet was an excellent example of how iPads were used to excite staff about technology and were also a means to interact with
students and build school pride. Kitty’s personal background in filmmaking was recognised and promoted by her principal, and together this experience and acknowledgement were an authoritative combination for access to other teachers’ classrooms. This approach to in-class mentoring and up-skilling teachers’ pedagogy using technology as the lever, arguably ‘worked’. It was remarkable that teachers would readily ask for support with technology, in preference to admissions of poor pedagogy, and in light of their history of non-acceptance of improvement gestures. Kitty’s growing group of ICT Champions was testament to her success. Technology as education reform continues to receive attention (Ball, 1994; Gunzenhauser & Noblit, 2011; Seitz, 2007; Stoll & Temperley, 2009; Tapscott, 2009; Thomson, 2011). In earlier education studies, Nias (1989) claimed that professional identity was related to how teachers respond to educational reforms and this factor more generally pertained to how teachers saw themselves based on their interpretations of their continuing interaction within their context (Watt & Richardson, 2008). Adaptation to changes in learning and teaching is about having an attitude of “digital expectancy” and this is not limited to teachers, but includes students, parents, employers, government and the wider community (Howell, 2012, p.62). Gabby accommodated her personal and professional contextual realities, and developed colleagues’ familiarity with technology within and across the education jurisdiction. This professional commitment included representing her region at several international education conferences. What she enacted, mediated by technology, was unique. This theme is detailed below.

**Technology changes time**

Gabby invested significant personal time in technology integration; she used the metaphor of “choosing the right dress for the right occasion” to describe that process. Rushing into using technology was not something she championed, and for Gabby, thoughtful choices about what was better to use for (what) learning were central (Thorsen, 2008). Above all, making certain the technology worked immediately was paramount. In Gabby’s classroom, longer
blocks of time were a pedagogical choice, alongside recognition that if students were to produce good work, it could not be achieved in short timeframes (Davis, 2006; Landhausser & Keller, 2012). The term “slow learning” used by Thomson (2011) is useful here, as it describes the opportunity for children to engage with longer and larger tasks, and work together in ways that allow them to learn from one another. Gabby’s notion of technology changing time also includes an aspect of “creative learning where variety in sequencing and pacing are offered” (Thomson, 2011, p. 262). There is increasing tendency in Australian classrooms to segment lesson time in primary schools into shorter blocks of learning time; this action is seen as a consequence of two factors: crowded curriculums and pressure by education jurisdictions to prepare students for various testing regimes (Dulfer, 2012; Gunzenhauser & Noblit, 2011; Stoll & Temperley, 2009). In some high schools, there is experimentation with shifting timetables and subject timeframes to enable technology rich environments to be more effective (Baker, Fabrega, Galindo & Mishook, 2004; Kolbe, Partridge & O’Reilly, 2011; Mass2020, 2013). In Kitty’s digital media projects, time and having more time was a reason cited by students for their liking the film projects. Notions of time link back to Papert’s idea of flow (1993) and that ‘getting into flow takes time’.

Research (Facer, 2011) suggests a re-imagining of schools that are designed for “future building not future proofing” and re-conceptualising the way the school day is organized is part of that re-imagining (p. 133). Time is seen as an effective vehicle to nurture learning and can be further nourished when technology nurtures community. This theme is now considered.

**Technology nurtures community**

Teachers are integral to learning communities in the classrooms in this study. The sense of community is nicely captured in Woolgar’s (1988) idea of “workbench” or “workbench communities” and he described them as typically involving small groups of individuals who work closely together to solve problems of immediate and joint concern around tables (p.
John and Wheeler (2008) used the idea to place emphasis on “classroom community in technology rich contexts”. Furthermore, they suggested that if classrooms are set up this way, then “technology can act as a catalyst to shift pedagogy from more transmissionist forms to more social-constructivist approaches” (p. 119). This pedagogy issue, and how technology as part of learning community extends classroom boundaries, is taken up further in Chapter 9. Students working on benches and around large tables were first mentioned in Nina’s classroom. How students worked and learned together mattered, and Nina saw her role mainly as the leader of the learning community in the classroom, in terms of the “mothership” metaphor. Students in Gabby’s and Kitty’s classrooms saw their teachers as leading the classroom, and they would readily seek their guidance and support. Gathered around tables, both Gabby and Kitty saw space as a lever to build the learning community, and this was reflected in the pedagogical approach. Other researchers (Gruenewald, 2003; Nixon & Comber, 2011) have theorised space as important to ‘place pedagogies’ in digital cultures involving young people.

Gina’s beliefs about technology as a key promoter of learning communities in classrooms were very close to the other teachers. In each new context, Gina quickly got to know the students’ names. She did this to build rapport. This action was her commitment to facilitate students working together, to solve learning issues and share understandings. To assist her sense of connection to community, Gina made a point of nurturing her professional technology community using a PLN, a personal learning network. This practice enabled her to combat the ‘professional technology isolation’ she sometimes felt. She was very active in the Twitter space and saw this as the ‘best means’ to connect her to technology-savvy colleagues beyond the work context. Like Gina, Kitty’s commitment to “Brekkie with a Techie”86 was her link to an outside professional technology community. She readily

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86 This professional learning opportunity was a before-school, weekly connection via video-conference to teachers across the region interested in technology. It was organised by technology consultants in regional education sites.
presented useful technology tips to peers, and often took suggestions from these sessions and enacted them the same day. Nina and Gabby tended to rely on individual technology contacts outside of school to foster professional community. TeachMeet [AUS][87] is a relatively new initiative where teachers share stories of good practice, practical ideas and personal insights into teaching with technology. It is reasonable to suggest that all of the teachers felt some kind of ‘professional technology isolation’ in their contexts. The isolation meant that, as leaders in their context, there was really no one to learn from. The sense of professional technology isolation wasn’t a pre-occupation. But, it was spoken about by all of the teachers, and it was overcome to some degree by personal initiatives and contacts.

The schools and education communities in which Gabby, Gina, Nina and Kitty worked did reward and appreciate their technology leadership. The technological leadership of the teachers in the study was profound, generous and munificent. It was re-shaping whole school culture in the contexts in which they worked and the schools accommodated the teachers’ passion for technology. In field notes, from incidental discussions with colleagues and the principals of the schools in which they worked, this fact was a repeated theme. Technology is implicated in having potential to shape school culture and in a comment in Education Nation Linda Darling-Hammond states “media and technology can spark innovation and redefine teaching and learning” (Chen, 2010, p.1). In the same text, George Lucas suggests that “technology is a virus that is changing education” and refers to education as “the single most important job of the human race” (Chen, 2010, p xiv). Conceptions of technology integration being driven by contextual accommodations are underpinned by how Technology defines the game and it is to this theme the analysis now turns.

Now popular in Australia, TeachMeet [AUS] is gaining momentum among technology interested teachers, for further detail access http://www.teachmeet.net/
Changing and improving ‘teacher quality’ is a concern for many educators around the world, and for school leadership, technology integration can pose tensions and dilemmas (Fullan, 2011; Gurr & Drysdale, 2012; Hargreaves, 2011; Mulford & Edmunds, 2010; Thomson & de Bortolli, 2012; Warner, 2006; Zhao, 2009, 2012). Technology is one of the key drivers for change more generally in society and for schools it is particularly important (Chen, 2010; Lee & Gaffney, 2008; Papert, 1996; Pink, 2009). All the teachers in this study expressed their frustrations with existing school and education structures, and the lack of technology enthusiasm and knowledge of colleagues. To say they felt conflicted would be an understatement. At the day of cross case-analysis, this issue dominated some of the discussions. They all loved their work and the experience of the cross-case day gave comfort to them; knowing other teachers were doing similar things validated their sense that they were on the right path to good learning for students. In interview, Nina said: “It has been great to finally meet like-minded colleagues, sometimes you can feel very alone”. However, standardised testing regimes like NAPLAN (see glossary), and the political agendas in schools sometimes worked against what the four teachers viewed as more effective ways for students to learn. In Gabby’s case: “I am often accused of not teaching, yet parents want their children to be in my class”. Gina argued that: “NAPLAN should be telling us more about our students’ progress and how I can improve my teaching”. Kitty provided an anecdote about her own child’s teacher who had been teaching the same way for 18 years, and wasn’t going to change. She challenged the teacher, and the principal rang and thanked her for “saying what she couldn’t”.

Issues around performativity (Ball, 2003; Craft, 2005, 2008, 2011b, 2012; Darling-Hammond, 2010; Facer, 2011; Hatcher, 2011; Lassig, 2009; Newton, 2012; Mishra et al, 2013) were a concern for the teachers in the study. This is increasingly the case for many teachers across the globe. For teachers who value the freeing up of classrooms for creativity,
possibility, student-centred learning, and greater acknowledgement of technology in the lives of young people, it is particularly challenging. On cross-case day, Nina shared a newspaper clipping from a major national newspaper: *Let’s bring classrooms into the 21st century* (Murdoch, 2011). It was text from a speech given by Rupert Murdoch about what needs to happen to education in schools. The teachers read it, and expressed surprise that they agreed with almost every issue he raised. Nina had expressed in interview that current school practices “hijacked learning”, and she didn’t know how much longer she would be able to subjugate her values to the “superficial values” of schools in their current form. As they discussed the Murdoch article, Kitty mentioned “I like Ken Robinson and his ideas” and she added: “Education should be customised to students … current teaching is about conformity and standardisation”. Gina gave an example of why students should be more creative, citing eminent Australian cardiac surgeon, Victor Chang, who was, in her words: “An example of creativity in action”. She said: “I feel strange being defined as an ‘exemplary teacher’, it doesn’t sit well and implies I can’t get any better. I feel like I am fluffing my way through most of the time”. The other teachers laughed, and nodded in agreement. The teachers in the study knew how to ‘play the game’. Perhaps it was time the education game was redefined?

In the next section, the emergence of a *fresh equation* formed by five conceptions from four teachers’ knowledge of technology classroom, are presented.

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8.6. What emerges?

The analysis from the classrooms of Gabby, Gina, Nina and Kitty highlighted new and important possibilities for technology integration into pedagogy and curriculum. In summary, these are constructed from knowledge of theory, creativity, public learning, and life preparation. Collectively, these conceptions work in concert with the fifth conception, contextual accommodations. The *fresh equation* for technology integration in algorithmic form is summarised in Figure 6 below.

\[ T + C + P + L + C = \text{high possibility classrooms (HPC)}. \]

![Figure 6: Fresh equation for technology integration is T + C + P + L + C = high possibility classrooms (HPC).](image)

This chapter set out to explore commonalities and differences across four teachers’ knowledge of technology integration in classrooms of Australian school students in Stages 1-5. In order to do this it analyzed the dynamic relationships between technology, pedagogy and content and the interactions between these knowledge components within the broader
conceptual framing of TPACK (Mishra & Koehler, 2006), and offers a new *fresh equation* for teachers’ knowledge of technology integration. In effect this *fresh equation* adds another layer to the TPACK framework, namely illustrating what it might look like ‘in action’ in the classrooms of exemplary teachers. The *fresh equation* has five conceptions and they were presented in five sections in the chapter.

The **first conception or “T”** showed how theory drives technology practice was supported by seven themes: technology drives construction of learning, technology enhances purposeful teaching, technology focuses planning, technology enriches subject matter, technology promotes reflective learning, technology shifts conversations and thinking, and technology engages students in authentic ways.

The **second conception or “C”** for creativity for learning through technology was demonstrated through five themes: technology boosts creativity, technology creates opportunities for production, technology unleashes playful moments, technology support values, and technology differentiates learning.

The **third conception** confirmed the “P” for public learning through technology. The conception was displayed in two themes: technology scaffolds performance and technology enhances outcomes.

The **fourth conception** presented the “L” for life preparation using technology. It has four themes: technology operationalises the real world, technology gives voice, technology means ownership and possibility, and technology reveals effectiveness.

The **fifth conception** and final part of the algorithm is “C” for contextual accommodations using technology. There are four themes in the conception: technology remains personal and professional, technology changes time, technology nurtures community and technology defines the game.
In Chapter 9 of the thesis, the conclusion gives a summary of the study findings. It resolves what the findings mean and how this new study has satisfied the central research question:

*How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?*

In answering this question, crucial *fresh* understandings were offered about what technology integration looks like in the classrooms of a group of exemplary teachers. This *fresh equation* has strongly built on the TPACK framework (Mishra & Koehler, 2006), an influential framework of technology integration. The conclusion follows.
Chapter 9: Conclusion

This thesis has investigated teachers’ knowledge of technology integration in Stage 1-5 classrooms at four school sites. First, it showed that a group of teachers identified as ‘exemplary’ conceptualised their knowledge of technology integration around theory, creativity, public learning, life preparation and contextual accommodations. Second, it illustrated how this conceptualisation forms a fresh equation for understanding technology integration in teaching and learning, which can be shared more widely across other teachers’ classrooms. Chapter 1 set out the background to the study, the significance of the central research question, and gave an overview of the methodology. The chapter also established that the TPACK framework was a highly useful lens for fostering new directions in understanding the dynamic relationships of technology, pedagogy and content in practice. Chapter 2 located the history and development of the TPACK framework and how other national and international research linked to the leading groundwork it established for technology integration. The chapter argued that scrutiny of technology integration, from the perspective of education policy and reports in the UK, the US and Australia situated the importance of technology integration in schools. This section also focused on the main issues and debates that have emerged from studies of technology integration including the work of Craft, Gardner and Robinson, as well recent seismic shifts in education as articulated in “futures” literature. Chapter 3 detailed the case methodology and methods for the research design including how the selection criteria for the study participants were justified. Ways of analysing the data were also articulated. The following four chapters of the thesis presented the rich collective data of the study participants: Gabby in Chapter 4, Gina in Chapter 5, Nina in Chapter 6, and Chapter 7 featured Kitty. The fresh equation for technology integration in high possibility classrooms in Chapter 8 was synthesised out of in-depth analyses of the data that focused on both commonalities and differences in the teachers’ approaches.
In this final chapter, the conclusions of the study are drawn in response to the central research question and implications for education policy, teachers’ pedagogy and professional development are discussed, with connections being made to the research literature. In the last section of this Chapter, five suggestions are made for directions for future research in the field of teachers’ knowledge of technology integration.

Before drawing conclusions and implications, it is necessary to recapitulate the central aims and questions of the study. The thesis commenced by posing the question:

*How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?*

This central question had two sub-questions:

*How does the conceptualisation of teachers’ knowledge of technology integration form a ‘fresh’ understanding for technology implementation in teaching and learning?*

*What is the emergent form of ‘new knowledge’ about technology integration that can be shared more widely across school contexts?*

A brief summary of the study’s results and conclusions in answering the research questions are both presented in the next section.

**9.1 Summary of results and conclusions**

This study has three distinct features. The first is the provision of four case studies of exemplary teachers’ knowledge of technology integration, presented as a series of full descriptions that serve as exemplars of what is possible to achieve using technology in today’s classrooms. The second feature is the study’s clear response to the persistent calls for more case studies of teachers’ practice in technology integration in both Australian (Finger et al, 2007; Jordan & Dinh, 2012) and international education contexts (Ertmer et al, 2001,
Previous studies of technology integration have, for the main part, revolved around studies of graduate or experienced teachers’ contexts using particular technology devices, like laptops (Dunleavy et al., 2007; Hervey, 2011). The third feature of the study is that it fills a gap in the research literatures, in what is known about knowledge of technology integration in practice from teachers’ perspectives. Therefore, together this distinctive examination of data from a group of exemplary teachers’ knowledge of technology integration in Australian classrooms gives critical, fresh insights to what is now known.

From the cumulative analysis reported in this study, five conceptions of exemplary teachers’ knowledge of technology integration are constructed. These conceptions are theory, creativity, public learning, life preparation and contextual accommodations. One initial from each of these five conceptions comes together to form a fresh equation: such that $T + C + P + L + C$ creates what is being termed $HPC$ or high possibility classrooms (or $T + C + P + L + C = HPC$). As identified through data and analyses presented in the previous five chapters, each conception is underpinned by several pedagogical themes, with a total of 22 individual themes underlying all five conceptions. Of the five conceptions, theory-driven technology practice was the conception most common to all teachers in the study, and within each of the four remaining conceptions there were important similarities and differences.

The research has shown that high level theory driven technology practice can counteract pressures teachers may feel just to ‘simply to teach to the test’. Across some education research literature (Gardner, 2012; Hargreaves, 2011; Ward & Parr, 2011) there is frequent provocation to resist performative cultures of standardised tests (Chen, 2010; Richardson, 2012; Zhao, 2012), which thinly veil learning in schools in narrow terms, and evidence is provided that such ‘testing regimes’ will not fulfil what students need to lead successful adult lives into the future (Darling-Hammond, 2010; Ravitch, 2010, 2013; Zhao, 2012). The
four teachers in this study take the view that technology integration is about opening up creativity and encouraging students to take risks with their learning. Futures in education in such classrooms are much more about visions of students as empowered learners and the teachers’ seamless integration of technology is the critical driver that enacts student autonomy (Craft, 2010, 2011a; John & Wheeler, 2008; McWilliam & Taylor, 2012; Pink, 2006). This kind of vision for classrooms has implications for current education policy agendas in schools.

Education policy agendas in Australia, the US and the UK are constrained by a dual focus on a) accountability and testing, and b) exclamations for more creativity and project-based approaches to learning in schools (Barron & Darling-Hammond, 2008; Bos & Krauss, 2007; Gurr & Drysdale, 2012). Three Australian states – NSW, Victoria and Queensland – have used education funding from the Federal Government to drive important technology integration initiatives from which positive results are beginning to emerge (Finger et al, 2013; Fluck, 2011; Howard et al, 2012; Romeo, 2013). Such findings contrasted with earlier discourses about safety and risk, in key policy documents in the Australian National Curriculum (ACARA, 2012). For example, language in new curriculum documentation (ACARA, 2013) now couches technology in terms of general capabilities such as: “applying social and ethical protocols and practices, investigating, creating, communicating, managing and operating ICT” (p. 53). Such ideas better reflect current practice. New education research in the latest Fair Go Project (Munns et al, 2013) articulates cases of teachers who consciously plan creatively, and make spaces for all students’ creative engagement and imagination in learning. Actions in these teachers’ classrooms were surrounded by “expectations of high intellectual quality in students’ achievements” (p. 124). Such themes are also reported in salient projects from the UK (CCE, 2012; Luckin et al, 2012; Thomson et al, 2012), the US (Dilworth et al, 2012; Ito, 2013; James, 2009; Jenkins, 2011) and Australia (Hayes et al, 2006). It is important to acknowledge that while the findings of
research in this thesis are echoed in the current literature, there are important new implications for teachers’ knowledge of technology integration in classrooms that may well be of interest to education policy makers, school leaders, teachers, teacher educators and teacher professional associations. While it is recognised the implications from a small but in-depth study are context-specific, they raise broader understandings of technology integration across larger groups of teachers. By abstracting and projecting the findings, they may be useful for educators beyond the immediate contexts described here, and therefore provide interesting, important possibilities for future education research. The Chapter now turns to the research implications.

9.2 Implications of the study
The research in this thesis has taken the TPACK framework into classrooms, with a collection of rich and detailed case studies that show what is possible when knowledge of technology integration is practised by exemplary teachers. Each section in the implications discussion that focus on the fresh equation of theory, creativity, public learning, life preparation and contextual accommodations will be followed by further elaboration on what this emergent form of ‘new knowledge’ means for education policy, teachers’ pedagogy and professional development. Theory-driven technology practice provides the initial insight and implications, and the following section now turns to that discussion.

9.2.1 Theory
A crucial result was theory-driven technology practice. This conception was underpinned by seven pedagogical themes, namely: construction of learning, purposeful teaching, focused planning, enriched subject matter, promotion of reflective learning, shifts in conversations and thinking, and authentic student engagement. Implications for each of the themes will be discussed in turn.
In the first theme, when teachers’ practice is ‘constructed’ in more student-centred and less didactic ways, it gives students the necessary freedom to personalise their learning and determine problems or questions that they want to explore. This kind of teaching is still led by the requisite curriculum content and inquiry-based approaches are ideal structures for learning. Many teachers find the idea of students being more self-directed challenging, as it draws into question the teacher’s role. Some teachers feel they do not have the necessary skills or leadership support to ‘loosen the reins’ on their teaching practice and maintain a focus on learning.

This first theme of ‘construction of learning’ in the theory conception carried over into the second theme of ‘purposeful teaching’. If teachers practise using technology by linking it to what students do in the classroom, then it can validate and better match the learning or the pedagogical purpose of lessons and activities. For example, students might need more time to write, present and record responses on digital microphones or set up a presentation in a Notebook file. A clear pedagogical approach builds both teacher and student familiarity around a defined purpose for technology integration in the classroom.

The third theme of ‘hard’ or ‘focused planning’ means having a repertoire of ways of working when students use technology in the classroom. When teachers use simple pedagogical techniques like the ‘3 X 3’ or the ‘red slip’, or tools like blogs and wikis, they scaffold the learning plan for lessons. The plan becomes explicit and provides a reference point for students to stay on task. Blog platforms facilitate students knowing what the teacher has planned in a topic or unit of work and how the learning will unfold. Learning becomes less ambiguous to students and the structure of a blog can provide a means to communicate classroom learning beyond the ‘classroom walls’ – to parents, for example.

Another implication for practice emerges from the fourth theme and presages better understanding of core concepts in disciplines for students. If teachers combine discipline or
curriculum knowledge with project-based approaches, then students have more opportunities to ‘enrich their knowledge of subject matter’ and develop their thinking skills.

In the fifth theme, ‘reflective learning’ implies more deliberate moments for students to think about learning because of personal access to technology. The faster pace of learning in classrooms when technology is utilised highlights the importance of providing opportunities for students to quickly record and then reflect on what they learn.

‘Shifts in conversations and thinking’ in the sixth theme means teachers paying more attention to the questions they ask students in classrooms. While not necessarily a new idea, when combined with ready access to mobile devices, resolution to questions can be provided efficiently using devices like iPhones, laptops, or iPads. Having at least one mobile device in the classroom operated by the teacher or students helps to create an engaged learning culture of ‘I’m not sure ... so let’s find out’ and fosters the idea of a ‘community of learners’ all learning together in a more distributed manner.

The seventh theme, ‘authentic student engagement’ involves the role of technology in forming an invisible connect to the digital world through concrete experiences. For example, you learn about filmmaking by becoming a filmmaker. Or, you learn about blogs, by becoming a blogger. All schools might consider offering digital filmmaking projects where ‘creative practitioners’ or ‘artists in residence’ provide the expertise. In the next section, the implications of theory in technology integration for education policy, teachers’ pedagogy and professional development are considered.

9.2.1.1 Implications for education policy, teachers’ pedagogy and professional development

Education policy that recognises the importance of teachers continually renewing their exposure to education theories emerges from the study. Deliberate and frequent conversations about ongoing learning are central to professional practice and should
commence in teacher education programs. All of the teachers in the study had continued their professional learning beyond initial teaching qualifications. They had integrated what was learned from ongoing professional experiences and could readily identify theoretical and pedagogical frameworks like Quality Teaching, for example, as necessary for successful classroom practice (NSW DET, 2003). The current development of teaching standards, such as those developed by the Australian Institute for Teaching and School Leadership is one way in which governments can seek to address teacher renewal. Adherences to teaching standards are often vexed issues for teachers and frequently serve as more “stick than carrot” (Gurr & Drysdale, 2012). Release time from face-to-face teaching, and professionally focused sabbaticals for teachers in schools every five years, could be a step towards reconnecting theory with practice. Experimenting with pedagogical tools like blogs and wikis, as well as using project-based approaches to learning in inquiry-based structured like QUEST, can broaden teachers’ pedagogical repertoires. More occasions to play with technology at school, in particular with mobile devices and software programs on iPads, or learning how to make films in iMovie, are vital if teachers are to better understand the potential of technology for student learning. It can be concluded that every teacher will perhaps need access to a personal device in their staff room; just as they once demanded a standard issue chalk box, laptops or mobile devices are now required. In addition, further, well-funded and more frequent teacher professional development in technology integration in context, together with opportunities to co-plan and co-teach in teams, is another way to support the transition. The implications of the second conception of creativity are detailed in the next section.

9.2.2 Creativity

In the second conception, creativity through technology is sustained by five themes: the first theme is boosting creativity, the second is creating opportunities for production, the third is
unleashing playful moments, the fourth is supporting values, and the fifth theme is differentiating learning. Each of these themes has particular implications and these are detailed below.

‘Boosting creative learning’ comes through hands on activities and the overt articulation of tapping into students’ creativity. This might come through direct engagement with digital technologies, or it might mean working with more traditional technologies such as string and cardboard. Less emphasis is placed on every student doing the same thing at the same time, from the same template. Instead, individuality is nurtured and the ‘mess’ of variety that comes as part of the process is welcomed.

Creative learning taps into the second theme of ‘production’. This theme means providing students with more occasions to produce or make something imaginative as a response to content stimuli. If students have responses to learning that are not prescribed or set by the teacher, and can make or produce their own creation, it activates creativity and imagination (Luckin et al, 2012). Opportunities for open-ended responses to learning experiences mean students have freedom to create and produce something that is more meaningful to them to demonstrate their learning.

The third theme of ‘unleashing playful moments’ implies that teachers, too, can play in their classrooms. Filming, making and creating are ways to open up thinking, and to ‘walk in the shoes of learners’ and be re-connected to the young person’s world.

Closely tied to play is the fourth pedagogical theme of ‘values’, particularly in terms of joy and celebration. It entails making time to articulate to students that learning matters, at school and ‘in this classroom’. Commenting on, or celebrating what students create by recording, scanning, or displaying work that is produced, is central. Sending home digital copies or work in e-portfolios to parents, enhances learning connections for students.
The fifth theme, of ‘differentiating learning’, involves possibilities for students to work at their own pace on a task – or on different tasks – and then to move onto deeper or extension work if the task is completed before the allocated class time. This means teachers can step back, let go and see their students, for example, have multiple pieces of work in progress at the one time, and then choose to publish just one to ‘final copy’ standard. The conception of creativity has implications for education policy, teachers’ pedagogy and professional development, and these implications are detailed below.

9.2.2.1 Implications for education policy, teachers’ pedagogy and professional development

Creativity is on the current education policy agenda (Oakley, 2009) in many countries and in Australia it has been manifested most recently in a new document Creative Australia (Australian Government, 2013). The focus is on workforces skilled with people who know “how to be flexible, think and create”. Therefore, schools have a crucial role in preparing young people for future jobs in creative and innovation industries (Chen, 2010; Zhao, 2012). A quick scan of future Australian education conferences significant for education leaders shows creativity is receiving long overdue attention (ACEL, 2013). The spotlight in education policy has been on better schools, not necessarily better education for young people (Zhao, 2012). For pedagogy in classrooms, creativity involves teachers themselves engaged in producing and making. For example, in the ‘flipped classroom’ short segments of video material on key concepts recorded by the teacher are viewed by students prior to lesson time. Filmed or photographed assessment outcomes are also recorded by teachers and watched by students online. This pedagogical approach entails modelling; letting students see teachers using technology, practising with it, trying new applications in front of the class while students are working. Such ideas have strong implications for preservice and ongoing teacher professional development and the prioritising of more time for creativity focused professional learning in the school week. Strong examples of these approaches would be the
implementation of creativity and technology integration components in teacher education programs, groups of ‘technology championing creativity leaders’ in all schools, and/or timetabled afternoon sessions once a week when students and teachers all learn technology together, in the style of the Generation YES projects (Martinez, 2000). Implications of the third conception of public performance are detailed in the next section.

9.2.3 Public learning

The third conception, public learning through technology, is supported by themes of ‘scaffolding performance’ and ‘enhancing outcomes’. What students produce in their classrooms can be enlivened by technology, and this entails ‘scaffolding performance’ through recording, filming, podcasting the learning and playing it back to a real audience, on an interactive whiteboard, an iPad, or on a screen using a digital projector. Setting tasks for students that are completed using simple applications on mobile devices, which can then be easily shown to the class, can create riveting viewing and learning for students. Many students like to see themselves ‘perform’ and learn through the production process. ‘Enhanced outcomes’ in ‘public learning’ also come as a consequence of knowing that someone, most likely their peers, will be watching what is presented. The implication for students is ‘I will do my best work, or better work, because it’s on display’. In this sense, the digital medium seems to be more powerful than the painting hung on the classroom wall.

Public learning has powerful implications for education policy, teachers’ pedagogy and professional development, and is discussed in the next section.

9.2.3.1 Implications for education policy, teachers’ pedagogy and professional development

Education policy must acknowledge that test or prescriptive responses are limiting for students. In final year examinations in some Australian education jurisdictions, extended responses in a few curriculum areas have opened up ways for students to demonstrate
performance. Nonetheless, in the early and middle years of schooling, responding to multiple choice tests are still the dominant measures of student performance (Dulfer, 2012). Results from this study strongly suggest that such approaches should be supplemented, or replaced, by teacher and school-based assessments over longer time periods. For example, teachers might record students’ work using technology and then be able to share and critique such work samples with colleagues, or showcase students’ achievements in the wider community. At parent-teacher evenings student work samples can be shown or preserved in e-portfolio reports, strengthening parent-school partnerships in learning and assessment of learning. Implications of the fourth conception of life preparation are discussed in the following part of the Chapter.

9.2.4 Life preparation

The fourth conception, ‘life preparation using technology’, is supported by four themes: operationalising the real world, giving voice, ownership and responsibility, and the revelation of effectiveness in terms of self-regulation and self-efficacy. ‘Operationalising the real world’ means that technology is normalised and its presence in the classroom is equivalent the ubiquity of the chalk box for teachers or colouring pencils for students. The reasoning is that technology is everywhere and the classroom should be no different. The second theme of ‘giving voice’ implies that teachers need to provide opportunities for students to experiment with, and communicate their ideas online, work in community and in teams online, and view what others produce online. The third element has ramifications for student learning, by encouraging students to ‘take ownership’ and step outside their comfort zones whilst within the safety of classroom contexts. For example, ‘I may not want to answer a question in class but I can write the answer online, where I have time to correct and perfect my final copy’. The final theme of effectiveness implies that there is an important role for technology to support students to self-regulate what and how they learn by giving them more opportunities to develop self-efficacy to improve self-concept and achievement (Hattie,
2009). The notion here is that if students can leave school as ‘empowered learners’, they can take their place as global citizens who are prepared for life and are ready to participate in society (Chen, 2010; Craft, 2011; OECD, 2013; Pegrum, 2009). Implications of this conception for education policy, teachers’ pedagogy and professional development are detailed below.

9.2.4.1 Implications for education policy, teachers’ pedagogy and professional development

Funding of technology hardware rollouts to schools, in Australia and internationally, has been promoted and fulfilled in various education policies (ACARA, 2012; DfE, 2010; DEEWR, 2008; NSW DER, 2009; OECD, 2013; US Department of Education, 2010b). Such commitment by government needs to be sustained, as technology quickly becomes obsolete and requires continual funding renewal.

If preservice and experienced teachers learn alongside students in developing their technology skills, such approaches can mean more distributed classrooms where both students and teachers are in-task (Munns et al, 2006). In such spaces, work occurs around work benches, students learn by themselves, have access to the classroom teacher and to outside experts, and are not totally dependent on their regular teacher for ‘every next move’.

Technology professional development in schools can be built around knowing how to access appropriate experts in the community and around a mentoring approach where more ‘tech savvy’ teachers co-teach with less ‘tech-savvy’ teachers (Chen, 2010). Preservice teachers should be ‘tech-savvy’ and graduate professional teaching standards in technology integration featured in all teacher education programs. Implications of the fifth and final conception of contextual accommodations are expanded on in the last section of the Chapter.
9.2.5 Contextual accommodations

The final conception, ‘contextual accommodations using technology’ is maintained by four pedagogical themes: the personal and professional, changes to time, nurturing community and defining the game. The first theme implies a need for more teachers to embrace technology and spend time at home and at school ‘playing around’ with it. Extension of ‘personal use’ has the potential to cross-over into better ‘professional use’. Examples of these extensions and possible transitions include seeing what the iPhone can do, or understanding how certain applications on the iPad are useful for learning, it might be uploading photographs, at home and at school, or contributing to social media via news feeds, and blog and wiki spaces. In reality, few schools to date have embraced ‘longer blocks of learning time’, which is the inherent implication of the second theme. Research has shown that when schools dispense with short learning timeframes, students have enhanced opportunities to get into flow (Chen, 2010). If teachers ‘nurture community’, whether that be tech–savvy parents, or outside colleagues through online professional learning networks, it has the potential to grow technology practice in meaningful ways. Further implications from contextual accommodations are detailed in the next section, again focusing on education policy, teachers’ pedagogy and professional development.

9.2.5.1 Implications for education policy, teachers’ pedagogy and professional development

Education policy regulations do not extend to how the school day might be ‘carved up’ in terms of time constraints. Instead, time concerns manifest in school principals having more autonomy about such issues, in localised decision-making initiatives (NSW DEC, 2011). Furthermore, this transition in teachers’ use of technology in classrooms draws on personal skills leveraged against professional use, when required to perform bureaucratic tasks, like report writing using online proformas, or uploading test results onto spreadsheets. Principals, such as those in this study, optimised technology professional development in context, by...
recognising teachers who had the ‘technology spark’ and appointing them into technology leadership positions. Co-teaching using such leaders to improve learning can often begin under the guise of assistance with ‘better technology integration’. Regular, self-paced technology professional learning at the school site, with a leading technology mentor paired with ‘less confident’ teachers, is also a useful strategy for schools. Findings from this study suggest that funding of such positions in schools needs to be prioritised, as does access to in-school technicians to repair, maintain and replace obsolete devices. Design of learning spaces for future classrooms is also important (Burke, 2011; John & Wheeler, 2008) and could form course work considerations in teacher education programs. Implicit here are ideas of working in teams in common spaces and extending learning networks beyond classroom walls.

Partnerships with schools using an array of community-based partners provide real-world contexts for student learning, and fostering students’ links to much bigger or whole communities. Professional development with preservice teachers, academic partners, or creative practitioners from the field, should support development of teacher pedagogy in creative endeavours; for example, in story-telling specialist workshops. When teachers define the ‘education game’ it means governments are more likely to listen to their concerns, there is less pressure to teach to tests, and accountability in schools places greater value on the professionalism and judgment of teachers. Opening up the current limitations of responding to curriculum in school education is important, and will assist better personalisation, or customisation of education, that is more relevant and more significant for students. Continuing to play the current ‘education game’ is arguably not the answer. In the last section of the Chapter suggestions for future research are detailed.
9.3 Future research suggestions

Four future research directions or projects are suggested as outcomes of this study of teachers’ knowledge of technology integration. The first direction targets inclusion of video data in case study research of technology integration in classrooms. Rich visual exemplars are useful for teachers’ professional development. Such exemplars could sit alongside written descriptors of high possibility classrooms (HPC). An action research project designed with HPC themes, requiring a group of teachers to video record colleagues while co-teaching, would add to its validity and increase the generalisability of the current study. Such vignettes could be analysed and reflected upon, in pairs or groups in teacher professional development sessions, using theme descriptors to understand what was captured to determine next steps or areas for improvement.

The second suggestion involves more case studies of teachers’ knowledge of technology integration in subject areas within high school contexts. Such cases could provide useful understandings for discipline-specific needs of technology integration. Discipline teams within schools could take the HPC conceptions, apply them to the development of a unit of work, incorporate ‘flipped classroom’ or blog and wiki structures and evaluate their effectiveness in student learning outcomes. Research that incorporates more data from the voice of students and their experience of learning in different contexts, for example, single-sex, rural, or low socio-economic status (SES) schools will also add to the validity and generalisability of the current study.

A third proposal is for a continued study with the same teachers in this research, to see how their conceptions of technology integration alter, or remain the same over time. It would be useful to go back to the same four contexts, conduct a further round of observations, interviews and focus groups, to see from a longitudinal point of view whether the conceptions remain the same or change over time. An important question could be: what
fosters ongoing professional development of teachers’ technology integration? It might also be advisable to track a group of the less tech-savvy teachers within the same contexts, who have been mentored by the exemplary teachers in this study and see what conceptions emerge from the mentees’ practices.

The fourth plan for future research is being taken up in technology initiatives elsewhere, and involves investigations of early career teachers who are technology savvy and who have been exposed to teacher education initiatives (Dilworth et al, 2012; Romeo et al, 2013). It may be opportune to examine whether these teachers’ knowledge of technology integration is defined by similar or different conceptions to the four teachers in this study. Furthermore, teacher education programs could benefit from the inclusion of the findings of this study in pedagogy, or teaching and learning units in university courses. Such units could feature exemplars of HPC classrooms gathered from data in the proposed research in the first suggestion. Another example could be a pilot study of final year teacher education students conducted during the concluding practicum, using HPC conceptions and pedagogical themes in a unit of work that is taught at school. This study would provide constructive insights for understanding the validity and generalisability of the research, in terms of graduate teachers’ creation of HPC during professional experience, and therefore what this might mean for ways to enhance their knowledge of technology integration in student learning. The pilot could form the basis of a purposive study of the same group of early career teachers as they start to teach in schools.

9.4 The final word: TPACK in action

To conclude, this thesis has presented a strong case for considering high possibility classrooms where teachers integrate technology with knowledge of theory, creativity, public learning, life preparation and contextual accommodations. The TPACK framework laid the valuable groundwork for the study and from that foundation it has been possible to further
elaborate on the TPACK framework by identifying *high possibility classrooms* comprised of T + C + P + L + C. This *fresh equation* provides a new and exciting scaffold for teachers to create the kinds of classrooms that all students need to inhabit in the future.
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Ministerial Council on Education and Employment Training and Youth Affairs


Ministerial Council for Education, Early Childhood Development and Youth Affairs


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Glossary

**App** is an abbreviation for “applications” and has been used in the information technology (IT) community for a long time.

**ATAR** is the Australian Tertiary Admission Rank and is calculated solely for use by universities to rank and select school leavers for admission to under-graduate tertiary courses.

**Audacity** is an audio editor for recording, slicing and mixing audio.

**Blogs**, short for ‘weblogs’, are interactive web pages most often used as a way to publish writing on a variety of issues with a variety of goals.

‘**Brekkie with a Techie**’ is a weekly professional learning connection for teachers in Kitty’s region. It takes place before-school via video-conference and is for teachers interested in technology and is organised by technology consultants in regional education sites.

**CAD** refers to computer-aided design and is a software program that supports designing and modelling architectural structures in 3D.

**Claymation** is one of many forms of stop motion animation.

**Connected Classroom(s)** is the NSW State Government program that installed a ‘connected classroom’ in every public school across a three-year period, it includes an IWB, laptop, LCD screen, digital camera and microphones for multipoint video conferencing (Hunter, 2011).

**Cricket** is an app for an across-platform audio software library.  

**Desktop sharing** is a function on a laptop that allows the user to be at a computer and connect to a remote computer in a different location.

**DER** refers to Digital Education Revolution, a Federal Government initiative, to equip every Australian child in the last four years of secondary school with their own portable technology device, a laptop. At the time of data collection the program was in its third year; the program has since finished.

**Facebook** is an online, international social networking tool that connects people with friends and others who work and live around them.

**GarageBand** is made by Apple and is a software application that allows users to create music or podcasts.

**iMovie** is a proprietary video editing software application sold by Apple which allows users to edit their own movies.

**IWB** is the shorthand term for interactive whiteboard.
iWeb is a feature of Mac laptops that allows users to create and design websites and blogs without coding.

**Keynote** is a presentation software application developed by Apple.

**Kinect** is a motion sensing input device developed by Microsoft.

**LAN** refers to **local area network**; it is a computer network that interconnects computers in a limited area.

**Linoit** is an app for an online web sticky note service.

**LMS** or Learning Management System(s) are software applications that administer, document and track online events.

**Mind maps** are often used by teachers and usually involve a diagram used to visually detail information.

**Movie Maker** is free video editing software made by Microsoft.

**NAPLAN** refers to the Australian Government’s National Assessment Plan for Literacy and Numeracy, a testing system.

**Notebook** refers to SMART Notebook 10; the lesson creation software used on an interactive whiteboard.

**OneNote** is a Microsoft application for free-form information gathering and multi-user collaboration.

**PLN** is Personal Learning Network.

**Popplet** is an app for sharing ideas.

**Prezi** is a cloud-based presentation software program.

**Quality Teaching Framework** or ‘Quality Teaching’ (QT) is a term used to describe particular pedagogical practices that would normally fit within constructivism. The discussion paper featuring the three dimensions and 18 elements of the framework that is widely used by teachers in NSW public schools; the paper can be accessed here [https://www.det.nsw.edu.au/proflearn/areas/qt/index.htm](https://www.det.nsw.edu.au/proflearn/areas/qt/index.htm)

**Quest Atlantis** is now being maintained as part of the Atlantis Remixed Project, it is an international learning and teaching project that uses 3D multi-user environments to immerse children, ages 9-16, in educational tasks, accessed at [http://atlantisremixed.org/](http://atlantisremixed.org/)

**Scratch** is a programming language that enables students to create their projects including interactive stories, animations, games, music and art.

**SketchUp** is a software program that supports designing and modelling architectural structures in 3D.
SRN or Student Response Network is an application developed by a local teacher which is an evolved form of Audience Response Network, whereby students actively “live poll” in the classroom, in response to information and questions about content.

STEM is an acronym for the fields of study that refer to teaching and learning in Science, Technology, Engineering and Mathematics.

TaLe or the Teaching and Learning Exchange is a digital portal that gives structured access to more than 40,000 teaching and learning for teachers and students in NSW Primary, Secondary and Technical and Further Education settings: the public part of TaLe has open access, see www.tale.edu.au

TED is an acronym for Technology, Entertainment, Design, a non-profit group that is devoted to “Ideas Worth Spreading”, accessed at http://www.ted.com/pages/about

Testmoz is a free online test generator; its dashboard presents information in a way that is easy to read.

Twitter is an online social networking and microblogging service that enables its users to send and read text-based messages of up to 140 characters, known as "tweets".

YouTube is a video-sharing website.

Wii is a home video game console.

Wikis are content management systems, where web pages are stored separately and the pages are assembled on the fly as people access them.

Wordle is an app which generates “word clouds” from text that users provide. The clouds give greater prominence to words that appear more frequently in the source text.

Wow words are new words; the link to the UK program is http://www.sparklebox.co.uk/literacy/vocabulary/wow-words.html#.T45nXLMzCRo

Yammer is a social networking tool. It is used by teachers in the DEC to file share, collaborate and exchange questions and answers, accessed at https://www.yammer.com/product/
Appendices

Appendix A: Participant invitations, Consent forms and Teacher interview questions

Appendix B: Example of interview data (transcript)

Appendix C: Observation schedule and Cross-case day plan

Appendix D: List of original open/first level codes

Appendix E: Lesson plan for Model Car Challenge, with car examples

Appendix F: Sample of a Red Slip used by Kitty
Appendix A: Participant invitations and Consent forms

UWS Letterhead

INVITATION TO PARTICIPATE – PRINCIPAL

Study title: “Exploring technology integration in teachers’ classrooms in NSW public schools”.

Dear Principal (name inserted)

A teacher (teacher’s name) from your school has expressed a willingness to participate in the new study “Exploring technology integration in teachers’ classrooms in NSW public schools”. If you agree to (teacher’s name) involvement in the research could you please pass this invitation to (teacher’s name) as it is my understanding that he/she uses a range of innovative technology practices that align with the ‘exemplary criteria’. Information about the research is provided below.

The study is to be undertaken by the principal researcher Jane Hunter, PhD candidate at the University of Western Sydney as part of the requirements of doctoral study. Supervision of the research and the subsequent dissertation, is being carried out by Associate Professor Geoff Munns (T: 02 9772 6449) and Dr Bronwyn Cole (T: 02 9772 6667), both academics in teacher education in the School of Education at the University of Western Sydney.

Identification of ‘exemplary’ teachers for this study has been done on the basis of the teacher's:

- highly proficient use of a range of technology
- use of technology daily with students in almost all teaching and learning activity
- use of technology in an innovative and engaging manner for teaching and learning with students
- initiation, guidance and contribution to professional learning in technology with colleagues in the school context and beyond
- having trialed new technology when the school participated in previous projects and research; and
- being held in high regard by colleagues for their commitment to the teaching profession.

The research uses qualitative methodology and the data collected will form one of the chapter’s of a case study in the final PhD thesis.

The main research question is:

1. How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?

The central question has two sub-questions:

2. How does the conceptualisation of teachers’ knowledge of technology integration form a ‘fresh’ understanding for technology implementation in teaching and learning?
3. What is the emergent form of ‘new knowledge’ about technology integration that can be shared more widely across school contexts?

The teacher's commitment

Data comprising written, audio, and photographic and blog records will be collected by the principal researcher, Jane Hunter who will visit the school for a total of 5 days plus a pre-site visit. Times and suitable days will be negotiated with the teacher at all times. The teacher is free to withdraw from the study at any time without providing any explanation. Data will be collected in the following ways:
Interviews – three conversations for approximately 60 minutes each, semi-structured format where the questions will probe the three main research questions listed on page 1. 6-8 students chosen at random (considering a balance of gender, academic ability and diversity) will be interviewed in a focus group (for approximately 30 minutes) about their perceptions of learning using technology in the teacher’s classroom.

Classrooms observations - using an observation schedule to record and understand what actually occurs.

Documents/artefacts – any relevant school policy documents, or syllabus/lesson plans or digital artefacts used by the teacher.

At the conclusion of the data collection period a focus group discussion with the other ‘exemplary’ teachers for cross-case analysis day – held at a mutually agreed location and date.

Data will be kept in locked filing cabinets and password protected computer files/environments and will be coded to ensure confidentiality. For the study purpose, your school and the teacher’s name will be given pseudonyms to protect privacy. The data will be stored for five years from the date of last publication.

Digital images of the classroom will be used to support the written data in the analysis, interpretation and reporting of the cases. No participant will be identifiable from any images used in dissemination, unless their specific permission is obtained.

The teacher will receive a copy of the case study from the thesis. In publications from the study, the teacher will have the opportunity for their participation to remain confidential, or to have themselves or the school identified. The published research will be a contribution to new knowledge in the area; it may be used to support the professional learning of teachers with technology/ies, and possibly further research in the area.

Thank you very much for considering this invitation, and I hope that you will give approval for (teacher’s name) to be involved in what I trust will prove to be exciting and worthwhile research. It would be appreciated if you could distribute the relevant information sheets and consent forms to the identified teacher and the students’ parents to gain their permission to participate in the study. The research has been approved by SERAP in the NSW Department of Education and Training.

Yours sincerely,

Jane Hunter

Contact – E: j.hunter@uws.edu.au; T: 02 9772 6550; M: 0400 489 609

28 August 2010

NOTE: This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval Number is H8247. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Research Ethics Officers (T: 02 4636 0683 or 4736 0684). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
TEACHER INFORMATION SHEET

PhD Study Title: Exploring technology integration in teachers’ classrooms in NSW public schools

I would like to invite you to participate in a new education study. You have been identified as an ‘exemplary teacher’. It is your practice as an ‘exemplary’ teacher that will be of value in developing understanding of how particular teachers integrate pedagogy, content and technology into learning for students in NSW public schools.

Please find information about the research below.

The research is to be undertaken by the principal researcher Jane Hunter, PhD candidate at the University of Western Sydney as part of the requirements of doctoral study. Supervision of this research and the subsequent dissertation, is being carried out by Associate Professor Geoff Munns (T: 02 9772 6449) and Dr Bronwyn Cole (T: 02 9772 6687), both academics in teacher education in the School of Education at the University of Western Sydney.

Your identification as an ‘exemplary’ teacher has been made on the basis of:

- being highly proficient in using a range of technology
- using technology daily with students in almost all teaching and learning activity
- using technology in an innovative and engaging manner for teaching and learning with students
- initiating, guiding and contributing substantively to professional learning in technology with colleagues in the school context and beyond
- having trialed new technology when the school participated in previous projects and research; and
- being highly regarded by your colleagues for your commitment to the teaching profession.

This research uses qualitative methodology and the data collected will form one of the chapter’s of a case study in the final PhD thesis.

The aim of the research is to understand three themes in the teaching practice of four ‘exemplary’ teachers who use ‘technology in the school context. The first theme targets the nature of the teachers’ technology knowledge for teaching; the second is teachers’ perception of technology in pedagogical decision making; and the third focuses on what actually occurs in terms of the teachers’ subject matter knowledge when technology is integrated into learning for students.

The main research question is:

1. How do a group of teachers identified as ‘exemplary’ conceptualise technology integration?

The central question has two sub-questions:

2. How does the conceptualisation of teachers’ knowledge of technology integration form a ‘fresh’ understanding for technology implementation in teaching and learning?
3. What is the emergent form of ‘new knowledge’ about technology integration that can be shared more widely across school contexts?
Your commitment

Data comprising written, audio, and photographic and blog records will be collected by the principal researcher, Jane Hunter who will visit the school for a total of 5 days plus a pre-site visit. Times and suitable days will be negotiated with you at all times. You are free to withdraw from the study at any time without providing any explanation. Data will be collected in the following ways:

Interviews – three conversations for approximately 60 minutes each, semi-structured format where the questions will probe the three main research questions listed on page 1 of the Teacher Information Sheet. 6-8 students chosen at random (considering equal numbers of boys/girls, range of academic abilities and diversity) will be interviewed in a focus group (for approximately 30 minutes) about their perceptions of learning using technology in your classroom.

Classrooms observations - using an observation schedule to record and understand what actually occurs.

Documents/artefacts – any relevant school policy documents or syllabus/lesson plans, or digital artefacts used/produced by you. All intellectual property for the documents/artefacts provided to the researcher will be retained by you.

At the conclusion of the data collection period a focus group discussion for a cross case analysis day with the other ‘exemplary’ teachers – held on a mutually agreed date and a suitable location.

Data will be kept in locked filing cabinets and password protected computer files/environments and will be coded to ensure confidentiality. For the study purpose, your school and your name will be given pseudonyms to protect privacy. The data will be stored for five years from the date of last publication.

Digital images of the classroom will be used to support the written data in the analysis, interpretation and reporting of the cases. No participant will be identifiable from any images used in dissemination, unless their specific permission is obtained.

You will receive a copy of your case study from the thesis. In publications from the study, you will have the opportunity for your participation to remain confidential, or to have yourself identified. The published research will be a contribution to new knowledge in the area; it may be used to support the professional learning of teachers with technology/ies, and possibly enable further research in the area.

Thank you very much for considering this invitation, feel free to contact either myself (details below) or one of my supervisors should you require further explanation. The study has been approved by SERAP in the NSW Department of Education and Training.

Yours sincerely,

Jane Hunter
28 August 2010

Contact – E: j.hunter@uws.edu.au; T: 02 9772 6550; M: 0400 489 609

NOTE: This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval Number is H9247. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Research Ethics Officers (T: 02 4636 0883 or 4736 0854). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
TEACHER PARTICIPANT CONSENT FORM

PhD Study Title: Exploring technology integration in teachers' classrooms in NSW public schools

I ____________________________ (participant's name) agree to participate in the PhD study Exploring technology integration in teachers' classrooms in NSW public schools being conducted by principal researcher, Jane Hunter (T: 02 9772 6550) from the University of Western Sydney.

I understand that I have been identified as an 'exemplary' teacher according to criteria on the Information Sheet. The purpose of this research is to understand the nature of my technology knowledge for teaching, as well as my perception of technology in pedagogical decision making and what actually occurs in terms of my subject matter knowledge when I integrate technology into learning for the students in my classes.

I understand that data comprising written, audio (from interviews and focus group discussion), and photographic and private blog records will be collected by the principal researcher who will visit the school for a total of 5 days plus a pre-site visit. During this time the principal researcher will interview me three times, observe my lessons, speak with some of the students I teach and collect documents/artefacts from lessons/units of work. All intellectual property for the documents/artefacts provided to the researcher will be retained by me. I will also participate in a focus group discussion with other teachers in the study.

I am aware that any digital images of me, the school or my classroom will be used to support the written data in the analysis, interpretation and reporting of the research and that no participant will be identifiable from any images used in dissemination, unless specific permission is obtained.

I know that I can contact the principal researcher, or supervisors Associate Professor Geoff Munns (T: 02 9772 6449) and Dr Bronwyn Cole (T: 02 9772 8657) at the University of Western Sydney if I have any concerns about the research. I also understand that I am free to withdraw my participation from this study at any time I wish and without giving a reason. I agree that the principal researcher has answered all my questions fully and clearly. I agree the research data gathered from the study may be published in a form that does not identify me in any way if I choose not to have my name and school acknowledged.

This research has been approved by the NSW Department of Education and Training.

__________________________________________________ ___/___/

Signed by

NOTE: This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval Number is H 8247. If you have any complaints or reservations about the ethical conduct of the research, you may contact the Ethics Committee through the Research Ethics Officers (Tel: 02 4936 0863 or 4736 0864). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
PARENT INFORMATION SHEET

PhD Study Title: Exploring technology integration in teachers’ classrooms in NSW public schools

Your child’s teacher (name) is participating in a new study on understanding of how particular teachers integrate pedagogy, content and technology into learning for students in NSW public schools.

The research is to be undertaken by the principal researcher Jane Hunter, PhD candidate at the University of Western Sydney as part of the requirements of doctoral study. Supervision of this research and the subsequent dissertation, is being carried out by Associate Professor Geoff Munns (T: 02 9772 6449) and Dr Bronwyn Cole (T: 02 9772 6667), both academics in teacher education in the School of Education at the University of Western Sydney.

Inclusion of your child’s teacher in the study has been made on the basis of (teacher’s name):

- proficiency in using a range of technology
- use of technology daily in teaching and learning activity
- substantive contribution to professional learning in technology with colleagues in the school context and beyond
- past participation in trials and research using new technology; and
- being held in high regard by colleagues for their commitment to the teaching profession.

Jane Hunter will visit the school for a total of 5 days plus pre-site visit to gather data from classroom observations, interviews and focus groups for the study. It is possible that your child may be asked to join a focus group discussion (students will be randomly selected on the basis of equal numbers of girls/boys, range of academic abilities and diversity) on what it’s like to be in the classroom of a teacher who uses technology in learning. You are free to refuse your child’s participation without providing any explanation.

All data for the study will be kept in locked filing cabinets and password protected computer files/environments and will be coded to ensure confidentiality. For the study purpose, your school and your child’s name will be given pseudonyms to protect privacy. The data will be stored for five years from the date of last publication. Digital images of the classroom may be used to support the written data in the analysis, interpretation and reporting of the cases. No participant will be identifiable from any images used in dissemination, unless their specific permission is obtained.

Thank you very much for considering this information, feel free to contact either myself (details below) or one of my supervisors should you require further explanation. The study has been approved by SERAP in the NSW Department of Education and Training.

Yours sincerely,

Jane Hunter
….. June 2010

Contact – E: jhunter@uws.edu.au; T: 02 9772 8550; M: 0400 489 609
NOTE: This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval Number is H8247. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Research Ethics Officers (T: 02 4636 0883 or 4736 0884). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
PARENTAL/CAREGIVER CONSENT FORM

PhD Study Title: Exploring technology integration in teachers’ classrooms in NSW public schools

I ____________________________ (parent/guardian’s name) agree that my child ____________________________ (name) can participate in the PhD study Exploring technology integration in teachers’ classrooms in NSW public schools: towards a fresh pedagogical equation being conducted by principal researcher, Jane Hunter (T: 02 9772 6550) from the University of Western Sydney.

I understand that the purpose of this research is to understand how teachers integrate technology into learning. I understand my child’s teacher has been identified as ‘exemplary’ and as the parent of a child in that classroom I acknowledge the importance of further understanding what some teachers do when they effectively imbed technology into learning.

I understand that data comprising written, audio (from a focus group discussion), and photographs will be collected by the principal researcher who will visit the school for a total of 5 days plus a pre-site visit. During this time the principal researcher plans to select at random some of the students (Gr 3 only) for a focus group discussion on what it’s like to be in the classroom when technology is used for learning.

I am aware that any digital images of my child will be used to support the written data in the analysis, interpretation and reporting of the research and that no participant will be identifiable from any material used in dissemination, unless specific permission is obtained.

I know that I can contact the principal researcher, or supervisors Associate Professor Geoff Munns (T: 02 9772 6449) and Dr Bronwyn Cole (T: 02 9772 6667) at the University of Western Sydney if I have any concerns about the research. I also understand that I am free to withdraw consent for my child to participate in this study at any time I wish and without giving a reason. Such withdrawal will not affect my child’s academic progress. I have discussed this letter with my child and my child is willing to participate in the research. I agree the research data gathered from the study may be published in a form that does not identify my child in any way.

This research has been approved by the NSW Department of Education and Training.

______________________________   __/__/__
Signed by parent/caregiver

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TEACHER INTERVIEW QUESTIONS

PhD Study Title: “Exploring technology integration in teachers’ classrooms in NSW public schools”

The research schedule includes three rounds of interviews with each participant. Each interview (length – approximately 60 minutes) will be recorded on an audio player and then transcribed by the principal researcher. Once the transcription is complete the participants will have the opportunity to review and member-check the account.

What is provided here is an outline of the key themes for the questions to be covered in three semi-structured interviews. Probes are not included; the principal researcher will be responsive to the answers to posed questions and probe accordingly. It is anticipated that by the time of the final interview, there may be additional aspects that have arisen from classroom observations and document/artefact collection. A note about the planned cross-case analysis day with all teachers is on page 2.

Round 1 Interview

Part A - Teaching background – teaching experience, role in the school, stages and subjects taught, key people in the school that support your use of technology/ies, self appraisal of ‘exemplary’ status

For example

How long have you been teaching?
What is your role in the school?
Classes/stages/subjects taught?

Part B – Experience using technology/ies for both personal use and at school

For example

Describe what sparked your initial interest in using technology/ies?
What technology/ies do you use at home? and at school? frequency?
How have you kept your own technology professional learning current?

Part C – Understanding and conceptualisation of teaching and learning pedagogy, subject matter and the use of technology/ies.

For example

How would you describe your own teaching pedagogy? Knowledge of subject matter and approach to using and finding out about technology/ies?

Canvass the teacher’s plans for teaching and learning over the time of the data collection period.

Round 2 Interview

More in depth questions on pedagogy, subject matter and the use of technology/ies in reference to what the principal researcher has observed in the school/classroom context, but particularly this interview will cover the questions listed below.

Jane Hunter, University of Western Sydney, November 2010
For example:

How do you prepare for a lesson using technology/ies? What decisions do you make about the pedagogical approach and the subject matter you will cover?

Describe a lesson where you used technology/ies – this may also be a lesson that was observed by the principal researcher (what were you doing? what were the students doing? were there aspects of this lesson that you consider innovation or not being done by other teachers in the school or in your professional wider circle?) Was the lesson effective? Why? Did the lesson achieve the student learning outcomes you planned?

What role does knowledge of subject matter or content play when you integrate technology into learning for the students in your class?

How does your knowledge of subject matter link to pedagogical knowledge?

How would you describe the nature of your pedagogical content knowledge?

How would you describe your particular technology knowledge?

Does that technology knowledge change your approach to how you teach a topic, KLA or subject?

How do you think you have developed the technological pedagogical and content knowledge that enables you to effectively integrate technology into teaching your students? Is it unique or different to the teaching approach of your colleagues? Why?

Round 3 Interview

The final interview will seek to draw together issues/information or observations that have arisen over the data gathering period in terms of the key research questions.

For example

Is there something about your practice that could be shared more widely?

Explain.

Any additional reflections, attributes or moments you would like to share?

Note:

At this session each teacher will be provided with an initial summary of their case. Questions for the planned teacher focus group will be drawn from responses to the three individual interview questions. This conversation will support and strengthen cross-analysis; it will be recorded, transcribed and member-checked with the participants.
Three semi-structured interviews: XXXX
Length: approximately 50mins

Notes FYI.

The interviews will be recorded and when the transcriptions are done I will send them to you for member-check – so that you are happy with the accuracy and you can change/add anything you said on the day/s.

Round 1 Interview

Part A - Teaching background - covers your teaching experience, role in the school, stages and subjects taught.

How long have you been teaching?

What is your role in the school?

Classes/stages/subjects taught? Main focus?

Can you describe the class I am going to observe over the next week or so …? – what are some of its defining characteristics? Is there anything important for me to know about?

What did you study at university? Which courses do you remember? How much of your pre-service training do you use in your current approach to teaching with this class?

Do you belong to any teacher professional associations? eg PTA?

What sort of things made a “good teacher” when you were a student?

Why did you become a primary school teacher?

Self appraisal of ‘exemplary’ status - what do you think about that title? ie highly proficient, use technology daily, innovative/engaging approach to teaching and learning, supports the development of colleagues in the school, trialled new technologies previously - and participated in other research projects, held in high regard because of what you do in the profession and as a leader in your school.

Part B – Experience using technology/ies for both personal use and at school.

What is does the term technology mean?

Describe what sparked your initial interest in using technology/ies?

What technology/ies do you use at home? and at school? frequency?

How have you kept your own professional learning current? …. both in terms of technology, curriculum, pedagogy and new approaches to teaching and learning?

Jane Hunter, University of Western Sydney. November 2010
Part C – Understanding and conceptualisation of teaching and learning pedagogy, subject matter and the use of technology/ies.

How would you describe your own teaching pedagogy?

What about your knowledge of the subject matter you teach in each KLA?

How would you describe your approach to using and finding out about technology/ies (new)?

What is your philosophy when using technology/ies with students?

In your classroom there are number of technology tools – describe how you have learned how to use them. How would you describe your own level of expertise? Do you favour one over the other? Why?

Part D – Context

Who are the key people in the school that support you in your teaching approach with technology?

What are the main factors that support your use of technology?

Are there any factors that hinder what you are doing? eg adequate technology support …? 

Part E – Canvass the teacher’s plans for teaching and learning over the time of the data collection period.

Your plans for this observation week?

Round 2 Interview

More in depth questions on pedagogy, subject matter and the use of technology/ies in reference to what the principal researcher has observed in the school/classroom context, but particularly this interview will cover the areas listed below.

How do you prepare for a lesson using technology/ies? What decisions do you make about the pedagogical approach and the subject matter you will cover? What part do the various syllabus/es play?

Describe a lesson where you used technology/ies – this may also be a lesson that was observed by the principal researcher.

What were you doing?

What were the students doing? were there aspects of this lesson that you consider innovation or not being done by other teachers in the school or in your professional wider circle?

Jane Hunter, University of Western Sydney, November 2010
Was the lesson effective? Innovative? Why? Did the lesson achieve the student learning outcomes you planned? How do you assess the students’ use of the various technologies in your classroom?

What does the term content/subject matter knowledge mean to you? What were the key concepts you wanted the students to understand in this lesson?

When we talk about integration of subject matter into learning what does that suggest?

What role does knowledge of subject matter or content play when you integrate technology into learning for the students in your class? How do you decide that?

What is pedagogical knowledge?

Can you describe how your knowledge of the subject matter today links to your pedagogical knowledge? ie your pedagogical content knowledge?

How would you describe your particular technology knowledge? is it fluent?

Does that technology knowledge change your approach to how you teach a topic, KLA or subject? In for example …… something I saw today? Why did you decide on that approach?

How have you developed the technological pedagogical and content knowledge that enables you to effectively integrate technology into teaching your students? Is it unique or different to the teaching approach of your colleagues? Why?

Round 3 Interview

The final interview will seek to draw together issues/information or observations that have arisen over the week in terms of the key research questions.

Is there something about your practice is use of content, technology or pedagogy that could be shared more widely?

Explain.

Any additional reflections, attributes or moments you would like to share?

Note:

When all the data is collected I will ask you to come to a session with the other teachers in the study.

At this session each teacher will be provided with an initial summary of their case. Questions for this conversation will be draw from responses to the three individual interview questions. The conversation will support and strengthen cross-analysis; it will be recorded, transcribed and member-checked with the participants.

Jane Hunter, University of Western Sydney, November 2010

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Appendix B: Example of interview data (transcript)

INTERVIEW - 111021_001

Interviewer:
This is the second interview with G .... we're going to talk about Monday when I was in your classroom for the whole day. I'd like you to reflect for a moment on how you go about preparing for a series of lessons like the ones I saw on Monday.

Interviewee:
All right, so preparing for a series of lessons, firstly I think it's the content is driven by the syllabus, so we've got to teach certain things so it makes sense. And on Monday it was the two outcomes was physical phenomenon and investigations, so that the whole learning sequence. We sort of didn't do a lot on the investigation bit, but I was trying to get the students into thinking that what do scientists do? They do a lot of observing, looking, and hopefully we'll get to the bit of asking questions at the end of it. So the syllabus sort of drives the content. And then I try to think about how the students are going to learn that content, and I'm really - I think I explained it last time as well is that I'm really keen on students constructing their own knowledge. So, if you think of the physical phenomenon outcome for stage two, it's about energy, and understanding energy sources and forms of energy. And it could be really easy, we could do that in probably about half an hour in a classroom. Get it up on the board, write energy, I gave an example two seconds before you started recording. Yes, write the title up there, draw up your two centimetre margin, "Energy is .... these are different types of energy. Renewable energy is - does anyone know what renewable energy is?" A student might put their hand up, "Yes, that's solar panels". "Okay, we'll write that in". We might make a list, but at the end of the hour even, if it takes you an hour, I don't think the students would have had a really deep knowledge about what energy is. They would have had a really good understanding of handwriting and drawing margins, but not really taking on board what they've just written. I'd prefer if we did that at the end and I said to them, "Hey, now we've finished this unit, can you write everything you know about energy down?" I'm hoping that they'll be able to regurgitate or write their own understandings in of what energy is. So that's why the beginning of the lesson in that case was - and I do this often with topics like that, is that getting the students to think about how does this connect to me? And getting them to really - like asking them questions, getting them to work together, making lists, in this instance it was, so that they can understand where energy is used, what sort of machines use energy, what are systems? And because they're bouncing off each other, some of the groups, I think you noticed on Monday, were just sticking to the electrical stuff, and then someone said, "Oh look, there's different types of energy, hence the toilet machine or system". But yeah, it's that sort of thing, like getting them to - they've now learnt off each other. And then while I could retain that, because they've had a conversation about it, and they'll argue about it, there was - the other group was talking about batteries and whether or not was it a tap - is a tap electric or not electric? Well a tap is mechanical, and the students were arguing, and it's good for them to argue a little bit about it. And then they asked, "Okay, is it electric or non-electric?" And then you sort of scaffold the questioning: "So, okay, why do you think it's electric?" Well, you get hot water and that's why I think it's electric. And the other student's saying, "Well no, no, no, but the actual tap is mechanical". They're more likely to remember that conversation than if I'd gotten up on the board and said - well we probably wouldn't even have talked about taps and said, "Okay, well solar energy helps us heat our water" or something. They wouldn't have even considered that.

Interviewer:
They made that connection.

Interviewee:
Yes, whereas now they've connected it to something in their home.

Interviewer:
I think there was one child that said, "Is the human body a system?"

Interviewee:
Yes.

Interviewer:
Yes, so they actually even took it more broadly.

Interviewee:
Further, yes. Yes, so like the respiratory system. And I thought, “I didn’t even think of that, that’s awesome”. You know? So it’s connecting it to them so they’re understanding what a system is. So yes, when I’m planning I look at the syllabus and then I think about, “Okay, well how can I get the students to construct that knowledge for themselves?” And hence the asking of lots of questions.

Interviewer:
So in terms of that area of science, how would you rate your own subject matter knowledge of the physical phenomena of potential and kinetic energy? How do you prepare yourself to teach that?

Interviewee:
Okay, yes. Well, it’s one of my favourite subjects, which is really good, but yes, if it wasn’t, so if it was a HSIE topic or whatever, like I remember the first time I taught the British colonisation unit, I mean, yes, going through school you don’t get much of it, and when at uni doing HSIE they don’t actually give you the content, it’s just glossed over, it’s not deep enough in my view. So then, yes, I’d go on to the net and find out more information, go to the library and read up on it and stuff like that, because I think it’s important that I know where I need the students to get to. It doesn’t mean, necessarily, that I have to have all the answers, but if I’m expecting them to understand, say, at the end of a few days, or when we finish this unit, that there’s different forms and sources of energies and they need to be able to explain some of them, I need to have an idea of where I want them to go with that. Does that make sense? So they need to be able to explain it, I need to know. It doesn’t necessarily mean that I tell them that I know, hence the omnivores and the herbivores in the other lesson. Because, yes, I knew that it was an omnivore, but – I knew enough about the topic that there was in another name, so what’s the other one called? And if we’d gone with that further I couldn’t help myself in that lesson, it probably was not appropriate, but if – yes, if that was my class I’d say, “Oh, cool, that’s a really good question, I’m not sure”. And the point of that is that, yes, the question’s important, how are we going to find out? I know the answer, but – does that make sense?

Interviewer:
So the practice - when they do ask those questions, that practice of yours of putting up the question somewhere in the room, is that something you always do?

Interviewee:
Yes. And then eventually the students tell each other, “That’s a really good question, let’s write it up”. And they get into the habit of, “Okay, well we’ve got some time, let’s look up one of the questions.” That’s like one of the things you do in free time. Because there’s no such thing as free time in a classroom, really. It’s got to be purposeful.

Interviewer:
Exactly. Ok so that characterises your content, or your approach to content. Now let’s think about the pedagogical aspects of what you were doing? Was that fairly typical of what I’m seeing you do even in your role as consultant. So is that fairly typical?

Interviewee:
Of what I do in a classroom?

Interviewer:
Yes.

Interviewee:
Yes. If that was my class that I taught every day, and yes.

Interviewer:
You’d start the lesson off with the idea of gathering, and then ...

Interviewee:
Yes, I want to get them interested. If it was a really bland topic, and I can’t think of one right now, but we might get straight into the building or the making, just to get them interested, and then ask the questions later. So there was one topic, it was a science one again, and we were looking at the properties of materials. So I wrote the students a book about .... what’s his name?

Interviewer:
Newton?
Interviewee:
No, the egg guy. Newton, come on. The egg man.

Interviewer:
Oh the egg man, the egg man, yes, yes, yes. [Laughter].

Interviewee:
The egg man, did I tell you about him last time?

Interviewer:
No.

Interviewee:
Yes, I wrote the students a little sort of story book – I can bring it in and show you, it’s really good, hey, about the amazing egg man who worked in the circus and he was doing all these tricks and one of the tricks that he had to do was the cannon ball trick but he came out of the cannon and smashed, not good, so Dr Dumpyt came and put him back together.

Interviewer:
Oh, okay.

Interviewee:
So that was okay, but he didn’t want to get hurt again, so the students had to create a contraption that would allow him to be shot out of something without him breaking. So I would start with that and just get the students to go for your life, build something, and then we’d go back, “Okay, why is it working, why is it not working, how can we make it better?” And go that way. If it was – does that – yeah. It’s the same sort of thing with one of the hitty topics, I think it was a stage one or stage two where you look at community, so I’ve got the students to design their own town, go for it, design it. And obviously when they design it – I mean, it gives you a gauge as well where the students are at in their thinking, but when they design it they don’t think that, “Okay, well maybe it’s not a really good idea to have the hospital next to the garbage dump”, or they might not even think of putting the garbage dump there, so the rubbish just goes who knows? You know? So getting them to design, that gives me an idea of where they’re up to, and then asking the questions after and getting them to redesign and work backwards sometimes.

Interviewer:
So you’d throw them in the deep end?

Interviewee:
Yes.

Interviewer:
Yes, with a topic. Or a concept, yes.

Interviewee:
And it’s sort of what we’re doing now with …

Interviewer:
And work backwards from that, yes, okay.

Interviewee:
Yes, and it’s almost like a project based learning type of model, so you start off with the big question, or this is where we’re going, and then you sort of fill in the details as they go. And it helps – it sort of flips the learning, in a way, because you’re not starting off with, “Okay, this is everything you need to know, and this is why it’s going to be useful, because you’re going to do something at the end”. As opposed to, “Okay, this is what we’re going to be building, so we’re going to build the best model car, so we’re going to need to know something about energy, so let’s learn about energy first so then we can build the car. Let’s look at how other toys work so we can build the car. Why is it important that I’m looking inside this toy, or pulling it apart? Does that make sense? So then they’ve got a purpose at the end.

Interviewer:
Yes, no, that does make sense. So just in terms of that, you know, like I saw you use a lot of different technologies in that lesson on Monday.

Interviewer:
Screwdrivers, yes.

Interviewer:
So, from your perspective, what were they? You know, how did your technology knowledge inform what you were doing … how would you describe your technology knowledge?
Interviewee:
Yes, it's pretty good. How would I describe my knowledge? Yes, well I know how the things work, and yes, I've got an interest. Is that enough? Ask me more questions.

Interviewer:
Okay, yes - it is pretty good, it's jolly fantastic.

Interviewee:
Well I know about shift and control keys. What .... okay, go on. [Laughter]

Interviewer:
So ... you integrate so many different technologies - is that a deliberate ploy - I mean, you actually had the whiteboard with you ... you were doing a lot of diagram work. You were then using your Mac to - can you just describe what you thought you were doing?

Interviewee:
Okay. What was I doing? It's just the way that a classroom functions. They're tools that we used. I guess it comes back to the tool, that they're just tools that we use depending on what I want to do. Like I needed to show the students - I wanted them to - see the diagrams, so we drew diagrams, I think one of them was just ...

Interviewer:
You do that a lot, yes.

Interviewee:
... the solar thing, I think it gives better understanding - I find it really easy to - I think in pictures sometimes, and I find it easy to understand things when I see a picture. So I might read something and I'll draw the picture and that will help me, or I'll mind map it or something. So I think it gives the students another way of understanding what I'm saying, so it's not just me saying, "Okay, well" - I think it was the solar energy we were talking about, how the hot water gets heated up.

Interviewer:
In the shower you had - yes.

Interviewee:
Yes, if I'm talking that, some of the students will pick it up, but then if I talk it and I draw it, a few more students will pick it up, and if we make some sort of odd remark about the guy singing in the shower or something I think it becomes more memorable as well, so it's like next time they go into the shower or they hear about someone singing in the shower they think, "Oh yes, hot water, yes solar energy, oh yes, I remember that lesson, I remember how that works!" Does that answer your question?

Interviewer:
So they're almost like mental cues, aren't they, based on a visual, yes.

Interviewee:
Yes. And it gives the students another way of accessing ...

Interviewer:
Because then you actually then required the students to go and draw their own diagrams ... and film it.

Interviewee:
... the model guided and independent stuff. So, I've got to model it first before I can expect the students to do it. I can't just say, "Hey look, now you're going to draw a diagram." Like what, what's a diagram? How do I draw it? Is it a picture? What is it? What's it look like? I probably could have done a bit more on doing more explicit sort of criteria of what the diagram should look like, what should it include and that sort of thing, like in hindsight. And I probably would have done that if the time constraint, the two days is just stressing me out a bit.

Interviewer:
Yes. Hmm.

Interviewee:
So, I mean, we would have done the explicit - that's where the explicit lesson comes in, so when the students can explore - that they've got a purpose for listening to - drawing a good diagram. And then they're more likely to listen and pay attention. Whereas if we just started the lesson off and said, "Okay, well this is how you draw diagrams", it's not connected to anything, there's no purpose. Yes, whereas now they've got a purpose, hopefully. They've got to draw the diagram.
of their final car, and animate it on the computer, so that someone else can actually build the car. So there’s a purpose.

Interviewer:
So were there particular aspects of that lesson that you thought were quite innovative, or not?

Interviewee:
I think the fact that I handed over the cameras — a few more teachers are doing that sort of thing, but in terms of technology you’re talking about, yes?

Interviewer:
Yes.

Interviewee:
I think I do a lot of letting the students explore and find out and I mean it’s hard work for the teacher to be able to answer a question with a question, but yes, I try to be that guide on the side. You know,... what’s his name, Vygotsky? That zone of proximal development; so the students are there, they’re looking, they’re observing, and it’s my job to be there to ask the right questions so that what they’re observing is creating some sort of construction in their heads.

Interviewer:
Yes, so question asking. Is it important that those questions are recorded, like you were saying before, but that you’re consciously asking questions and you — so do you try to answer a question with a question sometimes?

Interviewee:
Yes. So, if you have a look at — one of the groups, it was Oni’s group, the student with the ‘rip cord’ with the elastic band.

Interviewer:
Yes, the whirligig, yes.

Interviewee:
That group, they weren’t quite sure where they were going, and why they’re looking at what they’re looking at, and then it’s — I could go in there and say, “Hey, look at this. This is what you’re supposed to be looking at, this is what it does.” But it was — I tried to sort of go there and say, “Okay, well let’s pull it apart. Let’s have a look at how it works. What happens?” Okay, and one of them, “Okay, you pull the thing and something happens and it spins off.” Why is it happening? Let’s have a look at it. So I’ll hold it, you have a look at it. As opposed to me just telling them the answer. I really want them to have a look at it and try and find the answer for themselves.

Interviewer:
So why are you doing that?

Interviewee:
Because it makes the independent learners, so they learn how to learn.

Interviewer:
So is learning how to learn... Important?

Interviewer:
Yes.

Interviewee:
Yes. Because there will be — it’s learning how to learn, and being able to internalise. If you know it for yourself, hopefully if one of those students in that group says, “Okay, well it’s the elastic band and we twirl it around and then when you let go it spins it because it’s got energy, and then the energy changes to moving energy”, then they’re more likely to remember it. If I just want up there and said, “Okay, the energy changes from this energy to that energy, that’s what’s happening”, I mean, they’re not going to remember it. And learning how to learn, asking those questions, is important otherwise — sort of, I don’t want to get philosophical, but that’s the whole point of education. Our jobs aren’t just to produce people that know certain facts and figures, our job is to produce students that can ask the good questions that will solve major world problems, you know? And we’re talking food crisis, energy crisis, the rest of it, we need students or a generation of students that will ask the question and say, “What if we try this? Or what if we try that?” If they’re not asking those questions, they’re not going to find the answer.

**The interview continued for another 20 pages, and ranged across PCK, TK and TPACK.**
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<td>Data about the teacher – what does she know/do?</td>
<td>Data about students – what are they doing?</td>
<td>What it can look like?</td>
<td>Examples of practice</td>
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</table>
| Content Knowledge/Tasks          |                                                 |                                            | • Teacher knows the actual subject matter that is being taught  
• Tasks are positive and allow all students to demonstrate what they know and can do but also challenge them to learn more  
• Students are encouraged and helped to see the connections between content of the lesson, technologies being used and the teachers pedagogical approach |                     |
| Technology/ies used              |                                                 |                                            | • Teacher is fluent in ICT  
• Solves their own/students technology problems                                                                                                                                   |                     |
<p>| Integration                      |                                                 |                                            |                                                                                                                                                                                                                       |                     |</p>
<table>
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<tr>
<th>Components</th>
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<th>Data about students – what are they doing?</th>
<th>What it can look like?</th>
<th>Examples of practice</th>
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**MAIN OBSERVATION/KEY IMPRESSION OF THE LESSON**

Observation and Reflection Guide
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<td>Technology/ies artefacts eg IWB, laptops, digital cameras</td>
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<tr>
<td>Student material eg written reflections, portfolios, works samples</td>
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</tbody>
</table>
Cross case analysis day at Fairfield RSL on 7 November 2011

14 Anzac Avenue, Fairfield; T +61 2 8707 0230

The purpose of the day is for you to reflect on your work and what appears to be common and contextually different in your pedagogies. It’s important that we focus on what is rather than what could have or might have been!

AGENDA

<table>
<thead>
<tr>
<th>Time</th>
<th>Item</th>
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<tbody>
<tr>
<td>9.30</td>
<td>Coffee and tea on arrival – meet n’ greet</td>
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<tr>
<td>10.00</td>
<td>About the day</td>
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<tr>
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<td>Teachers – sharing my teaching story so far</td>
<td>20 mins</td>
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<td>Within case analysis</td>
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<tr>
<td></td>
<td>Presenting the 7 big themes for each teacher – points for discussion – can they be synthesised?</td>
<td>40 mins</td>
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<tr>
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<td>Grab some tea/coffee/cake</td>
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<tr>
<td>11.15</td>
<td>What is common and what is different?</td>
<td>75 mins</td>
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<tr>
<td></td>
<td>Is there anything new here? Or has something been missed?</td>
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<tr>
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<td>Themes – let’s code them!</td>
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<tr>
<td>12.30-1.15pm</td>
<td>Lunch – eat and a walk?</td>
<td>45 mins</td>
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<tr>
<td>1.15-3.30pm</td>
<td>Specific examples – tell a pedagogical story</td>
<td>40 mins</td>
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<td>Theory – link themes to the model TPACK – is it in the data? Is more going on that this? Hypothesis? Explanations?</td>
<td>35 mins</td>
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<td>The research question</td>
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<td>3.30pm</td>
<td>Hand back case summary notes to Jane. End of the day – thank you again for coming! Phew...!!</td>
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Appendix D: List of original open/first level codes

Tree Nodes

- **Knowledge - TPACK model**
  - Content
    - APP
    - Assessment
    - Curriculum Knowledge
  - Pedagogy
    - Knowledge of learning
    - Learning in community
    - Philosophy of learning
    - Role of the teacher
      - Mentor as teacher
    - Reflective practice
    - Thinking about learning
  - Technology
- **Beliefs**
  - Philosophy
    - Emotional response
      - Aroused
      - Under aroused
  - Focus group nodes
  - Initiatives
    - Teacher professional learning
      - QUEST
  - **Learning**
    - Challenges
    - Expectations
    - Style
  - **Professional background**
    - Collegial support
    - Outside support
  - **Student autonomy**
    - Values
  - **Teaching**
    - Challenge
    - Skills
  - **Technology**
    - Changes
### Tree Nodes

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### Planning for programming by starting with assessment design

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<td><strong>Context:</strong> teacher(s)</td>
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<td><strong>Assessment due by:</strong></td>
<td><strong>What do we want our students to learn? (Deep knowledge element)</strong></td>
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<tr>
<td></td>
<td>Must be guided by syllabus content (not indications and foundation stage statements).</td>
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#### We want students to know that (BIG IDEAS):
Students identify various forms and sources of energy and identify ways in which energy causes change.

Students independently implement aspects of a scientific investigation, such as observing, questioning, predicting, testing, recording accurate results, analysing data and drawing conclusions. They demonstrate an understanding of a fair test and identify variables. Students select and safely use equipment, computer-based technology and other resources throughout the processes of investigation.

#### Links to Foundation/Stage Statements/Outcomes
- K-6 teachers refer to Foundation Statements towards the back of your subject document.
- 7-10 teachers refer to Stage Statements towards the back of your subject document.

#### This learning matters because:
Climate change and the energy crises are current, relevant and real issues in the students’ world. They are real problems. Students need to be aware of the energy sources that power the life they are comfortable in. It is also important for students to understand that there are alternative energy sources to non-renewable and polluting fossil fuels. This unit will provide the early understandings required by students in energy to solve the world’s energy challenges.

The unit will also introduce the investigative process so students will question and begin to think scientifically which is important in solving the world’s energy challenges.

#### Assessment task outline
Students will produce a multi-modal task that will teach other year 4 students about a form of energy. The task will also demonstrate the investigation they carried out on a toy powered by a particular energy form. For the students will need to develop a question regarding an energy system that they can investigate using the scientific process.

After considering the issues of battery pollution, students are to build a model car and investigate the best alternative to powering that car. They are then to develop a multimedia task that includes the plans and an explanation for other students to be able to build that car and understand how it works using the correct language of energy and investigations.

As a minimum the students’ cars should travel 3 metres within a 1 metre track and should be made mostly of recycled or recyclable cardboard material that can be easily found in the home. The cars need to be powered by something other than a battery and an electric motor.

#### Key outcomes for assessment
- PYP 5.1.4 Identifies various forms and sources of energy and devices/systems that use energy.
- NVQ 5.2.2 Conducts investigations by observing, questioning, predicting, testing, collecting, recording and analysing data and drawing conclusions.

#### Assessment criteria
- Students understand that:
  - Energy can exist in various forms e.g. movement, electricity, light, sound, heat.
  - Systems need an energy source in order to function, e.g. food for the body, petrol for the car.
  - Systems, like our body, use energy when they are working.
  - The student:
    - Poses “what if” questions, e.g. what if the motor was not moving.
    - Identifies, with guidance, the types of measurements and data to be collected and decides how to do this and with whom.
    - Records data in an appropriate form and works out trends or patterns in the collected data.
    - Reports to others, using simple fact sheets that have been chosen in consultation with the teacher, e.g. information reports, procedures and explanations.
    - Suggests improvements to procedures.

Unit prepared by: 2021 ©
Planning for programming by starting with assessment design

Program Plan

Summary of core components

Map the core knowledge and skills we need to teach to the students to order for them to successfully engage in the planned assessment.

In doing so, have we identified the syllabus content (NOT INDICATORS) we will be teaching in order to meet the assessment outcomes?

Component 1
Introduce the task and build interest.

Show powerpoint video regarding battery rubbish and toxicity. Give statistics of use.

In table groups students write down everything they know in their frames that are on batteries — alkaline and non-alkaline, rechargeable or otherwise, e.g., toys, but also computers, phones, cars, premise DVD players, lawn mower etc.

Discussion: That is a heap of waste. So it appears we have a problem? What do you think the problem is?

This problem: We have so many things that use batteries. We are throwing these things, but we are throwing all these things, but we have to do something about it.

Your challenge over the two days that we are working together will be to build this. We have 15 model cars that run on clean energy and to document all your findings using the computer. We’ll then use all the ideas you produce to build websites for other students in your school and from around Australia and the world to see and to learn from.

We will discuss what BEST means a little later but for now we need to find out a little bit more about energy and what makes our lives go.

Resources
- battery paper
- videos
- powerpoint list

Component 2
What makes this toy go?

- Model one toy and tell a bit about it together. Use a battery-powered toy. Draw a labelled diagram showing displaying the processes.
- Chemical energy in the battery creates electricity which moves the motor in the toy and the car moves.
- Battery dissection whole class
- World websites

- Write topic words on class.
  - energy
  - power
  - source
  - chemical
  - heat
  - light
  - electricity
  - scene

Component 3
Assessment outcome:

- In groups of 4 students build model car that is powered by energy source and create a report on energy.
- rubber band car analysers — show rubber band potential to spin things.
- balloon car analysers — Show balloon on string and explain.

Students need to design their car and make it using the pictures on a grade.

They need to cut out what powers the car. Where does the car get its energy? How does the car work? Draw a flowchart/decimal diagram with labels and images showing the process.

Model to students how to calculate their diagrams — fill down the table and then using these numbers and input this into the model. The first extension is to convert this into word files.

Groups take turns to the computer room to do this. Modelling of all ideas using spreadsheet may happen during lunch break on Monday morning as an explicit skills lesson.

Solutions: Ask a group of the two or three that are the most successful to demonstrate their cars.

Resources
- pictures for rubber band powered cars
- pictures for balloon powered car
- scissors
- rubber bands
- balloons

Unfilled prepared by

2011 ©
Planning for programming by starting with assessment design

Component 1: Developing Quality Criteria
- Recap: we've looked at energy, batteries and alternative ways to make a model car go. Now we need to figure out how to make the BEST model car.
- If our car is the BEST model car how will we know? Ask the students. Have them discuss in a group.

Keep in mind...
- It is provided by an alternative energy source
- Can travel at least 3 meters within a 1 minute span
- What else?

Resources
- Markers and paper to write criteria

Component 2: Investigating Alternative Power Sources
- Introduce the concept of investigations - asking good questions. Ensure students understand the connection to their work. Make the connection to scientists and engineers.
- Show them the steps of conducting a scientific investigation.

Show Multibeam video of battery investigation
- Students build solar car kits in their groups. Discuss what makes the cars go as a class.
- What might make them go faster? What can we change? How can we test if the test is fair? (show pushing and pulling string etc. as example of fair test if students are unfamiliar)
- Model writing one investigation up on the scaffold. Students hypothesise - write their hypothesis down and stick it on the front scaffold.
- Conduct investigation. Come to a conclusion.
- In their groups students try out their own investigations on the solar cars and write it up on the scaffold and then test their hypotheses.

Resources
- Multibeam battery video
- Bell and a scientific investigation
- Investigation scaffold large copy
- Copies of investigation scaffold for groups
- Solar power kit for each group
- Micro box cars

Component 3: Communicating the results
- Explain view scientific not only to students but also need to communicate their results and conclusions. Imagine if they didn’t? How would we know about their discovery. Scientists may write a book, magazine article, or a speech.
- What we are going to do is create a short documentary explaining to others what our investigation was, how it was done, and what we learned.

Stages of a science magic video by students
- Develop a short video
- Discuss the parts of the video.

What do we know in our video? Discuss with students and come up with a list.
- Title: about the investigation
- What the hypothesis is
- Results
- Conclusion
- Evaluation of investigation
- Might include diagrams
- People talking
- Photos with viewers

Students develop and test around 12 students
- As this is the first time working with this group with movie making it is envisaged that this process will be resource intensive.

Component 4: Evaluation
- Final comments
- Students write a reflection about their learning about energy and record this using the tip top format.

Prompt questions if required may include:
- What do you know about energy?
- What are some sources of energy that you know about?
- What does energy do?
- Explain how you have used energy in your investigation.

Resources
- Trip checker

Component 5: Model Car Challenge
- In their groups students consider the alternative powered cars they built earlier.
- Students hypothesise about how to make it the BEST model car. Students write up their investigation using the scaffold and then test the hypotheses.

Resources
- Instructions for solar hand powered cars
- Instructions for balloon powered cars
- Copies of investigation scaffold for groups
- Straws
- Tape
- Rubber bands
- Tissues

Component 6: Web Design
- Each group or a small group chooses a web designer to develop the two page website. Students brought about their hypothesis.
- Students used Web 2.0 tools to develop their websites. Appendix on student website to these tools.

Students use their websites to the students the websites they have created during the 2 days of learning.
Appendix F: Sample of a Red Slip used by Kitty

RED SLIP

Yr 9 History Period 5

31st May, 2011

Today’s objective: New blogED The Gallipoli Campaign. Enter the blog and go into ‘Recruiting for the War’. Study the post, and read the information beneath it. Five minutes only and sign into SRN client as soon as possible.

Homework: complete the question in that blog about the European rival power blocs. Then visit the 2nd post in The Gallipoli Campaign blog and answer the questions about the War Memorial.

- Parameters:
  - Stay on task (no multi-tasking)
  - Turn off your mobile phones and put in your bag. Take headphones out of our ears and put in your bag
  - Check the blog for testmoz URLs and further instructions and homework