TECHNOLOGICAL PEDAGOGICAL REASONING

The development of teachers’ pedagogical reasoning with technology over multiple career stages

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DEDICATION

This thesis is dedicated to the memory of my father (Mr Ronald Andrew Southern) who provided the inspiration to achieve great things, but sadly did not live to celebrate the completion of this thesis.
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merely to listen and provide the sounding board to allow me to think out loud and your willingness to review my work on many occasions.

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**Arriving at one goal is the starting point of another.**
ABSTRACT

Professor Lee Shulman (1987b) introduced a view of teaching that encompassed a series of six steps: comprehension; transformation; instruction; evaluation; reflection and new comprehension, which he termed pedagogical reasoning. He suggested an image of teaching as the exchange of ideas from the teacher, who must comprehend an idea to be able to shape and tailor it, in order for the student to grasp and understand the idea. This complex interplay of judgment and action is at the heart of pedagogical reasoning. Since 1986, there have been very few published research studies that have either tested or reported the use of Shulman's Model of Pedagogical Reasoning and Action to describe the realities of teaching. It could be suggested that many researchers could not move beyond referring to Shulman's other important contribution in proposing pedagogical content knowledge (PCK). What they seemed to have missed was how Shulman proposed that PCK was developed through the processes of pedagogical reasoning.

Shulman provided limited insight into the teachers studied as part of the Knowledge Growth in Teaching project undertaken at Stanford University. Those teachers were described in limited vignettes where Nancy, Colleen, Judy, Alan, George and Frank (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) were portrayed to help in understanding the intricacies of pedagogical reasoning. This study attempts to revisit Shulman's original work to understand how current teachers pedagogically reason, and, in particular, to understand the impact of digital technologies on their pedagogical reasoning. This research project used Shulman's view of teaching as a theoretical starting point to pose the question: How do teachers pedagogically reason with digital technologies?

The methodological approach taken for this project was a multiple case study that was underpinned by a qualitative frame based on a constructivist-interpretative paradigm. Seven competent digital technologies using teachers from differing year levels and subject areas were recruited to participate in this research project. Their pedagogical reasoning was explored through predominantly self-reported data.
accessed in the form of video-stimulated recall interview and think-aloud concept mapping interviews and they granted access to digital portfolios they had prepared. The methodology and design of the study were based on descriptions of practice to understand their pedagogical reasoning. Analysis of the data drew on the qualitative methods where themes were identified through a process of data reduction, where restories of practice were constructed to provide a view of their teaching practices.

The study revealed that Shulman’s view of pedagogical reasoning was not as simple as first proposed. These teachers comprehended their content from a wide array of digital technologies to understand what they needed to teach. Transformation was different for the teachers who started with the prepared curriculum materials, as they only needed to select and adapt these for their students, while teachers without the prepared curriculum tended to move around selection, preparation and representation as a combined process, not as Shulman had proposed of being separate. All of the teachers used digital technologies in creative ways for teaching and/or learning where many aspects of their instruction and evaluation were impacted by the use of digital technologies. They highlighted that reflection occurred at various places after instruction and new comprehension impacted all pedagogical reasoning processes and were not the last step in the process as suggested by Shulman. As a consequence, this study proposes a new model to represent how these teachers pedagogically reasoned with digital technologies.

To further explore pedagogical reasoning with digital technologies, the seven participating teachers were grouped according to their career stage. Donnatella, Drago and Viviana were new to teaching, and so they were described as ‘beginning’. Carmelina and Florentina together had over forty years of experience and they were described as ‘experienced’. What set Alessandra and Marcelia apart was that they were responsible for leading a change in digital practices at their schools, thus they were described as ‘lead’. To understand the development of pedagogical reasoning across the three career stages, the data highlighted the significant influence of knowledge of digital technologies. All teachers suggested that there were a number of internal and external factors that enabled them to pedagogically reason with digital technologies.
STATEMENT OF ORIGINALITY

I certify that this work entitled Technological Pedagogical Reasoning – The development of teachers’ pedagogical reasoning with technology over multiple career stages has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Signed: Vicky Smart

Date: 29 January, 2016
LIST OF PUBLICATIONS AND PRESENTATIONS

B1 – Book Chapters – Authored Research


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**E3 - Conference Publications (Extract Paper)**


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CHAPTER 1: INTRODUCTION

This chapter

This first chapter describes the educational contexts in which this study was situated to provide an understanding of the motivations and background to the study. To begin, this chapter presents the research aims and research questions leading to a discussion of the context. This study is situated in Queensland, Australia where there has been a number of state and national digital technology initiatives designed to help teachers integrate digital technologies in the classroom. The significance highlights the challenges that teachers face when thinking of teaching and learning with digital technologies and describes the path the researcher took in understanding the significance. Before progressing into the thesis, a definition of digital technologies is presented with the chapter concluding with an overview of this thesis. To begin, the aim and research questions are presented in the following section.

The Aim and the Research Questions

The aim of this study was to closely explore the experiences of seven practicing teachers as they pedagogically reasoned with digital technologies in their specific teaching context; in order to gain insights into the nature of and influences on their pedagogical reasoning. This thesis presents eleven stories or restories, as they have been termed here, that were developed from the data collected from the seven teachers. Each restory captures the complex influences on the decisions made by the participating teachers as they integrated various digital technologies in their teaching. In this study, a more intimate understanding of the pedagogical reasoning used when teachers integrate digital technologies is provided. Such understanding clarifies the complex nature of teachers’ work and through these restories it is anticipated that support and facilitation can be given in appropriate ways to understand the varying contexts. The study provides evidence of how change is occurring and the ways in which teachers are progressing learning through their commitment to their own professional knowledge growth.

Their stories that have been captured in their classrooms where the participating teachers have been asked to explain why and how they have used digital
technologies in their teaching and in student learning – that is they have been asked to explain their pedagogical reasoning. The seven participating teachers were all state employed teachers, in different teaching contexts and at different stages in their careers. The teachers’ contexts range from early childhood to secondary classroom settings. Their stories include a range of subject topics.

This study is timely because this project seeks to understand how teachers reason with digital technologies and what influences them to use digital technologies in their teaching. The purpose of this study was designed to reveal the voices of teachers at multiple career points to determine how they develop technological pedagogical reasoning. This will be explored using three career stages conceptualised as, early career, experienced and lead. Donnatella, Drago and Viviana, the early career teachers, were new to teaching. Carmelina and Florentina had been teaching for many years and were termed the experienced teachers. Alessandra and Marcelia were lead teachers in their schools, with responsibility to affect change in how digital technologies were used for teaching and learning.

The research project seeks to address the following research questions:

RQ1: How do teachers pedagogically reason with digital technologies?
RQ2: What are the differences in pedagogical reasoning with digital technologies across three career stages?
RQ3: What influences teachers when they pedagogically reason with digital technologies?

Context for the study

Rapid advances in digital technologies have resulted in major changes for many of us in many aspects of our lives from listening to music, watching movies, ways of interacting with friends and managing our finances. Many would claim that accessing digital technologies simplifies our daily living. For many teachers, the introduction of digital technologies into teaching and learning is a formidable challenge that forces them to rethink how they can use digital technologies in their teaching and to help their students engage in learning. To understand the context in which this study was situated, the following section describes the digital technology initiatives that
have been implemented within Queensland and nationally across Australia, to help teachers and schools implement digital technologies.

Queensland digital technologies framework

In Queensland, over the last decade, there had been a major technology program designed to support teachers in using digital technologies for teaching and learning. Known as The SMART Classrooms strategy, this evolved from an earlier ICT for Learning strategy. At the policy launch, the then Premier announced that students in primary and secondary schools needed “smart classrooms” because they were the “first generation to grow up surrounded by and using ICT” (Education Queensland, 2005, p. 3). The strategy provided various initiatives designed to build “a cohesive future-focused mix of products and services for schools to teach, manage, learn and innovate with new technologies” (Education Queensland, 2005, p. 2). A key illustration of the strategy used the Rocket Ship as a visual metaphor where the SMART Learner was placed in the cockpit (see Figure 1.1).

Figure 1.1 - SMART Classroom strategy – Rocket ship (Education Queensland, 2005)
The illustration of the rocket ship highlights the components of the SMART Classrooms strategy supporting the Smart Learner (Eden, 2012). The first component, shown at the bottom of the rocket ship, included the implementation of an Enterprise Platform across the state. The second component was OneSchool, a single online school system managed centrally for all schools that included: student management including behaviour management, student assessment and grading, timetabling and planning and assessment materials. The third component, Digital Learning Materials, included the Computers for Teachers (CFT) where teachers were provided laptops and a suite of digital resources. The fourth component, the digital pedagogies strategy included the SMART Classrooms Professional Development Framework (SCPDF) where teachers were encouraged to complete a tri-level accreditation digital portfolio process. Finally, the fifth component was Learning Space which included the development of a central website for a wide range of educational digital resources, professional learning communities and the learning management system for the creation of virtual classrooms. The illustration emphasized the interdependency of each of the elements, with each component relying on the others for collective success of the strategy. Also, the rocket ship illustration highlighted all of the stakeholders involved including: teachers; administrators; school support; parents and guardians; communities; and students.

A national project that determined the curriculum goals was the Australian Curriculum and it was designed to cover predefined subjects across all year levels. The government passed legislation to establish the Australian Curriculum, Assessment and Reporting Authority (ACARA) to develop and administer a national school curriculum, including content of the curriculum and achievement standards, for school subjects specified (Australian Curriculum Assessment and Reporting Authority, 2011). ACARA’s mandate included the development of the curriculum for each learning area that was based upon a continuum of general capabilities, including literacy, numeracy, creativity and ICT skills. The Australian Curriculum began implementation in Queensland schools in 2012 (Queensland Studies Authority, 2011).

To assist state employed teachers in the implementation of the Australian Curriculum, a Queensland project was established to develop materials for all teaching units across the year levels of Pre-school to Year 9. This project was called the Curriculum Into the Classroom. The project involved teams of teachers who were
given the role to develop for particular subject areas, “a comprehensive set of whole-
school and classroom planning materials for single level and multi-level classes,
students with disability and for students who study through the schools of distance
education” (Department of Education and Training, 2015). The materials included
planning documents and associated resources incorporating the use of digital
technologies. All schools were encouraged to use these state curriculum materials to
facilitate the implementation of the Australian Curriculum requirements.

Australian policy framework

There has also been a national policy to boost digital technologies use in
education titled the Digital Education Revolution. This national policy aimed to:

*contribute sustainable and meaningful change to teaching and learning in
Australian schools that will prepare students for further education, training
and to live and work in a digital world <where> educators require the
pedagogical knowledge, confidence, skills, resources and support to creatively
and effectively use online tools and systems to engage students* (Department
of Education Employment and Workplace Relations, 2011, p. 6).

One key principle suggested in the Digital Education Revolution Roadmap, was that
“educators require the pedagogical knowledge, confidence, skills, resources and
support to creatively and effectively use online tools and systems to engage students”
(AICTEC Committee, 2009, p. 6). The Digital Education Revolution included many
programs to support the development of digital learning materials, improved school
facilities and funding for student computers.

A further impetus for teachers to change their teaching practices to use more
digital technologies, was the introduction of *Australian Professional Standards for
Teachers* (AITSL, 2011). Until 2011, Australia did not have a national approach for the
definition of quality teacher standards and teacher registration. In 2010, the *Australian
Professional Standards for Teachers* were endorsed by all Australian and State and
Territory Ministers for Education as part of their agreement of the Ministerial Council for
Education, Early Childhood Development and Youth Affairs (MCEECDYA) (AITSL,
2011). MCEECDYA rationalized that the agreed standards describe what teachers
should know and be able to do at appropriate career stages.

MCEECDYA delegated responsibility for implementation of the professional
standards to The Australian Institute for Teaching and School Leadership (AITSL).
AISSL, in consultation with teachers, defined the standards in terms of the three domains of teaching: professional knowledge, practice and engagement. The professional standards "are a public statement of what constitutes teacher quality...<they> capture the nature of teachers’ work by articulating the abilities, knowledge, understandings and values of teachers requires as student and societal expectations of schooling change" (AISSL, 2011, p. 2). The implications of implementing the professional standards fell on state based teacher education authorities across Australia with pre-service teachers showing competence for graduation and teacher registration. For in-service teachers, the professional standards now provide the framework for annual performance reviews and professional development. Clearly, there has been a major state and national investment in providing resources and tools for teachers.

Significance of the study

This study is framed by the researcher's values, which have been shaped by beliefs in using digital technologies for teaching and learning, her previous experience as a teacher in using digital technologies and from her experience of working in the Queensland state education system. She has worked as a teacher at some of the schools included in this research project alongside some of the participating teachers. This allowed her access to be able to recruit them and negotiate entry into their classrooms for the purpose of research.

After many years working as a technology consultant, she decided on a career change into teaching. She completed a Graduate Diploma of Education and commenced teaching in the Queensland state education system. From the beginning, she has been a digital technologies using teacher and advocating for the use of digital technologies with her peers and her students. When she first started teaching, she was surprised to work alongside teachers who did not understand little alone use digital technologies in teaching or learning. The researcher became interested in why digital technologies were not being used in the classroom, when there was an abundance of digital technologies becoming available within the state education system and other accessible over the Internet. Being part of the state education system, the researcher participated in many state based programs and had received a Computer for teacher's laptop, used available digital technologies in the classroom, used virtual classrooms
with students and video conferencing for distance education, as a few examples of her digital technologies use. She also participated in the Smart Classrooms Professional Development Framework where she completed both the ICT Certificate and Digital Pedagogical License. By completing her own digital portfolio she saw how it provided a rich insight into teachers’ thinking and as a consequence, informed her to include these digital portfolios in her data collection strategy. For the duration of this research project, she has continued working as a digital technologies using teacher employed in the state education system.

In exploring the links between research and practice, the researcher discovered the work of Professor Lee Shulman and his Model of Pedagogical Reasoning and Action (MPRA) (Shulman, 1987b) and she deliberated how relevant it was to her teaching with digital technologies. Initially, she found that Shulman’s work focused on the Knowledge Base for Teaching and this dominated the research discussion. This highlighted the limited work investigating pedagogical reasoning as discussed in Chapter 2 - The Literature Review. To better understand Shulman’s MPRA, a visit to Stanford University to access Shulman’s personal files (Shulman, 2010), the reports from the Knowledge Growth in Teaching Project and the paper version of some of his students’ thesis was needed. While there, she was given the rare opportunity to hear Professor Lee Shulman speak and briefly meet him in person.

The researcher was not alone in looking at Shulman’s work for its relevance in teaching with digital technologies, as Pierson (2001) and Mishra and Koehler (2006) revisited Shulman’s important component of the Knowledge Base for Teaching in looking how Pedagogical Content Knowledge should be reimaged as Technological Pedagogical Content Knowledge, also known as TPACK. As part of this study, the researcher intended to explore the links between pedagogical reasoning and TPACK. To confirm her thinking on the relevance of MPRA, the researcher submitted a refereed paper (Smart, Sim, & Finger, 2013b) to the Society for Technology in Teacher Education (SITE) conference in 2013 in which a number of influential TPACK researchers (many they are discussed in Chapter 2) regularly attend and present their latest research. With the conference proceedings of over 700 refereed research papers, the researcher’s paper was awarded an Outstanding Paper Award, one of only seven awarded that year (http://www.editlib.org/awards/SITE/2013/). As well, the paper was awarded the Ann Thompson TPACK annual paper award from the TPACK
Special Interest Group. This confirmed her thoughts of the importance of this study, as it would contribute to the growing body of knowledge on TPACK to aid in understanding potentially how TPACK was developed through pedagogical reasoning.

From a different research perspective, the use of digital technologies in teaching and learning can be described as a ‘wicked problem’, in that technology integration cannot be conclusively explained or comprehended, as different participants see it differently; it has copious causes and is often an indicator of other difficulties (Mishra & Koehler, 2007). The factors affecting wicked problems are contradictory, difficult to recognize and changing the problem is embedded in multifaceted systems with many blurred interdependencies and possible explanations are not easy to see (Rittel & Webber, 1973). Framing the use of digital technologies in teaching and learning, as a wicked problem is not new, as Mishra & Koehler (2007) have also used the terminology when introducing TPACK. For this thesis, wicked problems provide a useful terminology that describes the realities of how teachers pedagogically reason with digital technologies. Describing this challenge as a wicked problem, means new ways of addressing this complexity are needed or new ways to understand how teachers pedagogically reason with digital technologies.

The issue is that change is part of the ‘wicked problem’ in relation to education and the integration of digital technologies for teaching and learning. This is a critical change that occurs in different ways, across different professional contexts. Koehler and Mishra (2008) explain that “integrating technology in the classroom is a complex and ill-structured problem involving the convoluted interaction of multiple factors, with few hard and fast rules that apply across contexts and cases” (p. 10). They suggest that the wicked problem of technology integration requires new ideas and ways of confronting this complexity. Understanding the complexities of the challenge of integrating digital technologies in teaching and learning is the subject of this thesis. The focus is to identify the pedagogical reasoning of teachers as they engage with using digital technologies in their classrooms.

There are many attributes that make using digital technologies appealing to teachers. Borko, Whitcomb, and Liston (2009) suggest that these include ease of access; ability to search and retrieve new information; the ability to combine many artefacts into the one space; immunity from time and place allowing teaching and
learning to be anytime and anywhere; and for course administration and record keeping. Borko, Whitcomb, and Liston (2009) suggest that new digital technologies share several properties that complicate their integration into teaching and learning. They suggest that there are unstable, new digital technologies developed and distributed and not fully tested, and, therefore, are either unreliable or incompatible with software or hardware. With the rate that digital technologies are changing, there is a continual process of updating/upgrading where users need to keep up with upgrades in order to take advantage of new features and maintain the reliability.

Borko et al. (2009) and Koehler and Mishra (2008) suggested that, for each digital technology, there are different affordances and constraints. In fact, in the 1990s this issue had been identified where particular digital technologies have their own propensities, biases and inherent attributes that make them more suitable for certain tasks than others (Bromley, 1998; Bruce, 1993). The integration of digital technologies by teachers is suggested by Koehler and Mishra (2008) to be challenging for many. Their research has shown that teachers often have inadequate experience, and as a result, technology integration is considered someone else's problem. For some, classroom contexts are varied and diverse and not suited to the use of digital technologies in teaching and learning. In Queensland, Australia, where this study was conducted, these challenges were attempted to be addressed through structured professional programs introduced to enable teachers to use digital technologies, as discussed in the following section.

Clarification of the terms

One of the challenges of research in the field of digital technologies is addressing the inconsistent use of terminology. Some researchers refer to digital technologies, while others refer to information communication and technology or ICT while others select from a range including computing, computer technology, educational technology, educational computing, or instructional technology. For this thesis, the term digital technologies is used and is intended to encompass all of the above terms, by using the explanation provided by Selwyn (2011) to define digital technologies as an umbrella term to represent a range of contemporary technology use, that is:

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• Computing hardware, systems and devices (such as desktop PCs, laptop computers, tablet computers, interactive whiteboards, simulation systems and immersive environments);

• Personal computing devices (such as mobile phones, ‘smart’ phones, personal digital assistants, mp3 players);

• Audio-visual devices (such as digital radio, digital television, digital photography, digital video);

• Games consoles and hand-held game machines;

• ‘content free’ computer software packages (such as word processors, spreadsheets);

• ‘content related’ computer software packages (such as simulation programs, tutorial packages);

• worldwide web content, services and applications (not least web-pages and web-based services);

• other internet applications such as email and ‘voice over internet protocol’ (such as Skype and other web-based telephone services) (Selwyn, 2011, pp. 13-14)

Mishra and Koehler (2006) remind that some digital technologies have been specifically designed for educational use, while others, they suggested are repurposed for educational use. The scope of this definition includes many diverse types of digital technologies that have been shared by the participant teachers described in this thesis.

Organisation of the thesis

A qualitative approach was adopted with a case study methodology to address the research questions. Seven case studies have been constructed and included in this thesis as part of an interpretive framework within which this study is located.

This thesis consists of eight chapters. Following the introduction in Chapter 1, Chapter 2 presents a review of the current literature from international, national and local sources to provide an analysis of the research relevant in the field of digital technologies, pedagogical reasoning and pedagogical reasoning with digital technologies. This is followed by Chapter 3, which explains the research design and methodology, to describe the qualitative approach to this study. The research design including the data analysis will be discussed. Chapters 4, 5 and 6 present the data analysis of the seven cases. Chapter 4 begins with the first group of three cases involving three participant teachers who are in their early career stage of teaching.
This is followed by Chapter 5, which examines two cases involving teachers who are in the experienced career stage. Chapter 6 presents the final two cases of teachers who are considered to be in the lead teacher career stage. Chapter 7 presents the cross case analysis of all of the case studies and discusses these findings in answering the research questions. Chapter 8 concludes the thesis through a summary of the study, emphasises the key achievements of the study, and proposes the potential for future research to inform teacher professional learning in relation to the ways in which teachers pedagogically reason with digital technologies.

**Chapter summary**

This chapter has outlined the introduction for this thesis, where the aim and research questions have been presented, the context in which the study is situated and the significance of the study is explained from the researchers perspective. While the conceptual framework will be discussed later, this chapter has introduced Shulman’s Model of Pedagogical Reasoning and Action (1987) to emphasise its importance to the study and in understanding pedagogical reasoning. Building on Shulman’s MPRA, the following research questions will be explored:

**RQ1:** How do teachers pedagogically reason with digital technologies?

**RQ2:** What are the differences in pedagogical reasoning with digital technologies across three career stages?

**RQ3:** What influences teachers when they pedagogically reason with digital technologies?

In an effort to confine the terminology within this study, a definition of digital technologies, salient to the understanding the perspective used in this study, has been provided. The following chapter introduces the literature.
CHAPTER 2: THE LITERATURE

Teaching is a complex practice that involves many aspects of teacher thinking. Kennedy (2008) suggested that one reason why there is an interest in teacher thoughts was because “thoughts are intertwined with practice. Therefore, if we want to understand practice, we need to also understand thoughts that guide practice” (p. 21). Many researchers have sought to understand teaching practice and in particular how teachers approach planning, evaluating or making decisions during active teaching. The earliest work emerged in the 1960s and is reflected in the literature reviews that Clark and Peterson (1986) and Shavelson and Stern (1981) completed to understand teacher cognition. Understanding teacher cognition is challenging, complex and underpinned by a sound body of knowledge and pedagogical reasoning that brings that knowledge into practice. One approach to understand teacher cognition was to understand the ‘what and how’ teachers use knowledge. In the 1980s, research moved towards articulating teacher knowledge with the belief that defining knowledge meant that knowledge could be measured. Shulman (1987b) proposed a knowledge base for teaching and as part of the process he speculated that teachers used that knowledge base when they pedagogically reasoned.

This literature review traverses thirty years of educational research from across the globe to understand how teachers pedagogically reason, and now with the availability of digital technologies in the classroom, how they pedagogically reason with digital technologies. This chapter introduces pedagogical reasoning as in Shulman’s Model of Pedagogical Reasoning and Action (MPRA) (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987). The chapter then moves into discussing how Shulman’s MPRA has been reported in the literature. The literature search focused on reported studies that have used Shulman’s MPRA to understand how teachers pedagogically reason and more recently, some studies have begun to explore how teachers pedagogically reason with digital technologies. This section is formatted based on the level of the teacher’s experience – pre-service and in-service. The chapter concludes with identifying the influences that can have an impact of pedagogical reasoning in the context of digital technologies. These three views of pedagogical reasoning inform the research approach presented in this thesis.
Knowledge base for teaching and the emergence of pedagogical reasoning

The development of a knowledge base for teaching has always been an important consideration in the education and professional development of teachers. Being able to define a knowledge base allows that knowledge base to be examined and assessed. To help in understanding the knowledge base of teaching, Shulman (1987b) provided a description where he asserted the knowledge base consisted of the following elements:

- Content knowledge;
- General pedagogical knowledge;
- Curriculum knowledge;
- Pedagogical content knowledge (PCK);
- Knowledge of learners and their characteristics;
- Knowledge of educational context; and
- Knowledge of educational ends, purposes and values.

PCK was considered the most important because it represented a distinctive body of knowledge for teaching that:

*represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organised, represented and adapted to the diverse interests and abilities of the learners and presented for instruction (Shulman, 1987b, p. 8).*

PCK exists at the intersection of content and pedagogy and was represented in the Venn diagram shown in Figure 2.2. Shulman (1987b) suggested that having content or general pedagogical skills was not sufficient for quality teaching, having the two combined as PCK enabled pedagogically powerful representations of the

*most regularly taught topics in one’s subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations and demonstrations – in a word, the ways of representing and formulating the subject that make it comprehensible to others (p. 9).*
Shulman and Sykes (1986) first proposed the knowledge base for teaching and pedagogical reasoning in 1986 in a paper titled *A National Board for Teaching? In Search of a bold statement*. Shulman and Gary Sykes, PhD student of Shulman at Stanford University, prepared the paper for the Task Force on Teaching as a Profession for the Carnegie Forum on Education and the Economy. Along with pedagogical reasoning, this paper presents the knowledge base of teaching, the call for the advancement of teaching as a profession and the establishment of a national board for teaching. Shulman and Sykes (1986) proposed a new assessment program that focused on teachers “knowledge and reasoning required for teaching, and to testing…that more closely resembles teachers use of that knowledge and reasoning in the course of teaching” (p.ii). They designed their assessment approach on a model of teaching that incorporates seven steps:

These activities correspond to the steps of coming to understand the material oneself, Reviewing critically in the light of one’s own understanding, Modifying the representations of the ideas to conform to pedagogical principles, Adapting those representations to fit the characteristics of the students to be taught, Presenting the ideas to the class and dealing affectively with questions and student responses, Evaluating the quality of what has been learned and taught, Finally, reviewing the lesson and Reflecting on what can be learned from experience (Shulman & Sykes, 1986, p. 15).

In their detailed response to each of these steps, they described how a teacher should be assessed for the national board.

The nature of pedagogical reasoning was explored in the Knowledge Growth in Teaching Project undertaken at Stanford University in the early 1980s (Shulman,
Gary Sykes, Suzanne Wilson, Anna Richert, Anne Reynolds, Sigrun Gudmundsdóttir, Cathy Ringstaff, Judy Haymore and Louette McGraw were among the few PhD students who focused on pedagogical reasoning while others primarily investigated the knowledge base for teaching (e.g. Pam Grossman, Maher Hashweh, Ann Reynolds and Samuel Wineberg). All were students of Shulman and were investigating novice and expert teachers’ practices to understand their knowledge base for teaching and how they pedagogically reason. Shulman (1985) explains their work:

*it places the teacher’s understanding, transformation and use of subject-matter knowledge as the central concern of the research program. Instead of looking at teaching skills that transcend the particularities of specific subjects or topics, we intend to examine the ways in which new teachers communicate their own understandings of academic content to classes of students* (p.2).

They investigated how subject-matter knowledge influences teacher thinking where they could explore the “relationships of that knowledge to teacher planning of instructional units and teaching” (Shulman, 1985, p. 2). The teachers included in the study were reported to be able to “take an idea or concept they hold rather firmly on their own minds and to organise and present it so that a group of high school students might grasp it” (Shulman, 1985, p. 4).

![Figure 2.3 - Model of Pedagogical Reasoning (Wilson et al., 1987, p.119)](image)

In a seminal article published in the Harvard Educational Review in February 1987, Shulman elaborated further on the knowledge base for teaching and pedagogical
reasoning. Shulman’s view of pedagogical reasoning was from the point of view of the skilled teacher, “who is presented with the challenge of taking what he or she already understands and making it ready for effective instruction” (Shulman, 1987b, p. 14). Shulman proposed a cycle of activities from comprehension to reflection with the “starting point and the terminus for the process is an act of comprehension” (Shulman, 1987b, p. 14). In 1987, Shulman co-authored a chapter, with Suzanne Wilson and Anna Richert (both PhD students of Shulman), in a book titled Exploring teachers thinking (Wilson, Shulman, & Richert, 1987). In that chapter, along with adding more to the descriptions of pedagogical reasoning, a graphical version of pedagogical reasoning was included and is shown in Figure 2.3. It describes how pedagogical reasoning was developed “through the process of planning, teaching, adapting the instruction, and reflecting on the classroom experiences, (teachers) acquire new types of knowledge” (Wilson, Shulman, & Richert, 1987, p. 117). To acquire that knowledge, they defined teaching in terms of the pedagogical reasoning from studying pre-service teachers making their transition into classrooms. They confirmed Shulman’s initial thoughts that there was a linear relationship among the constructs.

According to Shulman (1987b), pedagogical reasoning begins with comprehension, as teachers need to understand their content in several ways, by understanding the main ideas, and how they are related to one another or other related areas in the same discipline (Shulman & Sykes, 1986). As a teacher “must critically understand a set of ideas, a piece of content, in terms of both its substantive and syntactic structure <and> the relationships between that piece of content and other ideas within the same content as well as ideas in related domains” (Wilson, Shulman, & Richert, 1987, p. 119). The important words in this quote are critically understand, where a teacher must examine the errors or misrepresentations and how they might be corrected. Comprehension involves understanding the “basic facts and principles of the topic, their relationship to the substantive and procedural structures” (Shulman & Sykes, 1986, p. 16).

Comprehension of content does not merely mean understanding the content as any scholar from the content area but goes further “in the capacity of a teacher to transform the content knowledge … into powerful forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students” (Shulman, 1987b, p. 15). Not only do teachers need to understand their
content, they need to understand how the content aligns with the curriculum. Knowledge of the curriculum is important to ensure the prescribed content is covered and teachers need to understand the purpose of the curriculum for their students.

Shulman suggests the “comprehended ideas must be transformed in some manner if they are to be taught. To reason one’s way through an act of teaching is to think one’s way from the subject matter as understood by the teacher into the minds and motivations of learners” (Shulman, 1987b, p. 16). Transformation is about transforming the content to be taught into a format suitable for teaching and learning. Transformation requires some combinations or ordering of the following processes, where Shulman (1987b, p. 16) suggests that each employs some kind of repertoire:

1. **Preparation** (of the given text materials) including the process of critical interpretation
2. **Representation** of the ideas in the form of new analogies, metaphors and so forth
3. **Instructional selections** from among an array of teaching methods and models
4. **Adaptation** of these representations to the general characteristics of the children to be taught, as well as
5. **Tailoring** the adaptations to the specific youngsters in the classroom

Transformation is at the heart of teaching where teachers use their knowledge to transform the content into forms to enable their students to learn.

Shulman and Sykes (1986) suggests that preparation involves critical interpretation from the perspective of “one’s own content knowledge (which includes one’s grasp of norms and values), recognising gaps or flaws in the presentation of ideas or argument and determining how to repair these; and generating a number of alternative pedagogical representations of the key ideas” (p.16). Shulman (1987b) added that the teacher questions if the material is “fit to be taught” or are there any errors in the text (Wilson, Shulman, & Richert, 1987). Shulman (1987b) suggests the process of preparation will usually include (1) detecting and correcting errors of omission and commission in the text, and (2) the crucial processes of structuring and segmenting the material into forms better adapted to the teacher’s understanding and,
Shulman (1987b) suggests that **representation**

*involves thinking through the key ideas in the text or lesson and identifying the alternative ways of representing them to students. What analogies, metaphors, examples, demonstrations, simulations and the like can help build a bridge between the teacher’s comprehension and that desired for the students? Multiple forms of representation are desirable* (p. 16).

In addition Wilson, Shulman, and Richert (1987) suggests teachers need a representational repertoire that consists of “metaphors, analogies, illustrations, activities, assignments and examples that teachers use to transform the content for instruction” (p. 120) and this representational repertoire is developed over a teaching career. Shulman and Sykes (1986) add further that for representation teachers look at “examples from everyday life…from other disciplines…can be suggested and elaborated…that would comprise an arsenal of instructional weapons available if needed” (p. 17).

**Instructional selection** was only included in the Harvard Educational Review article (Shulman, 1987b), where he described that instructional selection:

*occurs when the teacher must move from the reformation of content through representations to the embodiment of representation in instructional forms or methods. Here the teacher draws upon an instructional repertoire of approaches or strategies of teaching. This repertoire can be quite rich, including not only the more conventional alternative such as lecture, demonstration, recitation, or seatwork, but also a variety of forms of cooperative learning, reciprocal teaching, Socratic dialogue, discovery learning, project methods and learning outside the classroom setting* (p. 16-17).

Thus, teachers select the best instructional approach for their content from their instruction repertoire.

Shulman (1987b) describes **adaptation** as “the process of fitting the represented material to the characteristics of the students…ability, gender, language, culture, motivations, or prior knowledge and skills that will affect their responses to different forms of representation and presentation” (p. 17). Student characteristics that may influence how they approach, interpret, understand or misunderstand the material include “student conceptions, misconceptions, expectations, motives, difficulties or strategies might influence the ways in which they approach, interpret, understand the
material” (Shulman, 1987b, p. 17). Wilson et al. (1987) provide an example of teaching the science of light where a teacher “might think about the preconceptions that students may have about light that will interfere with their learning” (p.120). Closely related to adaption is tailoring, which Shulman (1987b) describes “fitting of the material to the specific students in one’s classroom” (p. 17) adding that it “entails fitting representations not only to particular students, but also to a group of a particular size, disposition, receptivity and interpersonal chemistry” (Shulman, 1987b, p. 17).

Shulman (1987b) acknowledges “all of these processes of transformation result in a plan or set of strategies, to present a lesson, unit or course” (p. 17). He asserts that these “aspects of the process wherein one moves from personal comprehension to preparing for the comprehension of others, are the essence of the act of pedagogical reasoning, of teaching as thinking, and of planning – whether explicit or implicitly – the performance of teaching” (Shulman, 1987b, p. 16). The outcome of transformation is a “plan or set of strategies, to present a lesson, unit or course…it is all a rehearsal for the performance of teaching which has not yet occurred” (Shulman, 1987b, p. 17).

The next process of pedagogical reasoning is instruction. Shulman (1987b) describes instruction as

the observable performance of the variety of teaching acts… aspects of pedagogy: organizing and managing the classroom; presenting clear explanations and vivid descriptions; assigning and checking work; and interacting effectively with students through questions and probes, answers and reactions and praise and criticism(p. 17).

Shulman and Sykes (1986) add that instruction encompasses:

all the major forms of presentation, e.g., lecture-demonstration, recitation, small group cooperative learning, discovery lesson, use of manipulatives or laboratory (if appropriate to the subject area being taught), individual seatwork, the formulation, assignment and explanation of homework, individual and group corrective feedback, and the like (p. 18).

In addition, they suggest instruction includes “verbal fluency, quality of voice and projection, use of humour, general levels of activity and enthusiasm, energy, the projection of ‘curricular passion’ for the subject area” (Shulman & Sykes, 1986, p. 18).

According to Shulman (1987b) the first focus of evaluation is on evaluating student understanding in the classroom while teaching and then afterward through formal assessment. Shulman describes how evaluation entails “online checking for
understanding and misunderstanding that a teacher must employ while teaching interactively, as well as more formal testing and evaluation that teachers do to provide feedback and grades” (Shulman, 1987b, pp. 18-19). Wilson et al. (1987) added, “evaluation occurs during and after instruction. Teachers check for understanding and misunderstanding in their students as part of teaching…they deploy a variety of more formal modes of evaluation like unit tests and end of semester examinations” (p.120).

Shulman and Sykes (1986) provide a richer view of evaluation to include “subject-specific understanding…to how to fashion a classroom objective test, scoring procedures <and assigning> grades…that are both accurate and equitable” (p.18-19). Shulman (1987b) adds that to “understand what a pupil understands will require a deep grasp of both the material to be taught and the process of learning” (p.19) and he suggests that this understanding is “subject specific and to individual topics within the subject” (p19). Wilson et al. (1987) suggested the final focus of evaluation has a more personal focus where a teacher evaluates their effectiveness as in “teachers evaluate their own teaching through the process of reflection” (p. 120).

Shulman (1987b) describes reflection in terms of when a teacher looks “back at the teaching and learning that has occurred, and reconstructs, re-enacts and/or recaptures the events, the emotions and the accomplishments” (p.19), and where their objective is to learn from their experience (Shulman, 1987b; Wilson, Shulman, & Richert, 1987). Shulman (1987b) explains that reflection can be performed alone or in a group and teachers can use recording devices to revisit their action or they can use their memory to recall events. Shulman and Sykes (1986) suggest that reflection covers comprehension, transformation, instruction and evaluation to promote personal improvement. They suggest it involves the ability to analyse instruction critically and to work with others to seek constructive feedback.

Reflection leads to new comprehension, as

we arrive at a new beginning, the expectation that through acts of teaching that are ‘reasoned’ and ‘reasonable’ the teacher achieves new comprehension, both of purposes and of the subjects to be taught, and also of the students and of the processes of pedagogy themselves (Shulman, 1987b, p. 19).

Wilson, Shulman, and Richert (1987) describe new comprehension as comprehension that is enriched; “it is a new understanding that has been enhanced with increased awareness of the purpose of instruction, the subject matter of instruction and the
participants – teacher and students” (p. 120). They add that new comprehension are represented as a process that leads back into comprehension to all the processes of pedagogical reasoning to begin again.

From a review of the literature, which included an interrogation of Shulman’s publications, it is identified that he published differing versions of the MPRA, which were inconsistent across those publications. The first was in the article co-authored with Gary Sykes (Shulman & Sykes, 1986) where they suggested that MPRA incorporated seven major steps: (1) Comprehension, (2) Preparation, (3) Transformation, (4) Adaptation, (5) Presentation, (6) Evaluation and (7) Reflection. In an article published in the Harvard Educational Review in February 1987, Shulman included the following version of the steps: (1) Comprehension, (2) Transformation (Preparation, Representation, Selection and Adaptation and Tailoring), (3) Instruction, (4) Evaluation, (5) Reflection and (6) New Comprehension. In the version which he co-authored with Suzanne Wilson and Anna Richert (Wilson, Shulman, & Richert, 1987), the version of the model of pedagogical reasoning included the following steps: (1) Comprehension, (2) Transformation (Critical interpretation, Representation, Adaptation, Tailoring), (3) Instruction, (4) Evaluation, (5) Reflection, (6) New Comprehension. The third model was published as a circular model with each process leading on to the next as shown in Figure 2.4.

![Figure 2.4 – Revised Model of Pedagogical Reasoning and Action based on Shulman's 1987 version](image-url)
In these three key publications, he described the processes of transformation in three differing ways, as shown in Table 2.1. The processes of transformation initially included as major headings to being described under the heading of transformation. He moved from three processes to four processes from 1986 to 1987. All three included a form of preparation as a starting point. Selection was added in the last publication and adaptation and tailoring were merged into one process. Shulman did explain in a footnote that he had been inconsistent across his three publications. The second version was the one most cited in the literature and will be used to describe the processes of pedagogical reasoning.

Table 2.1 - Transformation described three different ways

<table>
<thead>
<tr>
<th>(Shulman &amp; Sykes, 1986)</th>
<th>(Shulman, 1987b)</th>
<th>(Wilson, Shulman, &amp; Richert, 1987)</th>
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<tr>
<td>Preparation</td>
<td>Critical interpretation</td>
<td>Preparation</td>
</tr>
<tr>
<td>Transformation</td>
<td>Representation</td>
<td>Representation</td>
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<tr>
<td>Adaptation</td>
<td>Adaptation</td>
<td>Instructional selection</td>
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<tr>
<td></td>
<td>Tailoring</td>
<td>Adaptation and Tailoring</td>
</tr>
</tbody>
</table>

In a response to Shulman’s 1987 article in the Harvard Education Review, Sockett (1987) suggested that pedagogical reasoning could not be elaborated and challenged that Shulman’s model neglected reason-in-action. Sockett (1987) explained that Nancy’s rich description only describes her general strategy of teaching

not her rich nuances of her excellence” because they that cannot be articulated, “as they simply emerge as reasoned action rooted in experience and commitment” (p. 153). This tacit knowledge “to be of sufficient complexity to resist statement in propositional form as rules of performance, to find expression in the knower’s performance without self-conscious awareness ... to be describable and observed by others (p. 153).

He went further to suggest that tacit knowledge is that its “exercise is spontaneous and not the product of a process of pre-hoc reasoning. It resists reduction to rules” (Sockett, 1987, p.154). Shulman (1987a) defended that he had included reasoning-in-action in MPRA but agreed that he failed to address its importance. Later Shulman (2015), in arguing the significance of pedagogical content knowledge, reiterated the importance of “thought and emotion but not ignoring the role of action in teaching practice” (Shulman, 2015, p. 10).

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More recently in discussing the development of PCK over the last three decades, Shulman (2015) reflected that his conception of the knowledge base for teaching was too cognitive and rational, leaving little room for the moral or affective dimensions of teaching where it was devoid of emotion, affect, feelings and motivation, all of the non-cognitive attributes, as:

*the affective aspects of teaching understanding and action are important both because a lot of what teachers ‘know and do’ is connected to their own affective and motivational states, as well as their ability to influence the feelings, motives, persistence and identify formation processes of their student (p. 9).*

Sockett (1987) also suggested that Shulman focused on knowledge rather than the affective. However, there is evidence that teachers’ ideas, beliefs and values may influence practice, as seen in the work of Webb (2002) where she has included teachers and student beliefs as an influence to pedagogical reasoning in her updated models. Shulman (2015) revisited the affective aspects of teacher understanding and action suggesting that a lot of what teachers know and do is connected to their own affective and motivational states. As well, many studies reported in this paper have suggested a link between teacher beliefs and pedagogical reasoning.

**The evolution of Shulman’s MPRA**

After discussion of Shulman and his Stanford team’s work over several years on the knowledge base of teaching and the development of the concept of pedagogical reasoning, this section discusses key research that has drawn on the Shulman’s MPRA to understand the general development of pedagogical reasoning by others across Australia and the world. The two key themes of this section are organised according to participating teachers level of experience. The first, then explores research literature around the general development of pedagogical reasoning; the second, concentrates on pedagogical reasoning with digital technologies. Each of the studies reviewed were qualitative in method and most consisted of detailed case studies of pre-service or early career teachers.
General development of pedagogical reasoning

Pre-service teachers

*Primary mathematics and science pre-service teachers*

Nilsson (2009) studied twenty-two pre-service science/maths primary teachers in Sweden to understand their pedagogical reasoning using Shulman’s MPRA. Using critical incidents, she wanted her pre-service teachers to reflect on their teaching concerns as well as more general pedagogical content concerns in transforming their knowledge into teaching activities, where it was possible, for pre-service teachers to pedagogically reason about critical incidents to “reframe pedagogic situations and develop more sophisticated understandings of what it means to teach” (Nilsson, 2009, p. 241). She suggested the model of pedagogical reasoning offers synergies with ways of considering student teachers’ needs and how through critical incidents can be used to enhance learning about teaching as they reflect on their practice. She developed a conceptual framework that showed her data inputs and the influences she was exploring and this is displayed in Figure 2.5.

![Diagram of pedagogical reasoning and action](image)

**Figure 2.5 - The process of pedagogical reasoning and action (Nilsson, 2009)**

Nilsson (2009) acknowledged that she used Shulman’s MPRA as a “methodological framework in order to better understand student teachers learning...
about teaching through connecting the phases of planning, conducting, evaluating and reflecting on a lesson” (Nilsson, 2009, p. 254) and she encouraged student teachers to share their experiences. She confirmed that MPRA provided a useful framework for working with per-service teachers for them to understand the work of teachers.

More recently, Nilsson and Loughran (2012) focused on the use of the CoRe (Content Representation) tool to understand pre-service science primary teacher development of pedagogical content knowledge. In her move to study PCK over MPRA, she like most researchers had focused on identifying and understanding both the nature of PCK and its development. Loughran, Mulhall, and Berry (2008) reported a number of studies of pre-service science teachers’ development of PCK. They suggested an alternative approach using CoRes (Content Representations) and PaP-eRs (Pedagogical and Professional – experience Repertoires) that teachers have used to “make concrete the abstract notion of PCK” (p. 1304). CoRes and PaP-eRs “were developed as both a method for exploring and representing expert science teachers’ PCK” (Loughran, Mulhall, & Berry, 2008, p. 1304). Loughran, Berry, and Mulhall (2012) described CoRes and PaP-eRs as a framework for thinking about practice:

*The CoRe framework created a coherent ways of conceptualising science content that reflected the inherent knowledge of practice that we saw in expert teachers but which they themselves so often struggle to articulate. PaP-eRs were developed to as a natural consequence of the need to dig deeper into the myriad aspects of the CoRe in order to capture the essence of teachers’ pedagogical reasoning and purpose; to make the tacit explicit (p. ix).*

More recent work from this group of researchers is presented later in the literature review to describe a new project they are undertaking to study in-service teachers’ pedagogical reasoning.

**Secondary mathematics and science pre-service teachers**

Peterson and Treagust (1992, 1995, 1998) used Shulman’s MPRA as a framework when looking at Australian pre-service science teacher development of the knowledge base through pedagogical reasoning. Over a number of years, they used a problem based learning in a pre-service science education course where they collected evidence from pre-service teacher reflective journals and assessment. The students were not given any formal instruction on Shulman’s MPRA and the pedagogical reasoning terminology was not used in the course. From a group of twenty-one pre-
service teachers, Peterson and Treagust (1995) conclude that their pre-service teachers “had been more likely to use a pedagogical reasoning framework based on the six stages, and had integrated their knowledge of science content, curriculum and learners in the process of preparing and teaching a unit of work” (p. 304). They did not challenge or add to Shulman’s MPRA.

James and Scharmann (2007) reported in their study how they used Shulman’s MPRA to help pre-service science teachers in the USA to develop analogies to improve their teaching of science concepts. They suggested that most pre-service teachers begin with a textbook when they are unfamiliar with the content. As a result they worked with pre-service teachers to develop analogies to improve their pedagogical reasoning abilities. The study used a treatment/contrast group where the treatment and contrast group were selected from the students studying the science methods class. Both groups participated in regular classes and completed identical assessment, the difference was in one class undertaken planning where they received instruction on how to create analogies. A variety of data was collected from the students including student work including their reflection papers and concept examples, planning documents and the students participated in interviews. The study found there was no significant statistical difference in pedagogical reasoning between the treatment and control group except for evaluation. The students’ reflections revealed that they were more interested in evaluating student learning then the treatment group. Overall they found that the use of analogies was a success and suggested that increased use of analogies was significantly correlated to improved pedagogical reasoning abilities.

Primary and Secondary mathematics and science pre-service teachers

Keast, Mitchell, Panizzon, Loughran, and Tham (in press) and Keast and Cooper (2015) found that the use of Slowmation helped their Australian primary and secondary pre-service teachers “better recognise and articulate aspects of their developing pedagogical reasoning and knowledge” (p. 5). By discussing their experiences with their peers they tended to ‘unpack’ their pedagogical reasoning in all aspects of their teaching suggesting that pedagogical reasoning does not happen in isolation. This reflective view of their teaching, through well-scaffolded discussion, offered the pre-service teachers “the opportunity to reflect on their practice and to
come to new understandings about the role they played in their students’ science learning” (Keast & Cooper, 2015, p. 10). This project is ongoing with more work describing pedagogical reasoning to be reported in the future. It is interesting for this study that they neglect to highlight the influence of digital technologies on their teachers’ pedagogical reasoning.

Secondary English/history/social science pre-service teachers

Ringstaff and Haymore (1987) and Ringstaff (1987) used MPRA as a framework to look at secondary early career teachers in the USA who were teaching out of their qualification areas, in other words teachers who were misassigned. Using Shulman’s MPRA, the paper provides a detailed breakdown of the pedagogical reasoning of two teachers to understand their differences, one who was qualified to teach English and the other that wasn’t. Use of the model provided a comprehensive view of their pedagogical reasoning to determine the issues facing misassigned teachers. McGraw (1987) used MPRA to understand early career teachers comprehension of subject matter. A teacher (Chris) was studied for two years to understand how he “transformed his knowledge of the subject matter into ideas, concepts, demonstrations and simulations to use as classroom instruction” (McGraw, 1987, p. 19). She found Chris’s background in anthropology influenced his comprehension, representations and evaluation in social studies and American history. She suggested that Chris comprehended materials that he was interested in and had knowledge of in his selection of the curriculum but when he was weak in subject matter he used his understanding of anthropology to “organise the curriculum, prepare representations to use in instruction and to evaluate student learning” (McGraw, 1987, p. 19). This work suggests there are a variety of factors that influence teachers when they begin their pedagogical reasoning.

Wilkes (1994) used Shulman’s MPRA with pre-service secondary business education students in Australia. He incorporated MPRA into his teaching “with particular focus on transformation and on the preparation and representation components of that process” (Wilkes, 1994, p. 3). The students were fourth year students “preparing to teach some combination of economics, accounting, legal studies, business management, information ICT and middle school commerce” (Wilkes, 1994, p. 3). He gave little attention to Shulman’s work instead choosing to
present MPRA “as a set of processes of central importance to the development of pedagogical content knowledge” (Wilkes, 1994, p. 4). He suggests that knowledge was something static while reasoning and action implied “a dynamic state in which knowledge is being tested and refined and new understandings generated” (Wilkes, 1994, p. 2). Wilkes used the student assessment to understand their development of pedagogical reasoning. He found evidence of their pedagogical reasoning in their first structured task and he asked his students to provide anonymous feedback of the model after completing their practicum. He reported that some students explicitly and enthusiastically affirmed the applicability of the model while some other students implied that the model was no more than common sense. The point is given here and raises the question – is pedagogical reasoning learned or innate? Or at least pre-service teachers can benefit from explicit teaching in pre-service teacher education.

Value of pedagogical reasoning on pre-service education

Most research on pedagogical reasoning in pre-service education has focused on mathematics and science pre-service teachers with some studies looking at English and social sciences. All have confirmed that MPRA offers valid model that can be used with pre-service teachers in helping them understand the work of teachers. A key element of MPRA is reflection where these studies have described how pre-service teachers have reflected on their practice. MPRA provides a framework for pre-service teachers to use in reflecting to describe the processes of teaching. A key question is whether pedagogical reasoning is learned or innate and whether pre-service teachers can benefit from explicit teaching? These studies suggest that when pre-service teachers reflect based on MPRA their pedagogical reasoning improves. The next section looks at the research on in-service teachers.

In-service teachers

Mathematics and science in-service teachers

Meredith (1995) used Shulman’s MPRA to understand how a early career mathematics teacher (Terry) in the UK developed his pedagogical content knowledge. From an interview she was able to identify a “number and variety of examples of pedagogical reasoning that occurred … <with> at least one example of each of Shulman’s four sub-processes of transformation” (Meredith, 1995, p. 177). She found
that Terry showed an enthusiasm for teaching mathematics where his own mathematical knowledge was a major source of confidence that informed his thinking about teaching. From his interview, she suggested it was clear that Terry held beliefs about the subject of mathematics based on how he had developed his understanding of mathematics and he held beliefs about a ‘generic’ mathematics learner “rather than the particular needs and different abilities and attitudes of individual learners” (Meredith, 1995, p. 181). Meredith suggested that this was possibly based on his own way in developing and understanding of mathematics. She suggested that Terry believed that he needed time to develop his own style for teaching mathematics. She concluded that Terry’s “development of pedagogical content knowledge appears to rest on reasoning that is directly related to his prior experiences of and beliefs about mathematics, learners and the task of the teacher” (Meredith, 1995, p. 184). Meredith highlights there is a strong relationship between the developments of pedagogical content knowledge and pedagogical reasoning that is developed with influence from previous experience and a teachers beliefs. This supports the ideas presented and connects in some ways to the work of Wilkes (1994).

Keast, Loughran, Mitchell, and Panizzon (2014) and Keast, Mitchell, Panizzon, Loughran, and Tham (in press) have been exploring the development of pedagogical content knowledge in expert science teachers in Australia. Their work has focused on understanding pedagogical content knowledge and more recently they have been very successful in obtaining research funding to be able to investigate pedagogical reasoning of primary and secondary science teachers in how they develop pedagogical content knowledge. There have been very few publications completed from this research project to be able to discuss their findings but their preliminary results suggest that Shulman’s model provides a useful framework for “understanding the underpinnings of expertise as an alternative to approaches such as teaching standards” (Keast, Mitchell, Panizzon, Loughran, & Tham, in press, pp. 14-15).

Keast, Mitchell, Panizzon, Loughran, and Tham (in press) contended that pedagogical reasoning isn’t linear, as first proposed. Keast et al. (in press) suggested that pedagogical reasoning involves processing that moves forward and backward, or what they termed “pinball reasoning” (p. 8). Their teacher’s pedagogical reasoning “shifted from one focus to another as thinking about one aspect of practice stimulated thinking about another in ways that reflected the diverse range of knowledge of
practice they had developed” (Keast, Mitchell, Panizzon, Loughran, & Tham, in press, p. 8). They termed this pinball reasoning and their view of pinball reasoning was developed through their interactions with the science teacher group formed for the research project. In their preliminary research findings, they described how they used Shulman’s MPRA to understand how teachers plan a unit of work, as it “offers an approach to describing expert teacher knowledge that can unpack the how’s and offer insights into the whys of practice” (Keast, Mitchell, Panizzon, Loughran, & Tham, in press, p. 14). They described how the teacher’s pinball around four focal points: Big Ideas; contextual constraints; student engagement; and quality learning and quality learners. Their use of the term pinball was to highlight how the teachers moved erratically around the four focal points when discussing their planning out loud.

The ‘Big Ideas’ construct is not new for science teaching, as Mitchell and Keast (2014) provided a justification for its use in science education. What is new is that this challenges Shulman’s finding they propose that all teaching begins with a text as these authors contend that all science teaching begins with a ‘Big Idea’. In data from their pedagogical reasoning project Mitchell and Keast (2014) suggested there are important differences between primary and secondary teachers in the way that teachers think about big ideas and the challenge in deciding the big ideas that are going to be the most useful. The initial findings suggested that there was little or no commonality to what the teachers were doing.

English/history/social science in-service teachers

Gudmundsdóttir (1988) completed her PhD dissertation under the supervision of Shulman as part of the Knowledge Growth in Teaching Project. Her thesis was devoted to answering the question - How do teachers use their content knowledge in teaching? She studied in the USA four expert secondary teachers of English and social studies, using her revised version of MPRA (as shown in Figure 2.6) to understand how they pedagogically reasoned. Her model was different to Shulman’s as she showed less processes, was only interested in the preactive and interactive phases of teaching, used similar names and proposed how knowledge was involved in the process. She described her model as a ‘simplified version’ because her study “was well underway while the MPRA was being developed” (Gudmundsdóttir, 1988, p. 40).
She argued her model was more empirical in contrast to Shulman’s, by suggesting that some “aspects of the model that simply do not seem to make sense in relation to the data presented” (Gudmundsdóttir, 1988, p. 40) in her study, as Shulman studied student teachers where she worked with veteran teachers. She acknowledged that she did not “consider how teachers learn from experience” (Gudmundsdóttir, 1988, p. 40), as the reason for not including teachers evaluation through their own reflection. In her model, Gudmundsdóttir (1988) suggested the input for pedagogical reasoning was the “intended curriculum” (p. 32), which she described could include the goals, content and materials depending where the teacher was located, as some of her teachers worked in schools where all teaching materials were supplied. She did not include a step for comprehension and did not describe how teachers comprehended the intended curriculum. She described pedagogical reasoning as the preactive phases of preparation, transformation and adaptation before the interactive phase of teaching. She highlighted that teaching overlapped transformation and adaptation to suggest they were both preactive and interactive.

Figure 2.6 – Reproduced version of Gudmundsdóttir’s Model of Pedagogical Reasoning and Action (Gudmundsdóttir, 1988, p. 19).

Gudmundsdóttir combined comprehension and preparation into one activity called “Preparation” where a teacher analyses the ideas in the curriculum with teaching in mind. In transformation she suggested that her experienced English and social
studies teachers transformed the curriculum into representations of the text in the form of stories, as their form of PCK. She suggested a story is:

*a way of approaching a course of study and understanding it for the purpose of teaching. The idea of a story captures the totality of a series of texts and make up a course of study. 'The story' is the idea that holds the texts together, giving them purpose, direction and drama (Gudmundsdóttir, 1988, p. 33)*.

She described how transformation was both preactive and interactive as a direct link between planning and action, as transformation involved organising content for pedagogical purposes by segmenting and structuring the curriculum to match their curriculum stories or themes or where they select from the curriculum for their story. She found that her experienced teachers diverged from the given text but pre-service teachers were unable to because they lacked knowledge of subject, pedagogy, students and PCK. She suggested her final phase of adaptation was where the curriculum was adapted to the students.

Tailoring, although not represented as a separate phase, she suggested was an extension of adaptation, where through adaptation the curriculum is individualised for the student. She saw adaptation as both preactive and interactive in the classroom, when student reactions required change in approach to enable the students to understand the idea and the idea could represent a possible new story topic for the teacher when teaching the same topic in the future. Gudmundsdóttir (1988) summarised that pedagogical reasoning was based on the plans teachers make during the preactive phase but with the simultaneity and unpredictability of busy classrooms, transformation and adaptation are enacted during teaching because the teacher is able to react to student need by deviating temporarily from their planning.

The most important difference between Gudmundsdóttir’s and Shulman’s models was recognition of the relationship between the knowledge base and the processes of pedagogical reasoning. In his many publications, Shulman did not clearly elaborate on the relationships between the knowledge base for teaching and the process of pedagogical reasoning to propose both in the one model. In contrast, Gudmundsdóttir was bold to begin her thesis chapter stating the relationship as:

*The Model of Pedagogical Reasoning and Action has two components: a knowledge base and process. The knowledge base is a logical model of the knowledge base for teaching. The process component describes a process of pedagogical reasoning and action that draws on the knowledge base. The
input into the process is the intended curriculum, the output is the knowledge taught to students (Gudmundsdóttir, 1988, p. 18).

The next number of authors have used Shulman’s MPRA as a framework for understanding historical empathy. Historical empathy as “the process of students’ cognition and affective engagement with historical figures to better understand and contextualise their lived experience, decisions, or actions” (Endacott & Sturtz, 2015, p. 1). While Cunningham’s (2007) focus was on the development of historical empathy, she chose Shuman’s MPRA as a framework to understand the pedagogical reasoning of her four teacher participants. In her doctoral study, Cunningham (2007) studied the pedagogical reasoning of four experienced history teachers over a two-year period using Shulman’s MPRA to understand teaching historical empathy. She used multiple semi-structured interviews, classroom observations and curricular documents to understand “the nature of history teachers’ thinking and practice with regard to fostering historical empathy in British classrooms” (Cunningham, 2007, p. 600).

Cunningham (2007) reported a number of students, structural and teacher factors that impacted the pedagogical reasoning of four history teachers based in the USA. There were a number of student factors that impacted pedagogical reasoning including: student capacities; student preconceptions; student reactions to difficult topics; and general student factors like behaviour interruptions can impact on a teachers’ pedagogical reasoning. The structural factors that impacted on pedagogical reasoning included: curricular time; availability and quality of resources; and curricular and examination specifications impacted teacher efforts. Finally, the teacher factors affecting pedagogical reasoning included the teachers’ learning processes; their control of classroom discourse; their content knowledge; their goals and roles; and their own emotions, dispositions or attitude for teaching.

More recently, Endacott and Sturtz (2015) also revisited pedagogical reasoning to understand how social science teachers based in the USA develop historical empathy. Endercott and Sturtz reported many studies of the benefits in student engagement and disposition when students were engaged in historical empathy. The purpose of their study was to intensively examine the “pedagogical reasoning of a social studies teacher as she incorporated historical empathy into an existing instructional unit for the first time in order to develop enduring historical understandings” (Endacott & Sturtz, 2015, p. 2). They proposed to build on the work of
Cunningham (2007) by adding to the body of knowledge on pedagogical reasoning and historical empathy.

Their teacher (Sofia) was a middle years social studies teacher who was in her sixth year of teaching. Sophia was chosen for the study because of her “experience in inquiry-based methods of instruction, her expertise in facilitating classroom historical investigations and her stated interest in incorporating historical empathy into her existing unit on Ancient Greece” (Endacott & Sturtz, 2015, p. 4). Before instruction, Sophia was asked to keep a planning log online, record a series of think-aloud planning sessions and then participate in an interview. For the instruction phase, she helped create an interview-observation schedule that allowed for data to be captured in an ongoing and interactive basis. During instruction, she was video recorded for six lessons and interviewed at the end of each lesson. After teaching, a post-instruction interview was held to following an assessment debate, and she participated in video-stimulated recall interviews to discuss her pedagogical reasoning. In the final stage, Sophia conducted a debriefing with her students regarding their participation in the unit as well as taking part in a telephone interview discussing the debriefing with the researchers.

They suggested that, prior to instruction, Sophia’s pedagogical reasoning included: creating a prompt to help students understand and analyse the topic; developed essential questions; create investigation activities; prepared instructions for students to create an online topic investigation sheets with a page each for “Big Ideas” and research notes; designed a display activity as a debate; and prepared for how she was going to ask the students to reflect on their learning. During instruction she moved around the classrooms and worked with her students where she checked on their progress by asking questions reminding them of the purpose of their work. She reminded the students to complete the online information sheet and record any ‘Big Ideas’. Sophia continually reinforced that the student interrogated the materials to consider varying historical perspectives and the authorship of the source.

Similar to Cunningham (2007), during the process of instruction they noted that Sophia made “unanticipated changes to her teaching ... as she worked more purposefully to encourage her students to think ... <her> changes became an increasingly important aspect of her pedagogical reasoning” (Endacott & Sturtz, 2015,
They suggested that Sophia worked with her students to review speech content preparing them for their assessment, and reminding them of the elements they should consider such as tone, flow, diction, delivery and powerful language. She encouraged her students to “add personal stories to speeches in order to take advantage of affective connections in a persuasive fashion” (Endacott & Sturtz, 2015, p. 11). Sophia’s reflection on her instruction was representative of her concern with how her students engaged in higher-order thinking by pushing her students to substantiate their claims instead of providing answers to questions.

The conclusion of Sophia’s pedagogical reasoning was in her reflection of where she placed the key learning activity in the lesson as her reflection revealed that she needed to find a better way to integrate the activity. She found that her students’ reactions to the content changed the way she asked questions and guided their reflection. She reflected that this would have changed her approach with this confirming Cunningham’s (2007) findings that “teachers place significant emphasis on the procedural aspects of teaching in addition to content concerns when reflecting on their pedagogical reasoning” (Endacott & Sturtz, 2015, p. 15). Sophia completed her planning phase, though the majority of changes she made were when she was teaching, or during instruction. Many of these changes were unanticipated “leading Sophia to reflect on the sequencing of instructional activities” (Endacott & Sturtz, 2015, p. 15) leading to her changes.

Endacott and Sturtz (2015), as with Keast et al. (in press) and Keast et al. (2014) found that pedagogical reasoning did not occur as a sequential flow of processes. For historical empathy, there could be less emphasis on planning prior to instruction and more emphasis to transformation during instruction based on the reaction of students. As historical empathy involves the development of affective engagement with the content, a key part of part of the process is working with students’ reactions in the classroom while teaching. Their research highlighted that the content can impact how pedagogical reasoning occurs before and during instruction and the important role student’s play in pedagogical reasoning during instruction.

Value of pedagogical reasoning for in-service teachers

There have been limited studies looking at the development of pedagogical reasoning of in-service teachers. Key efforts have focused on understanding the
development of pedagogical content knowledge with research continuing today with a
group of international researchers who have focused on the development of PCK for
science educators (Gess-Newsome & Carlson, 2013a, 2013b). For the studies that are
not looking at science, Gudmundsdóttir (1988) was able to provide a deeper view of
pedagogical reasoning of English and social studies teacher while Cunningham (2007)
and Endacott and Sturtz (2015) have used MPRA as a framework to explore
development of historical empathy. All have confirmed that MPRA offers valid model
that can be used with in-service teachers but suggest that MPRA is not as Shulman’
first proposed. Firstly, the processes may not occur in the sequential process, and
secondly teachers may, as suggested by Keast et al. (in press) pinball reason around
the different processes of transformation or they move erratically between the
processes where order is difficult to describe. This raises a key question as to whether
pedagogical reasoning is learned or innate? These studies suggest that pedagogical
reasoning is a useful framework to understand the PCK of teachers and the
development of historical empathy. The next section looks at the development of
pedagogical reasoning with digital technologies.

Development of pedagogical reasoning with digital
technologies

This section begins like the last section, by looking at what the literature
suggests in terms of the knowledge required for teaching with digital technologies.
Similar to the popularity of PCK, Koehler and Mishra (2005) suggested adding
Technology (T) to PCK it could become TPCK. When Shulman defined the knowledge
base and PCK, digital technologies in schools were not playing a critical part in the
learning process. He did see the potential for digital technologies but at the time of his
work the potential impact was only beginning to be understood (Shulman, 1986).
Digital technologies such as computers, electronic whiteboards connected with
projectors, access to the Internet were not as available in classrooms as they are
today. As a result, it is difficult to talk about teaching without acknowledging the impact
or potential impact of these digital technologies on teaching and learning. Mishra and
Koehler (2006) suggest

what has changed from the 1980’s is that technologies have come to the
forefront of educational discourse primarily because of the availability of a
range of new, primarily digital, technologies and requirement for learning how to apply them to teaching (p. 1023).

Although older technologies such as chalk, textbooks and overhead projectors, common technologies before computers, have now become transparent (Bruce & Hogan, 1998) and ubiquitous (Cox & Graham, 2009a).

New digital technologies “have constrained and afforded a range of representation, analogies, examples, explanations and demonstrations that can help make subject matter more accessible to the learner” (Mishra & Koehler, 2006, p. 1023). Unlike older transparent technologies, these new digital technologies are rapidly changing, are not designed for education, are not contextually situated and not easily applied in the classroom (Mishra & Koehler, 2006). They suggest that knowledge of digital technologies has become another important part of the knowledge base for teaching and teaching “requires developing a nuanced understanding of the complex relationships between technology, content and pedagogy, and using this understanding to develop appropriate, context specific strategies and representations” (Mishra & Koehler, 2006, p. 1029). Mishra and Koehler contend that now it is technology “that drives the kinds of decisions that we make about content and pedagogy” (Mishra & Koehler, 2006, p. 1029).

![Figure 2.7 – Intersection of technology, content and pedagogy = TPCK or TPACK](Reproduced by permission of the publisher, © 2012 by tpack.org)
To help teachers understand thinking with digital technologies, Mishra and Koehler (2006) proposed that technology was not merely an addition to content knowledge and pedagogical knowledge but an amalgamation of content, pedagogy and technology, where at the heart of the three is a technological form of PCK or what they have termed technological pedagogical content knowledge (TPCK) or it is now known as TPACK\(^1\) (Koehler, Mishra, & Cain, 2013; Koehler, Mishra, Kereluik, Shin, & Graham, 2014). Their TPACK framework is shown in Figure 2.7. Mishra and Koehler (2006) proposed that TPACK is the:

- *basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students’ prior knowledge and theories of epistemology; knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old one* (p. 1029).

With this new construct there has been a plethora of studies looking at defining and understanding how teachers develop TPACK. Voogt, Fisser, Pareja Roblin, Tondeur, and van Braak (2013), Chai, Koh, and Tsai (2013) both completed literature reviews where they identified 135 studies on TPACK to understand it’s theoretical basis and empirical application. Harris (2014) presented, after preparing the TPACK eNewsletter for over five years, that there were over 850 empirical published studies on TPACK. TPACK has become a popular framework for describing teacher’s knowledge.

Voogt, Fisser, Pareja Roblin, Tondeur, and van Braak (2013) assert that there have been three views of TPACK expressed in the TPACK literature: T(PCK) as extended PCK (Cox & Graham, 2009b; Niess, 2005)); TPCK as a unique and distinct body of knowledge (Angeli & Valanides, 2009); and TP(A)CK as the interplay between three domains of knowledge and their intersections and in a specific context (Koehler & Mishra, 2005, 2008, 2009; Koehler, Mishra, & Cain, 2013; Koehler, Mishra, Kereluik, Shin, & Graham, 2014). This highlights, that like PCK, the framework is not fully

\(^1\) TPCK was changed to TPACK to make a word that was easily pronounced and to highlight TPACK as the ‘Total PACKage’ as an integrated whole of the three domains (Thompson & Mishra, 2007).
understood (Angeli & Valanides, 2009) and the constructs “are not clear enough for researchers to agree on what is and is not an example of each construct... the boundaries between them are still quite fuzzy” (Cox & Graham, 2009b, p. 60). Segall (2004) suggests that while PCK “has often been cited, much used, seldom has the term or the lens it provides for the educative endeavour been questioned, engaged critically” (p. 490). Voogt, Fisser, Pareja Roblin, Tondeur, and van Braak (2013) suggest that there is “no universal agreement what PCK entails, there is also no agreements on what TPACK is” (p. 11). Graham (2011) also highlights that TPACK is built on an unsure foundation as “researchers are still lamenting the fuzzy definitions leading to the difficult in understanding PCK <where> the TPACK framework builds on the PCK framework and increases the conceptual complexity” (p. 1955).

Independent of the work on TPACK, the latest work to understand and define PCK was accomplished at the PCK Summit (Gess-Newsome & Carlson, 2013a, 2013b) where a group of prominent international science education researchers agreed on a consensus model of PCK and defined it in terms of the knowledge developed through reflection-on-action and reflection-in-action. Little research has been published where they are validating the model but a new book edited by Berry, Friedrichsen, and Loughran (2015), produced as a consequence of the summit, includes chapters prepared by many of the attendees offering hope that science education is progressing in defining an agreed definition of PCK. The problem is, this is only one group of researchers who have focused on defining PCK of science and there is no link to the TPACK conversation. It could be suggested by the lack of crossover research between these two separate groups of researchers that the PCK group do not acknowledge the importance of digital technologies where TPACK is a valid construct separate from PCK. An example, is the research undertaken by Keast and Cooper (2015), previously discussed where they used Slowmation (a digital technology tool for making stop motion movies) to understand the development of pre-service teachers PCK, with no mention of TPACK or the importance of digital technologies in their discussion.

Moving back to TPACK researchers who have studied PCK, Cox and Graham (2009a) found that TPACK could help in better understanding the potential contributions of digital technologies to the teaching of science. Working from Shulman’s original definition of PCK and through Lee and Luft’s (2008) review of PCK
conceptualisations, Cox and Graham (2009a) and Graham (2011) explored a more elaborate definition of PCK and TPACK together. From Lee and Luft’s (2008) analysis of the PCK research, where they identified eight common components of PCK, Cox and Graham selected two: representation and instructional strategies; and student learning and conceptions, as true conceptualisations of PCK to further explore TPACK. PCK was defined in terms of the general pedagogical activities or subject-specific activities or topic specific representations and for TPACK, technology was added to each construct. Cox and Graham (2009a) explored the components through two case studies to confirm their definition of the constructs.

![Diagram of TPACK Conceptualisations from Graham (2011).]

Extending the work from Cox and Graham (2009a) and Graham (2011), Graham, Borup, and Smith (2012) defined the components as: technological knowledge as general technology knowledge; technological pedagogical knowledge as knowledge of general instructional strategies and knowledge of general learner characteristics; and TPACK as knowledge of content specific instructional strategies, knowledge to transform content representations for teaching and knowledge of learner content understanding. A summary of their conceptualisations is shown graphically in Figure 2.8. Cox and Graham (2009a) called for further research, first that explored
TPACK in the form of in-depth case study research with practicing teachers with detailed examples of teacher’s knowledge in practice, second, for research looking at different grade levels, and third, for teacher educators to describe how teachers develop TPACK.

**Pre-service teachers using digital technologies**

Graham, Borup, and Smith (2012) used TPACK as a framework to understand the digital technologies integration decisions of pre-service teachers in the USA. They suggested that the TPACK framework provided “an analytical lens with which to look at the instructional decisions that teachers make … <as> very little research has focused on the how and why behind teacher candidates’ technology integration decisions” (Graham, Borup, & Smith, 2012, p. 533). They explored the differences between general and content specific reflections, and, by studying teacher candidates; they found their reflections increased in volume and quality after undertaking an educational technology course.

Keast and Cooper (2015) report how they were using Slowmation to help secondary Australian pre-service teachers develop their pedagogical content knowledge. Keast and Cooper used Shulman’s MPRA, as adopted by Nilsson (2009), as a coding framework for analysing pre-service science teachers discussion of using Slowmation for teaching science. To begin, the pre-service teachers were instructed how to use Slowmation and while on practicum they had to use Slowmation as a teaching strategy where their students developed a Slowmation video. Keast and Cooper (2015) suggest that pre-service teachers “have many important decisions to make regarding the use of Slowmation, such as whether or not a topic is suitable, which aspects should be assessed (and how) as well as matters raised by the use of group work” (p. 4). This process was captured in an assessment item where after practicum they gave an oral presentation describing their pedagogical reasoning and showing an example of the Slowmations. Shulman’s MPRA provided a useful framework for pre-service teachers to understand the complexities of developing their PCK while working with digital technologies. This paper does not reference or refer to TPACK as a separate knowledge from PCK although the students were working with a digital technology.
Value of pedagogical reasoning with digital technologies on pre-service education

There is limited research where Shulman’s MPRA has been used to explore pre-service teachers pedagogical reasoning with digital technologies. These two studies have confirmed that MPRA offers valid model that can be used with pre-service teachers when pedagogical reasoning with digital technologies. Again, an important element of MPRA is reflection where pre-service teachers have reflected on their practice. To extend the question posed previously is whether pedagogical reasoning with digital technologies is learned or innate and whether pre-service teachers can benefit from explicit teaching? The next section looks at the research on in-service teachers when they pedagogically reason with digital technologies.

In-service teachers using digital technologies

Primary in-service teacher

Finger and Finger (2013) described a Year five teacher (Mark) in an Australian school who has participated in a BYOD project at his school. They described the design, planning, implementation and ongoing reflection of his iLearn@eLearn approach in a virtual classroom. The paper explained how Mark set up a virtual classroom, as a place for students and their parents to access tasks, assessment, journals and grades. They describe his beliefs in using digital technologies as a way of demonstrating TPACK in meeting the Australia Professional Standards for Teaching in his pursuit of improving his teaching to be recognised as Highly Accomplished Teacher (AITSL, 2011). In response to the work suggested by Smart, Sim, and Finger (2013b), Finger and Finger call for a relook of MPRA to understand the implications of digital technologies. Like Smart, Sim, and Finger (2013a, 2013b) suggest that new view of pedagogical reasoning in terms of Technological Pedagogical Reasoning (TPR).

Secondary science in-service teachers

Starkey (2010a, 2010c) completed a doctoral study where she looked at the “decisions made by digitally able teachers…to explore the relevance of Shulman’s model of pedagogical reasoning within the context of the digital age” (Starkey, 2010c, p. 234). Her study looked at the practices of six early career secondary teachers in New Zealand to understand how they pedagogically reasoned with ICT. She used
think-aloud semi-structured interviews and observations to study the “pedagogical choices the case study teachers made when integrating digital technologies into their teaching practice” (Starkey, 2010c, p. 235). She used the headings from Shulman’s MPRA to understand the decisions they made when integrating ICT into their teaching practice. In her thesis, Starkey (2010a) included a descriptive case for each of the six teachers but did not provide a detailed analysis using Shulman’s MPRA to understand their pedagogical reasoning. In her published journal article Starkey (2010c) provided a detailed description of one of her teachers - Barry.

She described how Barry was teaching muscle function to high school physical education students in the case description. Barry had developed a comprehensive knowledge of muscle function in his undergraduate studies. In relation to comprehension, Starkey did not address his reasons for teaching muscle function and how it fitted with the curriculum to understand the purpose of his teaching. A further description of Barry was included in her thesis (Starkey, 2010c) that revealed that Barry was teaching an achievement standard as part of the New Zealand vocational education framework. Although Barry had a comprehensive understanding of muscle function, he had never taught this topic previously in a school but from the curriculum documents he decided to use an interactive website as his central source for the lesson.

Starkey began describing Barry’s transformation with the following steps beginning with his “teaching intention, then considered the teaching resources that he could use, critically analysing each for suitability of purpose” (Starkey, 2010c, p. 235). His critical interpretation began with the website and investigating how his students were going to access and then interact with the website for the lesson. She suggested that Barry had found there was an interactive quiz plus many interactive images that the students could manipulate. Starkey described how Barry prepared a webpage of links to the website “to limit students being distracted or getting lost as he was aware that this was a probability given the limited access to computers his students had experienced at school” (Starkey, 2010c, p. 238).

Transformation for Barry was the most confusing aspect of his pedagogical reasoning. As Starkey suggested, “Barry did not transform his subject knowledge, instead he selected resources and teaching methods that he thought would be
appropriate for his students to use to understand the specific concepts he was teaching” (Starkey, 2010c, p. 238). The website, designed for students of any level of education, allowed him to give the students the opportunity to explore, to enable their own learning based on what interested them while working with peers to encourage discussion. His selection from his instructional repertoire included how he shared the website in the classroom and how he arranged the students in the room.

Starkey (2010c) described how Barry used “a variety of instructional techniques, all of which focus on the observable aspects of delivering content or getting students to engage in activities” (p.238). She observed Barry introduce the learning intention, demonstrate how to access and use the website and during the lesson he moved around the room interacting with students. She explained that Barry had good classroom management in order to keep the students focused on learning as he “planned the lesson with this in mind, was vigilant throughout the lesson, he gave time to each students in the class as they accessed the major muscle group activities and he set up the lesson to minimise predicted off-task behaviour” (Starkey, 2010c, p. 239).

Starkey (2010c) described Barry’s evaluation from inside the classroom where Barry integrated student self-assessment, peer support and provided feedback. It was clear from Starkey’s description that Barry performed evaluation during the lesson. She did not explain if Barry had any technological issues that interrupted his teaching or how Barry assessed the students. Finally, she did not provide any thoughts Barry shared about his own performance. Starkey (2010c) suggested that teachers reflect in three ways; i.e. pedagogical decision-making; student engagement; and the effectiveness of the lesson. She described how she captured elements of Barry’s reflection based on the lesson she observed. Starkey described how Barry reflected that the use of the webpage kept his students on task and it was an effective strategy when using ICT. He acknowledged that the content of the website engaged them in learning about muscle function and the activities sustained them for the whole lesson. In reviewing her data there were multiple instances where Barry showed that he had developed new knowledge about ICT (e.g. Protopage was a good tool to direct students with the use of the Internet), his students (e.g. links to website stopped students from being distracted, the game engaged them) and his pedagogy (e.g. Barry
was able to manage behaviour with one student who was doing work for another class while working on the computer).

Starkey (2010c) concluded that Shulman’s MPRA provided a useful framework for looking at teachers decision-making. From her case study describing Barry, she was able to show evidence of each element of the model but suggested there were differences between the process of transformation, instruction and evaluation. She found that there were similar results across her six case studies but these depended on the resources that the teacher chose to use. All of her teachers used a variety of technological resources and her findings suggested that a major concern was that they were unsure how to use these resources to aid in teaching and learning, as they were “working from theoretical model of learning that pre-dated the digital era” (Starkey, 2010c, p. 241). Starkey proposed a model of teacher pedagogical reasoning and action for the digital age as shown in Figure 2.9.

Starkey retitled her whole process of transformation as “Enabling connections”, which she justified as the preparation for teaching. She began with the selection of resources but it was important to note the use of the term ‘appropriate’. She agreed with what Shulman was trying to achieve in the processes of preparation, as preparation involves the critical interpretation of given materials. In Barry’s case, he did not need to correct any content, as the interactive website helped improve Barry’s understanding of the content. To understand the transformation processes Barry understood the value of the interactive website where the students could explore muscle function from differing perspectives. Starkey described Barry’s instructional strategies of using classroom seating and encouraging peer support by allowing students to work collaboratively while investigating the website. Starkey did not provide any references to Shulman’s stages of presentation or instruction in her model but she did include two dot points devoted to instructional approaches in her third and fourth bullet points.
Figure 2.9 - Model of teacher pedagogical reasoning and action for the digital age
(Starkey, 2010a)

Starkey suggested that before deciding to use any educational website, the needs of the particular students must be considered. Barry used Protopage where he stored the links to the interactive website to alleviate the potential problems of searching the Internet to find the website. Starkey includes adaptation and tailoring as the last step in transformation where learning is personalised for students. It is clear from the case study that Barry began his transformation with his students in mind. He decided to use a website that he knew would engage the students and help them understand muscle function. Starkey's work highlights that teachers begin thinking about their students at the start of transformation when deciding appropriate resources and methods. However this is not reflected in where she placed adaptation and tailoring as the last step in enabling connections stage.

Starkey removed instruction and evaluation and replaced them with teaching and learning where she included formative and summative assessment and argued that, over the last twenty years, that evaluation of student learning has become integral to teaching. By removing instruction, Starkey removed the importance of the ‘in
classroom’ part of the process and in terms of evaluation. There were examples where Barry used formative assessment in the form of games and a quiz that the students accessed from the interactive website and they received immediate feedback. She made no mention of the assessment approach.

Secondary ICT in-service teachers

Webb (2002) studied secondary Information Communication and Technology (ICT) teachers to understand their pedagogical reasoning with implementing the ICT curriculum in the UK. Webb applied Shulman’s MPRA because it provided “a more detailed description of educational processes that … can provide a basis for examining the range of issues and problems associated with teaching and learning ICT” (Webb, 2002, p. 240). She updated Shulman’s model (Figure 2.10) by adding knowledge, ideas, beliefs and values, where she suggests that “the processes will be informed not just by knowledge but by ideas, values and beliefs that teachers use to prioritise and select from their knowledge base to justify their decisions” (Webb, 2002, p. 241). Her model showed the five processes of pedagogical reasoning in a sequential flow but the sixth process of new comprehension was missing.

Webb describes Comprehension as in identifying the ideas to be taught and using knowledge of education purposes, content knowledge and previous experience of teaching the topic. In working with secondary ICT teachers she highlighted that their beginning point for comprehension was the content laid out clearly in curriculum or the syllabus (Webb, 2002, p. 243). In a separate diagram, she described Transformation (shown in Figure 2.11) in terms of Shulman’s sub-processes: Preparation; Representation; Instructional selection; Adaptation; and Tailoring.
In the **Preparation** process, she suggests how a teacher might examine the key section in the syllabus to determine what they actually needed to teach, selecting from their knowledge base or textbooks. In **Representation** they think about the different ways that the required knowledge could be taught to the students where multiple forms of representation was desirable. For **Instructional selection**, she proposed that teachers use their knowledge of learners as influenced by their ideas, beliefs and values, to select pedagogical strategies for teaching the content. **Adaption** entailed
modifying the content to suit the students, taking into account all equity issues, prior knowledge, motivation and skill while Tailoring was the final process and involved fitting the plan to a particular group of students. Webb suggested teachers’ ideas, beliefs, values and learners impacted through all stages of transformation.

Figure 2.11 - Transformation of knowledge within teacher’s pedagogical reasoning (Webb, 2010, p. 99)

Webb (2002) defined Instruction in terms of the delivery of the content in a lesson where she emphasised that there was little research on effective teaching with ICT. She agreed with Shulman in that instruction involved performing a variety of teaching and classroom management though she added that ICT “lessons involve management of a complex range of sources of software and hardware” (Webb, 2002, p. 250). Webb suggests that ICT impacted Evaluation in terms of the assessment processes where teachers “need the pedagogical content knowledge to be able to predict problems, identify signs and be ready for key questions to enable students to make progress” (Webb, 2002, p. 251) when using ICT. She suggested that evaluation
was not only undertaken by teachers but by students when assessing themselves and that feedback from evaluation is important as it can be used to modify teaching and learning activities highlighting that instruction and evaluation are intricately linked.

Webb did not provide any description of why Reflection was included in her model and she did not include New Comprehension as a process but a flow on her diagram from Reflection to Comprehension. In studying pedagogical reasoning, Webb and Cox (2004) added a framework for pedagogical practices relating to ICT use. This framework “represents the processes involved in pedagogical practices and the main flows and stores of data” (Webb & Cox, 2004, p. 239). This model highlighted the importance of teachers’ knowledge, belief and values on their pedagogical reasoning and how that influences their behaviour and the development of lesson plans. The key aspect of this framework is the central focus on affordances, where Webb and Cox wanted to emphasise that ICT offered affordances.

In this way, Webb and Cox widen the focus of pedagogical reasoning to include the learner. This time their framework includes teachers’ pedagogical reasoning as a process on the left side highlighting the link between knowledge, pedagogical reasoning and teacher behaviours with pedagogical reasoning embedded in lesson plans. The right side of the diagram shows how the student’s knowledge, belief and values influence both their behaviour and how affordances can be used in the classroom. ICT provides affordances that are realised in the classroom Webb and Cox suggest that teachers can facilitate learning: by providing them with the affordance; by increasing the degree of an affordance provided by ICT; and by giving students additional information about an affordance.

In 2011, Webb published further work to refine her framework for pedagogical practices relating to ICT use. The new revised framework includes details of technological pedagogical content knowledge or TPACK, updates to the data stores to reflect assessment practices and new emphasis on the relationship between teacher, student and ICT behaviours. Webb suggested that “this framework combines individual and group regulation of learning where pedagogical reasoning is transparent as possible and shared between students, teachers and others involved in students’ learning” (Webb, 2011a, p. 11). A final version of the framework was published in 2014 where Webb (2014) provided minor modifications to her framework including a name.
change to the revised framework for pedagogical practices relating to ICT use and a revision of the text describing the learning interactions.

In the revised version shown in Figure 2.12, Webb (2010), pedagogical reasoning as a whole is missed and Webb’s focuses on the transformation of knowledge. Again all steps of transformation are included with this version showing an update to the types of knowledge that input into each process where the focus is on TPACK. In this model, the data flows of curriculum knowledge of materials; software has been replaced with TPCK. The first model not only included the processes but data flows to highlight the knowledge required for each process. Webb emphasised that she wanted to include the important factors and relationships in her model so they were not overlooked. The model shown in Figure 2.10 presented the flow of processes in a linear relationship in the same way that Wilson, Shulman, and Richert (1987) and Gudmundsdóttir (1988) had done years earlier. Her latest model shown in Figure 2.12 highlights that the processes are not linear showing the complexity of pedagogical reasoning, the reciprocal nature of the relationships that are interconnected and the importance of learners.

![Figure 2.12 – Webb’s revised framework for pedagogical practices relating to IT-use (Webb, 2011, p.12)](image-url)

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History in-service teachers

Feng and Hew (2005) applied Shulman’s MPRA to observe how ICT was integrated into planning instruction in their phenomenological study of in-service history teachers in the USA. They studied seven teachers where they interviewed and collected lesson plans. Their teachers ranged in level of experience from six months to 29 years. As their study focused on the teachers’ planning decisions they only looked at the first two of Shulman’s processes: comprehension and transformation and the sub-processes of transformation - preparation, representation, selection and adaption and tailoring. Comprehension was defined in the same way as Shulman suggested where these teachers comprehended: the purpose of lessons; curriculum standards; subject matter structures. Their findings suggested a modification to Shulman’s original ideas of transformation as shown in Table 2.2.

They found evidence that the teachers did not necessarily go through pedagogical reasoning in the linear manner as they responded to state exams and student characteristics. They suggested that Shulman’s definition of preparation was “too general and confusing a term to be used in our study” (Feng & Hew, 2005, p. 6) and therefore modified it to “interpretation” as they interpreted the curriculum. They found evidence of reflection in terms of teachers recalling past teaching and learning experiences and decided to add it to their model. They described reflection where the teachers recalled and thought about “general pedagogical knowledge from their past learning and teaching experience, such as what worked well, what did not work well, as well as the students’ characteristics or learning problems” (Feng & Hew, 2005, p. 7). They found evidence of representation, selection and adaption and tailoring to student characteristics and renamed it as “specification”. Specification was where the teachers engaged in planning for teaching and learning. They added two new processes: selection of ICT tools and caution. Teachers select the ICT tools to integrate into their lessons. Caution included the planning that the teacher does as a precaution as it anticipated the technical problems of using ICT if there was a technology failure. This model provides a different perspective of the processes of transformation that will be useful for this study.
Table 2.2 Comparison of Feng and Hew's model to Shulman's model of pedagogical reasoning and action (Feng & Hew, 2005, p. 6)

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<td>Preparation</td>
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<td>Representation</td>
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<td>Selection</td>
<td>Selection of technology tools</td>
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<td>Adaptation and Tailoring</td>
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Key outcomes for the MPRA as a results of the research over three decades

This literature review has included many research projects that have used MPRA to explore the pedagogical reasoning of teachers to add to the research base on pedagogical content knowledge and pedagogical reasoning. Though, over the last thirty years the focus of research has been on pedagogical content knowledge with very little empirical work completed examining Shulman's MPRA. This chapter has included an extensive list of papers but very few have actually looked deeper in the intricacies of the processes of pedagogical reasoning to confirm and critique the model. Of the 34 papers presented in this literature review only 22 studies have provided evidence of empirical work. Of the 22, only six authors have questioned the model and revised and updated it as a result of their work.

The empirical research in this literature review has been undertaken predominantly in the United Stated, then Australia followed by Sweden where over a total of only 267 pre-service, early career, experienced and expert teachers represented in the studies. Most studies have focused on pre-service teachers, then early career, then experienced with a few studies examining expert teachers. The most common approach for research was case study but a few mentioned the use of experiments. The most popular data collection technique was through individual or focus group interview though think-aloud and video-stimulated recall were also used to provide more detail of pedagogical reasoning. The second most popular method was
observation though in many studies pre-service teacher assessment was used to
determine the pedagogical reasoning of pre-service teachers with secondary pre-
service teachers studied the most. There have been multiple studies over the last 25
years to define and describe pedagogical reasoning highlighting its continued interest
and current relevance, especially with the major investment by the Australian
government in the Australian Research Council (ARC Discovery Grant 2014-2016
$343,000 project currently being undertaken at Monash University (http://monash.edu/science-

Shulman’s early work as part of the National Institute of Education described
the cognitive processing of teachers including the antecedents as well as the
consequences. The antecedents included the internal (beliefs, styles, goals, objectives
and knowledge) and external (cues, organisation and role expectations). Shavelson
(1983); Shavelson and Stern (1981) also identified the antecedents to teacher
judgment that include students, the nature of instructional tasks and classroom/school
environment. Although Shulman was a leading contributor to this foundation work,
much of this thinking was not acknowledged in his subsequent work in understanding
pedagogical reasoning though he made many references to knowledge, beliefs and
other factors in discussing pedagogical reasoning. To understand pedagogical
reasoning there is a need to understand what influences a teacher when they
pedagogically reason. The next section presents a literature review of the influences to
using digital technologies and how they relate to pedagogical reasoning.

Factors influencing the use of digital technologies for
teaching and learning

The literature emphasises the complex relationship between knowledge and
pedagogical reasoning. Gudmundsdóttir was the first to adopt a model where she
linked pedagogical reasoning with teacher knowledge (Gudmundsdóttir, 1988). Her
process of pedagogical reasoning (as shown in Figure 2.2) includes content
knowledge, pedagogical content knowledge, general pedagogical knowledge and
knowledge of the learner and its impact on the preparation, transformation and
adaptation processes of teaching. Others from the Knowledge Growth in Teaching
Project studying pedagogical reasoning were investigating how content knowledge
interacted in pedagogical reasoning, Ringstaff and Haymore (Ringstaff, 1987; Ringstaff & Haymore, 1987) studying teachers who were misassigned or teaching out of their fields, and McGraw (McGraw, 1987) studying early career teachers’ comprehension of subject matter. They used MPRA as a framework with findings suggesting that MPRA was suitable for the study of teachers’ pedagogical reasoning, but they did not imply any relationship between knowledge, beliefs and pedagogical reasoning. Throughout the case study descriptions presented by Gudmundsdóttir, Ringstaff, Haymore and McGraw, there are many mentions of the knowledge and pedagogical beliefs the teacher’s describe when talking about their pedagogical reasoning. These studies highlight the knowledge and beliefs about teaching and learning had a large influence on how they pedagogically reasoned.

There are many studies (Cunningham, 2007; Endacott & Sturtz, 2015; Meredith, 1995; Peterson & Tregust, 1992, 1995, 1998) described in this literature review that suggest another complex relationship between teachers’ pedagogical beliefs and pedagogical reasoning. The Knowledge Growth in Teaching Project studied early career and expert teachers to understand pedagogical reasoning where beliefs about content would have emerged as teachers expressed their confidence in teaching different topics. Peterson and Tregust (1995) and Meredith (1995) studied pre-service and early career teachers where their beliefs of the importance of teaching science and maths would have been a large influence in how they pedagogically reasoned. Cunningham (2007) and Endercott and Sturtz (2015) worked with social studies teachers where the studies focused on discussing their beliefs about the importance of teaching historical empathy.

Fives and Buehl (2012) suggested that the research on teacher beliefs span more than 57 years with more than 700 articles that “runs the gamut of research methodologies, theoretical perspectives and identification of specific beliefs about any number of topics” (p. 471). They found that teacher beliefs could be framed to include beliefs about self (sense of self efficacy, identity and role as a teacher), context or environment school climate and culture, relationships with colleagues, administrators and parents), content or knowledge, specific teaching practices, teaching approach, and students (diversity, exceptionality, language differences, ability, learning and development). They suggest that teacher beliefs, both explicit and implicit, create an
ongoing challenge as the teacher may not know or be able to articulate their beliefs that guide their practice.

Webb (2002, 2011a) highlighted the importance of ideas, values and beliefs about knowledge and students as an influence to transformation, instruction and evaluation processes of pedagogical reasoning. Webb and Cox (2004) argued that teachers often need to change their pedagogical beliefs for particular changes in their pedagogical practices to occur. In order to use digital technologies they need to believe that digital technologies are important for teaching and learning. Starkey (2010) studied early career digital technology using teachers to understand their beliefs about teaching and the use of digital technologies. With the change in access to technologies, change in students as digital natives and the change in curriculum emphasis, Ertmer (Ertmer, 1999, 2005, 2006; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ertmer, Ottenbreit-Leftwich, & Tondeur, 2014) identified beliefs as one of the strongest internal factors for teachers in deciding to use digital technologies in the classroom. Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012) examined the beliefs and practices of 12 award winning technology using teachers. Through interview and website review, they found evidence that the teachers’ beliefs were enacted in the classroom. Their beliefs highlighted how they used digital technologies to deliver content and reinforce skills, to complement and enrich the curriculum, and, most importantly, to transform teaching and learning as a new kind of pedagogy. One teacher held a strong belief that traditional methods of teaching were not suitable for teaching digital natives, while another teacher described a belief of wanting to find a more effective way of reaching his students through technology. Beliefs about digital technologies may have a significant influence on how teachers pedagogically reason.

Tondeur, Van Braak, Sang, Voogt, Fisser, and Ottenbreit-Leftwich (2012) also looked at the link between pedagogical beliefs and the use of digital technologies where they suggested “pedagogical beliefs affect how teachers integrate technology” (p. 11). They suggested that knowledge and beliefs “are intertwined, and therefore, both are often conceived as an inherent part of teacher knowledge” (Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2013, p. 7). With the introduction of digital technologies Voogt et al. (2013), referencing a variety of studies from 2005 – 2011, posited that there are two perspectives, namely, beliefs about the use of digital
technologies and pedagogical beliefs. Voogt et al. (2013) argued in support of Webb and Cox’s (2004) conclusion that, because teacher knowledge and beliefs are intertwined,

*that is not enough to only define teacher knowledge but also to study teachers’ pedagogical reasoning in order to fully understand teachers’ decision making about technology use...it is also necessary to understand how a teacher’s technological reasoning affects his (or her) decision making while using technology (Voogt et al., 2013, p. 11).*

The research reviewed in this chapter has revealed a number of external influences that have impacted upon teachers when they pedagogically reason. To illustrate, the National Institute Education (1975) suggested that student factors might influence teacher cognition. They defined the influences in terms of being antecedents to teacher cognition as they:

*include the variety of variables that serve as ‘cues’ to the teacher. These include student behaviour, student characteristics (sex, race, size, appearance, numbers), student records (including achievement, grades, measured aptitude, IQ, family background, attendance, previous behavioural problems) (p. 13).*

For many teachers, thinking about their students is at the core to their cognition, but with the introduction of new digital technologies teacher thinking must take on a whole new perspective. Some suggest that students, as ‘digital natives’\(^2\), want to use new technologies and so teachers must design learning that involves the use of digital technologies in order to engage students (Prensky, 2005). Bennett, Maton, and Kervin (2008) challenge Prensky’s view of digital natives, suggesting that digital natives are not so savvy in using digital technologies that engage them and that education does not need to significantly change in reaction to their increased awareness of digital technologies.

Multiple studies in this literature review acknowledge that students are a major influence on how teachers’ pedagogically reason. They plan for student engagement in the transformation stages, leading to how they engage during instruction stage, to how students are assessed in evaluation. Webb and Cox (2004) and Webb (2005, \(^{\text{Mark Prensky (2001) defined digital natives as “native speakers of the digital language of computers, video games and the Internet” (p.1).}}\)

\(^2\)
2011, 2014) included students in pedagogical reasoning when looking at the affordances that digital technologies offer teachers. They suggested as students take more control of their learning, this in turn will influence teacher pedagogical reasoning. Nilsson (2008) used student feedback to help pre-service science teachers understand their pedagogical content knowledge. Starkey (2010) reported in her case study that Barry considered student engagement when planning his lessons.

Nearly twenty years ago, Ertmer (1999) studied teachers to understand what was stopping them from effectively using digital technologies for teaching and learning. She suggested they encounter first-order barriers as “those obstacles that are extrinsic to teachers…types of resources (e.g., equipment, time, training, support) that are missing or inadequately provided in teachers’ implementation environments” (Ertmer, 1999, p. 50). Ertmer (1999) suggested there are a number of key external first-order barriers concerning availability of hardware and software tools, time for implementation, professional development and support.

British Educational Communications and Technology Agency (BECTA) (2004) defined these types of barriers as institutional or school level barriers, for example, lack of technical training and access to resources. Balanskat, Blamire, and Kefala (2008) defined barriers in terms of micro (teachers attitudes and approach to ICT), meso (institutional context) to macro (system-level barriers). Bingimlas (2009) described school level barriers as: lack of time to implement digital technologies; lack of effective training; and lack of technical support. Teachers need effective strategies to overcome or minimise these influences as they work using digital technologies for teaching and learning. Schools and educational systems have improved the availability of the technological resources that teachers need to use or they are moving to environments where students have their own digital technologies.

Somekh (2008) suggested the “interlocking culture, social and organisational context in which they live and work” (p. 450) as an impact on technology adoption with Ertmer (2010) agreeing that teachers can experience cultural pressure for pedagogical change. Somekh (2008) suggested that schools that have ample digital technologies, a focus on changing pedagogy; professional development, providing support with opportunities to discuss and explore solutions are successful in school wide pedagogical change. Somekh reinforced that the school context can have an impact of
the use of digital technologies for teaching and/or learning, while, Meagher, Ozgun-Koca, and Edwards (2011) suggested that when pre-service teachers are exposed to digital technologies in the school context on practicum, might improve their use of digital technologies when they begin teaching.

Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012) revisited the research on first-order and second-order barriers to update the status in recognition of the advances in digital technologies over this time. With major investment in digital technologies in schools across the globe, she reported a number of studies that suggested that many schools now have the hardware and Internet access for students. With the wide variety of low cost and easy-to-use software tools that are available over the Internet teachers and students have access to digital tools for teaching and learning. Ertmer et al. (2012) reported that there has been improved professional development with teachers feeling adequately trained to operate technological equipment, search the Internet and use administrative software. Finally, Ertmer et al. (2012) described how schools have improved the provision of support for teachers in digital technologies integration including administrative, technological, and professional and peer support.

Ertmer and Ottenbreit-Leftwich (2013) described how access to resources, curriculum materials and support (technical, administrative and peer) were provided to help teachers overcome their first-order barriers to using digital technologies in their classrooms. Teachers were reported to have better attitudes and more confidence with more meaningful use of digital technologies. Within the school environments there are a number of factors that influenced teachers in using digital technologies. Ertmer et al. (2013) described in multiple case studies where support from the school administration and, in particular the principal, positively impacted the teachers when implementing digital technologies.

There are a number of differing internal and external influences that enabled or acted as barriers for teachers when they want to use digital technologies for teaching and/or learning. Throughout this literature review there has been many mentions of teachers at different career points and there was no research looking at pedagogical reasoning across various career stages. The next section provides a review of the research on teacher career stages.
Teacher professional career stages

This section of the literature review attempts to provide a framework for the various career stages chosen in this thesis. Huberman (1989) suggested that each career stage lays the foundation for the next stage and teachers are continually building upon each stage to move to the next.

Fessler (1985); Fessler and Christensen (1992) proposed a model of the dynamics of teachers’ career cycles. Fessler proposed that the career stages of a teacher include: pre-service; induction; competency building; enthusiastic and growing; career frustration; career stability; career wind-down; and career exit. This model covers the full extent of teachers working careers where the stage reflects their attitude to teaching at that point in time.

Steffy and Wolfe (1998) described the stages as:

1. Novice – The novice phase begins when pre-service students first encounter practicum experiences as part of their teacher education program and continues through student teaching and the intern experience.
2. The apprentice phase begins for most teachers during the student teaching experience when they are given responsibility for planning and delivering instruction. This phase typically continues through the first year of induction and often into second and third years of teaching.
3. The professional phase emerges as teachers grow in their self-confidence as educators. Student feedback plays a critical role in this process.
4. The distinguished phase is reserved for those teachers who are truly gifted in their field. They exceed current expectations for what teachers are expected to know and be able to do.

Huberman’s (1989) identification of the developmental phases of a career are more focused on the concepts of life, age or years of experience. Huberman (1989, 1993) wanted to determine if there was an identifiable developmental sequence over a teaching career, and, if so, to identify its main patterns and configurations. Huberman (1989) identified the following main stages of a teacher’s life cycle:

1. career entry – survival and discover;
TECHNOLOGICAL PEDAGOGICAL REASONING - THE DEVELOPMENT OF TEACHERS' PEDAGOGICAL REASONING WITH TECHNOLOGY OVER MULTIPLE CAREER STAGES
Chapter 2: The literature

Steffy, Wolfe, Pasch, and Enz (2000) suggested there are several basic assumptions grounded in research, theory and best practices about the nature of teaching and teachers. Firstly, teacher development is based on a continuum for forward projection with a positive trajectory based on personal improvement. It is assumed that early career teachers want to become better at teaching over their careers. Steffy, Wolfe, Pasch, and Enz (2000) suggested that an advocacy model in that it offers a prescription for enhancing teaching. Secondly, the level of development in the life cycle of teachers is a function of personal characteristics, school context, support systems and solid preparation. Teachers individually cannot move through the stages but are reliant on a number of factors that work together to enable growth and development. Finally, Steffy, Wolfe, Pasch, and Enz (2000) suggested that teaching excellence is influenced by the teacher's ability to learn, do scholarly work and commit to professional growth. Teachers must commit to a continual process of reflections and development in order to improve their practice.

Lynn (2002) suggested the “movement in and between these eight stages is dynamic and flexible rather that static and linear” (p.4). Lynn (2002) suggested “teachers have different attitudes, knowledge, skills and behaviours at various points during their career” (p. 1) where they change “their concerns, instructional behaviours, understanding of children, awareness and understanding of the school and teaching environment and perceptions of themselves, their work and their professions” (p. 1).

Elsewhere, the Australian Institute for Teaching and School Leadership (AITSL) in the Australian Professional Standards for Teachers (AITSL, 2011) provided a definition for various teacher career points. These definitions are:

1. Graduate teachers have completed a qualification that meets the requirements of a nationally accredited program of initial teacher training.
2. **Proficient** teachers meet the requirements of full registration through demonstrating achievement of the seven Standards at this level.

3. **Highly accomplished** teachers are recognised as highly effective, skilled classroom practitioners and routinely work independently and collaboratively to improve their own practice and the practice of colleagues.

4. **Lead teachers** are recognised and respected by colleagues, parent/carers and the community as exemplary teachers. They have demonstrated consistent and innovative teaching practice over time. Inside and outside the school the initiate and lead activities that focus on improving educational opportunities for all students. (AITSL, 2011, p. 6)

Each career stage is described in the standards and offers a lens to view the professional knowledge development of teachers.

While it is clear there are a number of models that describe teacher career stages and there is no commonly accepted definition. There is agreement that there is a significant change from pre-service to in-service. This stage is often termed **early career**. From here, teachers move to building proficiency through experience, and many become fully professional and many will become “distinguished". AITSL terms this “highly accomplished", where the teacher is recognised as being effective in the classroom within their school community. Whether proficient or highly accomplished, all such teachers are “experienced". A final stage worthy of identification is that termed by AITSL “lead". This point such teachers are identified because they are influencing the professional growth of other teachers. These stages define the teachers in terms of the role they play. The above definitions attempt to address the capacity of the teacher to grow based on career progression, influences and opportunities provided in context. They can be useful to identify individual career achievements and facilitated professional aspirations.

**Chapter Summary**

Over the last thirty years, there have been a limited number of studies aimed at understanding teachers’ pedagogical reasoning and this literature review has attempted to provide an overview of the research that has used Shulman’s MPRA to understand how teachers’ pedagogically reason. Most of these studies are speculative.
TECHNOLOGICAL PEDAGOGICAL REASONING - THE DEVELOPMENT OF TEACHERS’ PEDAGOGICAL REASONING WITH TECHNOLOGY OVER MULTIPLE CAREER STAGES

Chapter 2: The literature

(Kennedy, 2008) in that most the studies are limited to case studies of individual teachers and many of these studies have not challenged Shulman’s original definition of pedagogical reasoning. With limited research and examination of the strength of MPRA, this signals a significant gap in the lack of research on pedagogical reasoning that is relevant for this study.

With the introduction of digital technologies and the consequential changes that digital technologies might have for teachers practice, some studies have investigated the implications of pedagogical reasoning with digital technologies. From the multiple studies discussed in this chapter by the authors, Webb, Feng and Hew, Starkey and Mercier, all commonly suggested that pedagogical reasoning changes when teachers begin to use digital technologies for teaching and/or learning. Webb (Cox, Webb, Abbott, Blakeley, Beauchamp, & Rhodes, 2004; Webb, 2002, 2005, 2010, 2011a, 2011b, 2014) discussed the affordances that digital technologies offer, Feng and Hew (2005) focused on the planning decisions of in-service teachers, Starkey (2010a, 2010b) proposed a new model of teacher pedagogical reasoning and action for the digital age and Mercier (2012) discussed the differences in pedagogical reasoning from the laboratory to the classroom. All capture elements of pedagogical reasoning with digital technologies of pre-service and in-service teachers from around the globe. Each study mentioned above has looked at Shulman’s original framework and challenged its soundness as a framework that can be used to understand the complexities of pedagogical reasoning with digital technologies. Their weakness is that their work is speculative and there is little empirical evidence to support their conclusions where their models have not been tested in multiple settings. This highlights the second significant gap that is relevant for this study.

It is clear from the research, that pedagogical reasoning in an age of digital technologies is complex, as there are many factors that can influence teachers when they pedagogically reason and there is limited research that describes the factors. This literature review highlights that teachers require the development of knowledge, the beliefs and the contextual environments that support effective practice. This suggests the third significant gap that is relevant for this study, that there is limited research that has identified and discussed the influences upon teachers’ pedagogical reasoning with digital technologies.
The final gap that is relevant for this study, suggests there is little research on teachers' pedagogical reasoning across various career stages. This research project will attempt to identify the similarities and differences across career stages of how teachers' pedagogically reason with digital technologies and what influences them when they pedagogically reason. With these gaps in mind, this study aims to investigate the following research questions:

**RQ1:** How do teachers pedagogically reason with digital technologies?

**RQ2:** What are the differences in pedagogical reasoning with digital technologies across three career stages?

**RQ3:** What influences teachers when they pedagogically reason with digital technologies?

Many studies have failed to examine both the strength of Shulman's MPRA and teachers' pedagogical reasoning, or more currently, teachers' pedagogical reasoning with digital technologies. Although teachers' actions can be easily observed, the knowledge, beliefs and teacher thought processes are considered methodologically challenging to researchers (Clark & Peterson, 1986). To address these challenges, the methodology that will be used for this study will be discussed in relation to the research questions in the following chapter.
CHAPTER 3: METHODOLOGY AND RESEARCH DESIGN

This chapter

The literature reviewed in the previous chapter provided the important foundations for this research project in relation to previous research that had been conducted about teachers' pedagogical reasoning with digital technologies. This chapter outlines the research design and methodology employed for this study. It begins with situating this study within the qualitative paradigm to substantiate how the qualitative frame shaped the research design and methodology. A rationale for the case study research strategy is then presented. Subsequently, the approach for recruiting the research participants is explained. The ethical considerations and approval are discussed before introducing the data collection methods, which included video-stimulated recall interviews, think-aloud concept mapping interviews, concept maps, and digital portfolios. Each method is described and justified before explaining the data analysis process. The chapter concludes with a discussion of the trustworthiness of the study.

Methodological framework

Qualitative paradigm

It is important to adopt a philosophical viewpoint or intellectual culture in conducting educational research (Blaxter, Hughes, & Tight, 2006; Oakley, 1998). This viewpoint guides the researcher into selecting the research approach and shapes the approach to the research process to support the investigation into the research topic. “Paradigms are essentially intellectual cultures, and as such they are fundamentally embedded in the socialisation of their adherents: a way of life rather than simply a set of technical and procedural differences” (Oakley, 1998, p. 155). Edwards (2002), in a presidential address to the British Education Research Association (BERA), suggested that, “as researchers, we ... interpret and respond in ways that are permitted in our own research cultures” (p. 9).

Research paradigms are the hidden assumptions that researchers use when they begin to comprehend, analyse and present the significance of their data. Guba
and Lincoln (1994) described a paradigm as a set of basic beliefs dealing with first principles. It is a worldview describing the nature, place and relationship to the world. For these reasons this study is specifically situated within what Denzin and Lincoln (2000) refer to as:

A constructivist-interpretative paradigm assuming a relativist ontology (there are multiple realities), a subjectivist epistemology (the knower and respondent co-create understandings) and a naturalistic (in the natural world) set of methodological procedures (p. 21).

The use of naturalistic inquiry is based on context, where context is viewed as a “complex web of unique interrelationships” (Erlandson, 1993, p. 16) within which the researcher participates in co-constructing the reality. Creswell (2009) suggested that qualitative research has many characteristics and that data should be collected in the natural setting. For this research project, data was collected in the natural settings of the participating teachers’ classrooms, in their schools, and in the process of their teaching. The researcher was the key person in negotiating and obtaining this data from the teachers. The researcher was the instigator of this project, negotiating with the principals and the teachers to gain their support and approval to be allowed into their classrooms for the purpose of undertaking the research.

Co-constructing knowledge between these teachers and the researcher is embodied in the heart of constructivism:

*Human beings do not find or discover knowledge so much as we construct or make it. We invent concepts, models and schemes to make sense of experience and we continually test and modify these constructions in the light of new experiences* (Schwandt, 2000, p. 197).

Teachers worked with the researcher to co-construct an understanding of their pedagogical reasoning with digital technologies. Crotty (1998) suggested that the epistemological considerations of constructivism focus exclusively on the meaning making of the individual mind. The constructions in the minds of the individuals are considered as real (Lincoln & Guba, 1985), in that, these are real teachers sharing their knowledge; constructions are not seen as truth but in terms of “the best informed and most sophisticated construction on which there is consensus at a given time” (Schwandt, 1994, p. 128). These constructions were of a personal nature’ as participants interacted with the researcher and were refined only through interaction between investigator and respondent (Guba & Lincoln, 1994). The task of the
researcher is to document and communicate these multiple and sometimes conflicting social constructions of meaning and knowledge. Therefore, the researcher becomes the research instrument through which the data are collected, analysed and understood.

For qualitative research, the role of the researcher is important and, as a passionate participant (Lincoln, 1991), the researcher is someone directly involved in the research, working with the participants, understanding them as a facilitator or voice re-constructionist. The quality of the research can depend on how well the relationship of trust is built with the participants so that they are willing to disclose their thoughts and reasons for their actions. The better the trust with the participants, the more open they are, and this enables the best chance of ‘richer’ and ‘thicker’ data that can be collected. It was evident that ‘rich’ descriptions of teachers’ thinking with digital technologies and the opportunity to uncover influences were essential to the research purpose.

**Role of the researcher**

The researcher has a unique understanding of teaching with digital technologies and teachers after teaching for nearly ten years. It is the experience of being a teacher that enabled the researcher to bring together practice and research in a meaningful way. As a teacher, the researcher has developed an awareness of how she had used digital technologies in her teaching to develop a deeper understanding of her own pedagogical reasoning with digital technologies. Through developing a deeper understanding of her practice, her pedagogical reasoning became more aware through the research process, reflections and exploration of pedagogical reasoning with other teachers. Her goal has been to understand and elucidate a framework of how pedagogical reasoning with digital technologies to help both pre-service and in-service teachers understand their practice in an age where digital technologies have been prevalent in schools.

The researcher has worked in the state education system as a teacher and researcher where she has gained an understanding of the culture and inner workings of schools. This facilitated her gaining access to complete this research project. The researcher had worked in one of the five schools in the study. This allowed access to be able to recruit the teachers to participate in this study. The researcher has worked
as a teacher in the university where the researcher tutored all pre-service teachers in
the completion of their teacher preparation digital portfolio. This experience assisted in
identifying and then recruiting early career teachers who were able to use digital
technologies.

These experiences provided relationships of trust to be built with the schools
and participants. Clearly, to claim an objective stance of the researcher is not possible
or desirable considering the personal nature of pedagogical reasoning with digital
technologies. The researcher's personal experience as a teacher in the state
education system will act as a filter in the interpretation of the participants' experiences
they share in this research project. A naturalistic interpretive researcher acknowledges
this relationship of the researcher and her role and provides a means to capitalize on
the reflexivity between researcher and the participants to co-construct an
understanding of pedagogical reasoning with digital technologies.

This research project focused on a reflective approach to gathering data. It is
difficult to capture teachers' thinking at the time of action. Many researchers have
struggled in identifying appropriate methods that can be used to investigate teachers'
thinking. In this study, video recordings of the classrooms enabled the researcher to
capture teaching moments. This provided the data on which interviews were based.
They stimulated the participants into sharing their pedagogical reasoning with digital
technologies. Asking the teachers to view video recordings of their teaching and
elaborate on the use of digital technologies, provided insights into their thinking. To
further understand their thinking, think-aloud interviews were recorded while they
completed concept maps. To provide a triangulated view of their practices, access to
their personal digital portfolios, which was produced as part of their professional
development activities for their employers, enabled the researcher to explore evidence
selected over time by participants of their digital pedagogical practices. These data
sources are explained further in this chapter. Each of the seven teachers constituted a
case study in this thesis and the use of these seven case studies constituted a multiple
case study research design.

Case study research

Case study research was selected, as it "comprises an all-encompassing
method – covering the logic of design, data collection techniques and specific
approaches to data analysis” (Yin, 2014, p.17). The case study research method is appropriate for research questions that ask ‘how’ or ‘why’ about contemporary issues (Gray, 2004; Yin, 2014). For this study that was attempting to understand how teachers pedagogically reasoned with digital technologies, it was an appropriate approach to use. This study sought to obtain thick and rich descriptions (Geertz, 1994) from individual teachers to understand how they pedagogically reasoned with digital technologies and what influenced them in their pedagogical reasoning with digital technologies (i.e. why did they make those decisions). Cohen, Manion, and Morrison (2011) suggest that a case study “provides a unique example of real people in real situations” (p. 289).

Yin (2014) provided a more specific two-fold definition of case study research firstly looking at the scope of a case study:

1. A case study is in empirical inquiry that
   • investigates a contemporary phenomenon (the “case”) in depth and within its real-world context, especially when
   • the boundaries between phenomenon and context may not be clearly evident. (Yin, 2014, p.16)

Case study has been selected because it allows the researcher to investigate the real world practices of teachers. This study has attempted to understand how each context has influenced the practices. The second part of the definition addresses the features of a case study:

2. The case study inquiry
   • copes with that technically distinctive situation in which there will be more variables of interest than data points, and as one result
   • relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
   • benefits from the prior development of theoretical propositions to guide data collection and analysis (Yin, 2014, p.17).

In answering the three research questions there are many variables of interest and data points, therefore data has been collected from multiple sources to triangulate the data. A theoretical framework based on Shulman’s Model of Pedagogical
Reasoning and Action (1987) has guided the data analysis in answering Research Questions 1 and 2. Internal and external influences or first-order and second-order barriers (Ertmer, 1999), has guided the data analysis to answer Research Question 3. Verschuren (2003) suggested that a distinguishing feature of case study research was 'holism' rather than 'reductionism', whereby, with holism, it is not necessary to look at the whole subject, person, group or organisation, but at a relevant area of interest. This study was designed to look specifically at pedagogical reasoning with digital technologies.

Multiple case study design was selected to explore the research questions to ascertain patterns, replication and contradictions within the findings (Yin, 2014). Creswell (2013) described multiple case study where “the one issue or concern is again selected, but the inquirer selects multiple case studies to illustrate the issue” (p. 99). Yin (2014) suggested that multiple case study design uses the logic of repetition, in which the researcher replicates the procedure for each case study. Multiple case study was the preferred methodology as it allowed the researcher to acknowledge the significance of career stage in any of the complex issues and relationships that teachers grapple with when they pedagogically reasoning with digital technologies.

Conceptual framework

The conceptual framework draws upon Shulman’s Model of Pedagogical Reasoning and Action and recent associated research to develop a graphical model that will guide the data collection and analysis of the case studies is shown in Figure 3.13. Embedded in the conceptual framework are the research questions with details of the variables of interest that were relevant to this study. These variables of interest provided a focus for the researcher when analysing the data and for answering the research questions.
Figure 3.13 - Conceptual framework to guide this research project

At the core of the framework is Shulman’s Model of pedagogical reasoning and action (1987) with the six process of pedagogical reasoning: comprehension; transformation; instruction; evaluation; reflection and new comprehension. Research Question 1 arose around thinking of what pedagogical reasoning would look like today; where digital technologies are abundant and have changed the approach to teaching. Research Question 2 follows from Research Question 1, and is influenced by the career stage, to understand what pedagogical reasoning with digital technologies is developed across the three career stages: early career; experienced; and lead. The outer diamond represents the internal and external influences guided by the work of Ertmer and associates (Ertmer, 1999, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ertmer, Ottenbreit-Leftwich, & Tondeur, 2014) in suggesting the first level and second level barriers. Research Question 3 evolved from thinking what influenced teachers to pedagogically reason with digital technologies in terms of elucidating the enablers and barriers.
Research participants

As literature review revealed, there are many studies of teachers’ pedagogical practices and influences that involve interviews and classroom observation. Very little research has been completed studying teachers’ pedagogical reasoning with digital technologies. Video stimulated recall interview, using the video of the teachers practice in the classroom as a stimulus, meant that the researcher was able to interactively probe with questions of ‘why’ in relation to their pedagogical reasoning with digital technologies. So, to gather data to understand how teachers pedagogically reason with digital technologies, the first step involved collecting evidence of teaching practice to provide opportunities for participants to review and recall their design decisions and intentions as well as reflect on their enactment in a timely manner. Listening to teachers tell their own stories of their reasons for their digital technology practices as they watched themselves teach, revealed their decision-making behind their digital technologies-enabled lessons. Intertwined in these stories, the influences that enabled or restricted their digital technologies use emerged.

The next step involved the development by each participant of a concept map with them describing their thinking out aloud. This provided a means to express the influences around using digital technologies in the classroom and school. It provided the researcher with a separate source of data on the phenomenon as it was experienced in each site. Finally, the digital portfolios (developed during initial teacher education for two beginning teachers and the Smart Classrooms Professional Development Framework for the others) were used to provide further evidence, particularly on personal professional expertise in the area of digital technologies for effective teaching and learning.

Participants were purposively sampled for the case studies with the data collection timeline from May 2012 to May 2013. Cohen, Manion, and Morrison (2011) describe purposive sampling as hand picking the case studies on “the basis of judgement of their typicality or possession of the particular characteristics being sought” (p. 156). This sampling approach was selected as the most suitable for this study as there was a need to access ‘knowledgeable people’ - those who have in-depth knowledge by virtue of their professional role, power, access to networks, expertise or experience (Ball, 2003). Teddlie and Tashakkori (2009) use the term
intensity sampling in which the sample is chosen because it provides clear examples of the issue in question, in this case study, digital technologies using teachers at different career stages. Initially, twelve teachers were invited, and, as the study progressed, seven were able to fully participate in all phases of the data collection.

The three early career teachers had been tutored by the researcher during their teacher preparation program, and were known to use and want to use digital technologies for teaching and learning. The participants invited as the experienced teachers were identified through professional networks. The knowledge of the participants by the researcher is acknowledged and addressed as part of the design, data collection and data analysis.

**Ethical considerations**

Approval to undertake the research project was granted April, 2012 (see Appendix A). In conjunction, the Informed Consent Packs (Appendices D-G) were developed and submitted with a human ethics application. The ethics applications were submitted to and approved by Griffith University Human Research Ethics Committee (GU Reference: EDN/89/11/HREC) (Appendix B) and the Department of Education and Training (letter dated 22/11/2011) (Appendix C).

To ensure the integrity, quality and trust worthiness of the research, Miles, Huberman, and Saldana (2014) suggest the key ethical issues to be considered are:

- Worthiness of the project;
- Competence;
- Harm and risk;
- Honesty and trust;
- Intervention and advocacy;
- Informed consent;
- Privacy, confidentiality and anonymity;
- Ownership of data and conclusions
- Benefits, costs and reciprocity;
- Use and misuse of results; and
- Research integrity and quality.
As teachers grapple with the complexities of digital technologies, this study will provide a framework to help understand how teachers pedagogically reason with digital technologies.

Participants have given informed consent where consent packs (consent form and information sheet) were distributed to participants at the time of recruitment and discussed on site prior to data collection. All participants were required to read and sign consent forms and were provided with information sheets. All consent forms and information sheets were submitted and approved as part of the ethics application process. The information sheet included written information about the nature of the research, a clear description of their role and time commitment, a clear statement on their right to withdraw from the research at any time without obligation, explanation of any repercussions, assurance of their right to refuse to respond to any line of inquiry during their participation in the project and an assurance of confidentiality and anonymity in the thesis or any publication that was completed from the project.

For this project, there were three different types of participants: school principals; students; and teachers. In order to enter each school, consent was obtained from the school principal (Appendix D). To be able to use a video recorder in the classroom, all students were requested to obtain consent from their parents/guardian (Appendix E). Students who were unable to provide a signed consent form were seated out of the view of the camera. Thus, the teachers completed two consent forms, one for video recording and interview (Appendix F) and the second for access to their digital portfolio (Appendix G). The digital portfolio consent form was used to obtain access to the digital portfolio from a central information technology service that was part of the state education system.

An important goal of the researcher was that all participants were to remain anonymous. Participants were reminded at each phase in the data collection process that participation was voluntary and they were free to leave at any time. The data collected from the teachers were treated in a confidential manner where all teachers were allocated a pseudonym (an Italian name bearing no resemblance to person except for gender), and the school they were employed in was described in general details as well as allocated a location pseudonym (an Italian town with no intentional
meaning). To protect the anonymity of teachers and schools, the goal in allocating and describing them was that each teacher and each school were unidentifiable.

The findings from this research project support the conceptual framework in terms of understanding how teachers pedagogically reason with digital technologies. Apart from the realities of some of the classrooms where the research was undertaken, the findings do not support contentious issues where the findings may be misinterpreted and used to support inappropriate policies. In summary, the research was conducted carefully, thoughtfully and was compliant in terms of the human research ethics approval.

Data collection

Yin (2014) suggested there are a number of sources of data available to researchers when using a case study methodology and argued that “no single source has a complete advantage over all the others … the various sources are highly complementary and a good case study will therefore want to rely on as many sources as possible” (p.105). The comparative strength and weaknesses of the forms of data collected for this study are summarised in Table 3.3. The documentation collected for this project fall under the two main categories of documentation and interviews.

Yin (2014) suggested that an important use of documents was to collaborate and confirm evidence from other sources while there is concern over documentation being ‘unmitigated truth’, where this is answered in terms of the purpose and audience. The research project generated the majority of data collected. The teacher education digital portfolios had been constructed by the participants for a separate purpose, as part of the teacher education programs or designed to meet specific professional development goals as part of the Smart Classrooms Professional Development Framework. The Smart Classrooms Professional Development Framework digital portfolios were prepared as part of a three phase professional development program run by the Department of Education with the objective of professional recognition for the use of digital technologies in teaching and learning. By understanding and documenting these objects “you are less likely to be misled by documentary evidence and more likely to be correctly critical in interpreting the contents of such evidence” (Yin, 2014, p. 107).
Chapter 3: Methodology and research design

Table 3.3 - Sources of evidence: strengths and weaknesses (Yin, 2014, p.106)

<table>
<thead>
<tr>
<th>Source of evidence</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation</td>
<td>Stable – can be viewed repeatedly</td>
<td>Retrievability – can be difficult to find</td>
</tr>
<tr>
<td></td>
<td>Unobtrusive – not created as a result of the case study</td>
<td>Biased selectivity, if collection is incomplete</td>
</tr>
<tr>
<td></td>
<td>Specific – can contain the exact names, references and details of an event</td>
<td>Reporting bias – reflects (unknown) bias of any given document’s author</td>
</tr>
<tr>
<td></td>
<td>Broad – can cover a long span of time, any events and many settings</td>
<td>Access – maybe deliberately withheld</td>
</tr>
<tr>
<td>Interviews</td>
<td>Targeted – focus is directly on case study topics</td>
<td>Biased due to poorly articulator questions</td>
</tr>
<tr>
<td></td>
<td>Insightful – provide explanations as well as personal views (e.g.,</td>
<td>Response bias</td>
</tr>
<tr>
<td></td>
<td>perceptions, attitudes and meanings)</td>
<td>Inaccuracies duty poor recall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflexivity – interviewee gives what interviewer wants to hear</td>
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</tbody>
</table>

The approach to recruit teachers included the following steps. To initiate the research project, the researcher contacted several teachers (via email) to invite them to participate in the project. Contact was made with teachers who the researcher had taught as part of a teacher preparation program (all of the early career teachers) or the researcher previously knew through a professional network. Once they had expressed interest in participating, the researcher sent an email to the school Principal to seek approval to undertake research in the classroom with the teacher. Some sites required the researcher to meet with the Principal to discuss the project and obtain consent. Then, the researcher, met face-to-face with the participant teachers to organise the signing of the teacher consent form, to decide on the class to be video recorded and provide student consent forms for the teacher to distribute to their students of the class.

The researcher attended the agreed class to video record the lesson, and met with the participant teacher after the video recording to complete the video-stimulated recall interview. This interview was audio recorded. The researcher organised a separate time after the initial process to complete a think-aloud concept map interview with the participant teacher, which was also audio recorded. The researcher requested access to their digital portfolios. The researcher provided a copy of all video recordings to each participant teacher. There was no transcription of the video recordings.
When investigating teacher thinking, there are a variety of methods through process tracing and stimulated recall that “attempt to collect data on mental processes and so use more or less direct probes of teachers’ thoughts and judgments” (Shavelson & Stern, 1981, p. 4). In process tracing, participants are asked to think-aloud while completing a task while stimulated recall is used when process tracing would interfere with the participant’s performance of a task (Shavelson & Stern, 1981). Thinking aloud while teaching a regular class would not be possible. As an alternative, the researcher can use audio or video recording of the lesson and after the lesson the recording is played back to the teacher and the teacher recalls their mental activities that accompanied their actions. Both methods employ verbal reports as an approach to collect data on the mental processes of teachers and assume that teachers are able to report on their thought processes. Think-aloud and video-stimulated recall interviews were both used in this research project to understand pedagogical reasoning with digital technologies.

A description of the seven teachers included in this study is shown in Table 3.4. Each was assigned a pseudonym to ensure their anonymity and all, but one, was female. There were three early career teachers, two experienced and two lead teachers. Most were video recorded and interviewed in late 2012. As can be seen in Table 3.4, the participating teachers worked in a variety of school types including primary and secondary school contexts, and one was part of a P-12 college.
Multiple sources of data were collected to be able to answer the research questions. For each case study, collected data included video-stimulated recall interview (VSRI), concept map (CM), think-aloud concept map interview (TACMI) and digital portfolios (DP). The relationship between the research questions, data sources and variables of interest are outlined in Table 3.5. The video-stimulated recall interview and the digital portfolios contained rich evidence of the participants pedagogically reasoning with digital technologies and grouping participants allowed a view of pedagogical reasoning with digital technologies across three career stages to answer Research Questions 1 and 2. The concept map and think-aloud interview offered some elements of the phases in Shulman’s MPRA processes of Reflection and New Comprehension, as teachers described what they thought about when deciding in
using digital technologies in their teaching. All data sources were used to answer Research Question 3.

Table 3.5 - Research questions, data sources and variables of interest

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Variables of interest</th>
<th>Data instruments</th>
</tr>
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<tbody>
<tr>
<td><strong>Research Question 1:</strong> How do teachers pedagogically reason with digital technologies?</td>
<td>Comprehension</td>
<td>VSRI ✔ CM ✔ TACM ✔ DP ✔</td>
</tr>
<tr>
<td></td>
<td>Transformation</td>
<td>✔ ✔</td>
</tr>
<tr>
<td></td>
<td>Instruction</td>
<td>✔ ✔</td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
<td>✔ ✔</td>
</tr>
<tr>
<td></td>
<td>Reflection</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td></td>
<td>New comprehension</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td><strong>Research Question 2:</strong> What are the differences in pedagogically reasoning with digital technologies across three career stages?</td>
<td>Early career teachers</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td></td>
<td>Experienced teachers</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td></td>
<td>Lead teachers</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td><strong>Research Question 3:</strong> What influences teachers when they pedagogically reason with digital technologies?</td>
<td>Internal Professional knowledge</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td></td>
<td>Professional mindset</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
<tr>
<td></td>
<td>External School Education system</td>
<td>✔ ✔ ✔ ✔</td>
</tr>
</tbody>
</table>

**Video-stimulated recall interview**

Shavelson, Webb, and Burnstein (1986) define stimulated recall as:

*Present and important alternative to retrospective interviews, and a necessary alternative to think-aloud message is it starting interactive teaching. With its rich source of stimuli – namely, replay of the teaching event – certainly the queues are available with which to improve the search of long-term memory and retrieval of the particulars of the past event (p. 82).*

Stimulated recall was first used as a method for educational research by Bloom (1953) when looking at college students in two different learning environments and their ability to recall cognitive processes. He found that participants were able to recall overt behaviour such as classroom activities, specific talk, or particular gestures with as high as 95 percent accuracy up to two days afterwards. He suggested that stimulated recall
from conscious thought was accurate enough for most educational studies. Clark and Peterson (1984) used stimulated recall in a laboratory setting to understand what teachers thought about while they were teaching. Parker and Gehrke (1986) used stimulated recall to understand the decisions teachers make during instruction, as separate from decisions made before or after instruction. Stimulated recall has been extensively used in research into teaching with Lyle (2003) reporting sixteen studies from 1985-2002. In the research of teachers reasoning with ICT, Vesterinen, Toom, and Patrikainen (2010) used video-stimulated recall to understand how teachers reasoned when teaching the concept mapping tool - CmapTools. They found that video-stimulated recall produced data that contained elements of teachers' interactive thinking including decision-making and reflection during the lesson. Henderson, Henderson, Grant, and Huang (2010) described how stimulated recall has been used in understanding: mental models; the relationship between teachers’ beliefs and classroom practices; reasoning; and decision-making. A recent search of Google Scholar reported over 19,000 results when using the terms ‘stimulated recall / education OR school OR teaching OR teachers adding ‘teacher thinking’ reduced the list to 390 results. Stimulated recall has become an acceptable approach for educational research and more specifically research into teachers thinking.

The use of video-stimulated recall, as a method for this study, was to stimulate the teachers to talk about the digital technologies they had used in the video recorded lesson and to understand how they decided to use that digital technologies in their classroom. Calderhead (1981) questioned if video-stimulated recall interview may not elicit true accounts of teacher reasoning whether the teacher might suffer from anxiety of being recorded and then viewing their performance in the classroom and that this might affect their recall interview. In this project, the participant teachers were reassured that the video was for one purpose only and would not be shared with anyone and the goal of the research project was not to judge the teaching performance. By using small equipment and not drawing attention to the recording process, research accounts show that most teachers quickly become engrossed in their teaching and so become unaware of the camera. The participant teachers were interested in their teaching and welcomed a copy of the video recording. For most it was the first time they had been video recorded while teaching and had participated in a research project.
The interviews were conducted in their classrooms when empty or in the staff room. Participants were asked to view their video and discuss out loud their thoughts about using digital technologies during the recorded lesson. Teachers were asked to operate the computer to stop and start the video wherever they thought appropriate to discuss something about their digital technologies use. The use of the video recording enabled the teachers to stop at micro incidents to effectively explain their intentions for their teaching with digital technologies and what was happening in the room. The researcher used the opportunity to ask questions that began with what, why and how. The researcher did not elaborate or explain pedagogical reasoning, as she wanted the teachers to answer the questions in their words without using the terminology of pedagogical reasoning. The researcher wanted the teachers to elaborate using their terminology.

**Think-aloud concept mapping interview**

Similar to the video-stimulated recall interview, think-aloud is another accepted process tracing method for researching teacher thinking (Clark & Peterson, 1984; Ericsson & Simon, 1998; Henderson & Tallman, 2006; Lyle, 2003; Parker & Gehrke, 1986; Shavelson, Webb, & Burnstein, 1986). Smargorinsky (1989) and Henderson and Tallman (2006) explain that think-aloud is designed to understand the mental processes as someone articulates or performs a task. Karasti (1997) alleges that think-aloud is a more invasive method of process tracing because it is perceived to interfere with the participants’ thought processes as it creates an artificial reality (Ericsson & Simon, 1984; Pressley & Afflerbach, 1995). Ericsson and Simon (1998) suggest that it can be difficult for participants to perform simultaneous tasks of thinking and verbalising their thinking. They, therefore, suggest that training and a model can help counteract this weakness. Henderson and Tallman (2006) suggest that researchers need to be aware of the training they demand of their participants to not alter their thought practices in order to use think-aloud as an effective method.

Preparing the concept map with a think-aloud interview allowed the researcher to see and hear the participants’ thought processes as they completed their concept map. The teacher was asked to draw a concept map to explain what they thought about when deciding to use digital technologies. The dialogue they shared provided their reasoning as to why they included the concepts on the map and provided much
more detail than just the one or two word description. In many case studies the participants explained why it was important. The researcher’s role was to listen and prompt that the concept map was about the use of digital technologies in their classroom and ensure the audio was being recorded.

**Concept map**

Novak and Carias (Novak, 2010; Novak & Cañas, 2006a, 2006b, 2008) first suggested concept maps as a hierarchical structure of concepts and relationships between concepts where concepts show a specific label usually a word or two in a node or box with lines showing linking words that create a meaningful statement or proposition of a relationship. Cañas, Carff, Hill, Carvalho, Arguedas, Eskridge, Lott, and Carvajal (2005) explained that a concept map is “a graphical tool that enables anybody to express their knowledge in a form that is easily understood by others” (p.2). Novak defined concepts as “perceived regularities in events or objects or records of events or objects designated by a label” (Novak & Cañas, 2006a, p. 4). Concept maps have been used an accepted approach for the study of teachers’ cognitive processes (Shavelson, Ruiz-Primo, & Wiley, 2005) providing an insight to teachers’ knowledge (Chen & Ennis, 1995; Clark & Peterson, 1984; McMeniman, Cumming, Wilson, Stevenson, & Sim, 2000). Open concept maps allowed the participants to select their own concepts and links; for closed concept maps, the participants are tied with predetermined concepts and links that they can use in constructing the concept map (Herl, O’Neil Jr, Chung, & Schacter, 1999). Cañas, Carff, Hill, Carvalho, Arguedas, Eskridge, Lott, and Carvajal (2005) suggest the concept maps are dependent on their context and that maps can have similar concepts and can vary from one context to another and are highly idiosyncratic. Therefore concept maps constructed by different people on the same topic, are different because they represent each creator’s personal knowledge.

In their classroom or staff room, after the video-stimulated recall interview process, the participants were asked to complete a concept map. They were asked to discuss the concepts they thought about when planning to use digital technologies. Concept mapping was used in this research study to gain data to help answer all of the research questions. A concept map was chosen as a data collection method as it allowed the participants to identify the concepts that they thought about when planning
to use digital technologies in their classrooms. The concept map was designed to evoke *thin* responses as labels assigned to the concepts and relationships while the think-aloud concept mapping interview was meant to evoke *thick* data to explain the concept and relationships (Geertz, 1994). The thick description around the concept map facilitated the participating teachers expression/articulation of their thoughts and beliefs around their use of digital technologies.

This study did not ‘train’ the participants on how to produce a concept map. The exercise focused simply on identifying the concepts and was not concerned with the format or structure of the concept map. Each participant was provided with an A3 piece of blank paper and asked ‘*what do you think about when deciding to use digital technologies in your classroom?*’. To begin they placed digital technologies in a circle in the centre of the paper. They were free to draw a concept map by adding concepts (as bubbles or words) and then drawing lines to show how these were linked together. The objective was to capture their concepts on paper and their thinking out loud rather than focus on drawing a correctly formed concept map. No predefined concepts were given to restrict or confine their thinking or preload their thinking with concepts that the researcher was looking for.

**Teacher digital portfolios**

Teacher portfolios are carefully selected samples of a teacher’s work or, as Shulman (1992) suggested, and Wolf (1994) agreed:

*A portfolio is the structured documentary history of a [carefully selected] set of coached or mentored accomplishments substantiated by samples of work and fully realised only through reflective writing, deliberation and serious conversation (Shulman, 1992, p.111 [bracketed changes in original]).*

Research suggests that teachers have been preparing portfolios from the early 1980s (Elbow & Belanoff, 1986). Teachers collect evidence of their teaching including: lesson plans; unit plans; task sheets; examples of student work; and observation of students (as a few examples). The personal collection of evidence supports growth in developing as a teacher. Portfolios are used in many pre-service teacher education programs as part of assessment (Çimer, 2011; Davies & Willis, 2001; Napper & Smith, 2006; Ryan & Kuhs, 1993; Willis & Davies, 2002). Napper and Smith (2006) suggested that portfolios were completed in teacher education as “evidence of meeting
all of the standards for professional licensure at the entry level ... <they include> lesson plans, presentations, reflections...to show how students process information and develop professional skills gleaned from their <pre-service> course" (Napper & Smith, 2006, p. 2).

Shulman (1992) suggested that portfolios “permit the tracking and documentation of longer episodes of teaching and learning” (p.396) than other forms of teaching evidence for example observation by an evaluator. Teaching is something that takes time and teaching, as intellectual work, can take time to unfold over multiple lessons. This intellectual work cannot be captured in small fragments of the lesson or a series of unconnected lesson fragments but a portfolio allows the teacher to provide an insight into the intellectual work behind their teaching practice and enable a wider view of connected evidence. Portfolios have the “potential to make unique linkages, connections and reflections among multiple experiences and artefacts” (Parkes, Dredger, & Hicks, 2013, p. 101). As portfolios are developed after teaching has been completed they are essentially reflections of teaching that include details of new comprehension of teaching practice and elements of knowledge that are captured for future use. Through the teacher reflection that is captured in words in the digital portfolio, a deeper view of their teaching work is revealed.

Reflection is a valuable tool as it enables rich learning or what Aristotle termed *phronesis* which means the weaving together of theory, context and practice (Parkes, Dredger, & Hicks, 2013) or simply practical wisdom (Green, 2009). The reflective process enables teachers to bring together the theories of education to their practices. Shepherd and Skrabut (2006) acknowledge that electronic portfolios “can increase reflection, develop content and pedagogy skills and facilitate communication between teachers and administrators” (p.31). Teaching is usually very isolated work where teachers may not have the opportunities to share and reflect on their practice. Capturing examples of teachers’ practices in portfolios can provide a place for teachers to be able to share their work with others including peers and school administrators. For this research project, portfolios offered the opportunity to examine evidence of teacher practice with digital technologies. The evidence selected by the participants was analysed to examine the decisions that underpinned their teaching with digital technologies.
In this research project, two types of digital portfolios were used. The first type of digital portfolio used in this research project was a Teacher Education (TE) portfolio that was prepared by pre-service teachers, to demonstrate evidence of achieving teaching competence at graduate level. Currently, for Australian higher education institutions, the format and approach for preparing digital portfolios has most commonly been conceptualised using the Australian Professional Standards for Teachers (AITSL, 2011). Having a strong framework in building the digital portfolio is “needed to equip teachers to investigate their learning with a greater sense of purpose and value in the e-portfolio reflective process” (Lee & Pohio, 2012, p. 553). This could facilitate a digital portfolio development that not only responds to a nationally recognised representation of the work, but also can develop evidence to contribute to a clearer understanding of what constitutes the teaching profession in the 21st century. Table 3.4 shows there were four teacher education digital portfolios used as a data source for this research project.

The teacher education digital portfolio included a ‘Belief statement’ where the pre-service teacher had described how they saw themselves as a teacher with references to educational research. Next a webpage was developed for each professional standard where pre-service teachers explained their understanding of each professional standard, their experience and evidence they had collected to support their response. This description provided insights into their experiences on their practicum and how they had developing initial teacher education. Donnatella, Viviana and Drago included a variety of evidence throughout their portfolios to justify how they had met the professional standards in preparation for registration. Their TE digital portfolios were included as part of their assessment for the graduate education studies and as assessment items, there were strict guidelines that needed to be followed.

The second type of digital portfolio used in this research project was prepared as part of a professional development program for employees, run by Education Queensland. A three level accreditation scheme was implemented from 2006 as a way to encourage teachers to use digital technologies in the classroom. Teachers begin with ICT Certificates to show understanding of using digital technologies purposefully. They progress to complete Digital Pedagogical Licences (DPL) demonstrating and reflecting their use of digital technologies. They then can advance to Digital
Pedagogical Licence Advanced, becoming teachers leading the transformation of learning through digital technologies (Department of Education Training and Employment, 2012). Each level of the accreditation asked teachers to provide evidence of their professional values, professional relationships, professional knowledge and professional practice that was mapped to the indicators. Five participating teachers: Alessandra, Carmelina, Drago, Florentina and Marcelia, all had prepared DPL portfolios, and these provided data for this research project. Alessandra prepared the earliest DPL portfolio in 2007 and Drago was the last to prepare his DPL portfolio in 2012. The DPL portfolios were all stored in a secure learning management system, however the teacher education portfolios were prepared in Google Sites and accessible through Google Sites with the web address supplied by the teacher.

Teachers prepared their DPL in a structured format as shown in Table 3.6. First, the teacher had to provide a description of the context, as the "Contextual Statement", which explained their school and how they developed their DPL. Second, they prepared a "Reflective Statement" that explained their beliefs and attitudes of using digital technologies for teaching and/or learning with reference to educational theory.

Table 3.6 - A summary of the digital portfolios used in this research project

<table>
<thead>
<tr>
<th>Details</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Pseudonym</td>
<td>Alessandra</td>
<td>Carmelina</td>
<td>Donnatella</td>
<td>Drago</td>
<td>Florentina</td>
<td>Marcella</td>
<td>Viviana</td>
</tr>
<tr>
<td>Digital portfolio type *</td>
<td>DPL</td>
<td>DPL</td>
<td>TE &amp; TE</td>
<td>TE &amp; DPL</td>
<td>DPL</td>
<td>DPL</td>
<td>TE</td>
</tr>
<tr>
<td>Accessibility **</td>
<td>C</td>
<td>C</td>
<td>O/O</td>
<td>C/C</td>
<td>C</td>
<td>C</td>
<td>O</td>
</tr>
<tr>
<td>Tool ***</td>
<td>L</td>
<td>L</td>
<td>W/W</td>
<td>W/W</td>
<td>L</td>
<td>L</td>
<td>W</td>
</tr>
</tbody>
</table>

* Digital Portfolio Type Code: DPL = Digital Pedagogical Licence; TE = Teacher Education
** Accessibility Code: C = Closed; O = Open
*** Code: L = learning management system; W = Website

Each DPL was required to contain either two or three “Items of evidence” depending on the coverage of the DPL indicators: professional knowledge, values, relationships and practice. For each Item, the teacher was required to provide
responses to a series of headings. These headings are shown in Table – DPL-Evidence item headings. For the DPL level, there were thirteen professional indicators that a teacher needed to ensure were covered and referenced throughout the DPL. Teachers map their responses to professional values, professional relationships, professional knowledge and professional practice indicators. The evidence is structured in a specific format as shown in Table 3.7. Finally, a Statement of Support prepared by the school Principal is included in support of the teacher’s digital technologies practices. After completion of the DPL, an ‘Accredited Facilitator’ is assigned by the employer to access the portfolio before a certificate is awarded. In constructing a DPL, the teacher can use various tools including webpages, virtual classrooms in the learning management system and or secure websites.

Table 3.7 - DPL format

<table>
<thead>
<tr>
<th>Digital Pedagogical Licence - Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Context Statement (500 words)</td>
</tr>
<tr>
<td>2 Reflective Statement (500 words)</td>
</tr>
<tr>
<td>3 Items (Explanation to support evidence – format in Table 3.6)</td>
</tr>
<tr>
<td>4 Evidence (e.g.: student work, unit plans, criteria sheets, photographs, lesson outlines, screen captures, websites, audio or video files)</td>
</tr>
<tr>
<td>5 Statement of Support (principal or delegate)</td>
</tr>
</tbody>
</table>

For each Item there were a number of headings as a structure that the teacher needed to complete to explain why the Item was included in the DPL. The headings are shown in Table 3.8. The first four headings provide an overview and context for the item. The Item overview extended the description to and the Reason for inclusion described details of why the item was included where the focus was on the use of digital technologies. The Development and planning described the process the teacher followed when planning the unit again with a focus on the use of digital technologies while the Sequence of learning described the series of lessons in the unit plan and how they were linked together. The Curriculum links was used to show how the unit was linked to the state curriculum documents. The Central focus of the student learning was where the teacher changed focus from what they were doing with digital technologies to looking at student learning. The Teaching and learning approach provided the opportunity for the teacher to explain what they were trying to achieve with their teaching and what they expected their students to learn with a focus on the use of digital technologies in the teaching and learning process. My learnings and
further reflection and information was included for the teacher to explain what they had learnt when implementing digital technologies into teaching or learning.

Table 3.8 – DPL evidence item headings

<table>
<thead>
<tr>
<th>DPL - Evidence item headings</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Title</td>
</tr>
<tr>
<td>b) Date of implementation</td>
</tr>
<tr>
<td>c) Evidence</td>
</tr>
<tr>
<td>d) Year level and student context</td>
</tr>
<tr>
<td>e) Item overview</td>
</tr>
<tr>
<td>f) Reason for inclusion</td>
</tr>
<tr>
<td>g) Development and planning</td>
</tr>
<tr>
<td>h) Curriculum links</td>
</tr>
<tr>
<td>i) Central focus of the student learning (curriculum intent)</td>
</tr>
<tr>
<td>j) Sequence of learning</td>
</tr>
<tr>
<td>k) Teaching and learning approach</td>
</tr>
<tr>
<td>l) My learnings</td>
</tr>
<tr>
<td>m) Further reflections and information</td>
</tr>
</tbody>
</table>

Multiple sources of data were collected to be able to answer the research questions. For each case study, data collection from the video-stimulated recall interview, digital portfolios, concept map and think-aloud interview enabled a multifaceted view of the participants’ pedagogical reasoning with digital technologies in order to answer the research questions. Grouping participants by career stage then allowed a finer analysis of pedagogical reasoning with digital technologies to explore those career stages to identify the progression of pedagogical reasoning with digital technologies. The next section outlines the data analysis approach adopted for this study.

Data analysis

The qualitative data for this study comprised of transcribed video-stimulated recall interviews, think-aloud interviews produced while completing a concept map, the concept maps themselves and the digital portfolios. Data analysis is the process of making sense from the data to communicate an understanding (Merriam & Tisdell, 2016). For this qualitative study, data were handled interpretively through different
levels of coding, classification, categorisation and reduction as recommended by Miles, Huberman, and Saldana (2014). They suggest that the researcher move:

selectively collecting data comparing and contrasting this material in the quest for patterns or regularities, seeking out more data to support or qualify these emerging clusters and then gradually drawing inferences from the links between other new data segments and the cumulative set of conceptualisations (p. 10).

When working with a large amount of qualitative case study data, Yin (2014) offered a tip in getting started – “You might start with questions…with a small question first, then identify your evidence that addresses the question” (p. 131). For this research project, as the questions focused on pedagogical reasoning, the starting point was looking at gaining an understanding of pedagogical reasoning.

Transcription

Prior to beginning coding, the interviews were transcribed using an international transcribing service (Revs.com). Audio files were uploaded to a secure location on the Rev’s website. Once completed Rev notified that the Word file was available for download on their secure website. To confirm the validity of the transcription, two interviews were checked to the original recordings with all errors highlighted. The errors were counted the percentage of error was calculated. The first interview (5612 words) highlighted 53 places where they were transcription errors with an overall error rate of 0.94 per cent. The second interview (2,024 words) highlighted 52 places where there were transcription errors with an error rate of 2.57 per cent. The interviews were updated to reflect the correct wording and that version was saved as a Word file. As there were low transcription errors in both interviews, all interviews were not reviewed in detail and where quotes were extracted from the data, the audio file was revisited to ensure that the quote was correctly reflecting the words of the participants. When quotes were selected for inclusion in the case studies, a reference scheme was developed in order to trace the quote back to its sources. This scheme is included in Appendix H. The transcribed interviews and other data items were assigned code scheme in order to simplify the coding reference used throughout the thesis. When the data was loaded into NVivo a line number was assigned to each line of data and when a quote from the data is included in this thesis the reference to the participant, data
Qualitative data analysis

Prior to beginning the data analysis a computer assisted qualitative data analysis software (CAQDAS) program NVivo version 10 for Windows was selected, as the data analysis tool to assist and support in this research project. Bazeley and Jackson (2013) recommend that NVivo can help during data analysis:

- to manage data – organise keep track of all interviews, concept maps and digital portfolio webpages and evidence, notes recorded as memos and information about data sources;
- to manage ideas – provide access to conceptual and theoretical knowledge generated in the process of completing this project;
- to query data – two are simple or complex questions of the darter and have the program retrieve from all the data any information relevant in determining answer. Those queries could be saved for further interrogation as part of the ongoing research process;
- to visualise data – to show the content and/or structures of cases, ideas or concepts at various stages of the analysis process. It allowed me to visually represent the relationships among these items in a range of interactive displays; and
- to report from data – using contents of the database to report the ideas and knowledge developed from the data sources.

(Bazeley & Jackson, 2013, p. 3).

Sinkovics and Alfoldi (2012) explain that the acronym is somewhat of a misnomer, in that it creates an inappropriate sense that the software takes over the analytical process and replaces the researcher’s unique skills in analysing and interpreting the data (Bazeley & Jackson, 2013; Hutchison, Johnston, & Breckon, 2009; Miles, Huberman, & Saldana, 2014; Sinkovics & Alfoldi, 2012). Sinkovics and Alfoldi (2012) suggest the software is “designed to facilitate the organisation and processing of data and enhance the dialogue between research and data” (p.4), by providing a toolset to help the analysis of abundant qualitative data. They add that by using a CAQDAS a qualitative researcher can “develop a greater degree of effectiveness and rigour at each step in the research process” (Sinkovics & Alfoldi, 2012, p. 5). Yin (2014) agrees, asserting that a CAQDAS is an able assistant and reliable tool to use in
data analysis suggesting that the output can be used to determine if any meaningful patterns were emerging in the data.

**Categorisation**

For this study, the process of data analysis began with Shulman’s Model of Pedagogical Reasoning and Action (Shulman, 1987b) to provide the first cycle coding scheme. The interview transcripts and digital portfolios were read and re-read to understand how these teachers pedagogically reasoned with digital technologies. Data was reviewed and assigned process codes to understand how teachers: comprehended what they needed to teach (Code: COMPREHENDING); how they transformed it for teaching (Code: TRANSFORMING); how they actually taught it (Code: INSTRUCTING); what evaluation strategies they used (Code: EVALUATING); how they reflected (Code: REFLECTING); and anything new they now comprehended (Code: NEWCOMPING). As part of first level coding, process coding “uses gerunds (-ing words) exclusively to connote observable and conceptual action in the data…actions intertwined with the dynamics of time” (Miles, Huberman, & Saldana, 2014, p. 75). Potential themes were identified with notes made on the pages and the code was tagged in NVivo with the goal to reduce or break down the data into “more manageable chunks” (Miles, Huberman, & Saldana, 2014). Within each heading, codes were assigned to “categorise chunks so the researcher can quickly find, pull out and cluster the segments relating to a particular research question, hypothesis, construct or theme” (Miles, Huberman, & Saldana, 2014, p. 72). This coding used “words or phrases from the participants own language” (Miles, Huberman, & Saldana, 2014, p. 74) to create *in-vivo* codes to understand pedagogical reasoning and external influences while *values* coding was used to identify any values, beliefs and attitudes to understand internal influences.

Concept maps were analysed looking at the concepts and relationships to identify what was internal or external to the teacher and coded with *descriptive* codes. A key internal influence identified in the literature was teacher’s professional knowledge. As professional knowledge is intrinsically linked to pedagogical reasoning, as knowledge-in-action, the data was analysed and coded for teacher knowledge. As the Model of Pedagogical Reasoning and Action was first proposed by Lee Shulman, in the same research he elucidated the Knowledge Base for Teaching (Shulman, 1987b;
Wilson, Shulman, & Richert, 1987). As the Knowledge Base for teaching is widely cited in educational research as a framework for describing teacher’s knowledge, it was decided that that would provide a useful schema to classify teacher knowledge for this research study.

As analysis progressed, individual case studies were handled interpretively through several levels of coding and classification with comparing and contrasting to Shulman’s original descriptions of pedagogical reasoning. Further exploration of themes was conducted using NVivo search facilities as well as manually re-readings of the transcripts and digital portfolio evidence. Each participant’s data case study is combined to construct a narrative description and includes displays of matrices and figures to emphasis certain aspects of the data. The restories were constructed and designed to “assemble organised information into an immediately accessible, compact form” (Miles, Huberman, & Saldaña, 2013, p. 13). Moving to the second cycle of coding, as these restories started to emerge, comparisons were made, using the constant comparison method, to the other restories and relevant research findings in the literature.

Each restory was developed individually and grouped with other restories in terms of the major themes highlighted in the data analysis concerning the career stage of the teacher. Restories within each group were analysed independently and then analysis was combined to see the individual and group picture. Cross-case analysis across groups was performed to understand the differences between groups or career stages of teachers. All case studies were explored and analysed using the same treatment. The comparative analysis of all seven case studies contributed to the findings, conclusions and theories that have been included in the concluding chapter of this thesis.

**Cross case analysis**

Cross case analysis provides the opportunity to compare case studies for commonalities and disparities. Each case study provides a description of how teachers have pedagogically reasoned with digital technologies within career stage. Cross case analysis within career stage can help determine if the case study is typical or diverse and allows for identification of differences and similarities between career stages. The approach taken to examine the data within and across seven case studies
was to first determine how they pedagogically reasoned with digital technologies to answer research questions. Initially, an analysis of the restories across all case studies was made to understand how the participants pedagogically reasoned with digital technologies and what influenced them. Each process of Shulman’s MPRA was used to understand the participant teachers’ pedagogically reasoning with digital technologies. From this, a list of assertions was proposed, which will be examined further in the discussion chapter of the thesis. To compare the findings from each case study, a variety of tables have been prepared based on the work of Miles, Huberman, and Saldana (2014). As themes of commonality or disparity were identified, the literature was revisited to confirm or challenge the validity of the theme. These tables are presented in Chapter 7, the cross case analysis of the seven teachers.

Restorying

Restorying is a technique where the researcher retells:

> the story in their own words. They do this to provide order and sequence to a story that might have been told out of sequence... the researcher provides a chronological sequence and causal link among ideas (Creswell, 2015, p. 511).

Mulholland and Wallace (2003) suggest that that primary research text is “reconstruction from the field text (journals, interviews, observations, etc.) that represent experiences of the field” (p. 6). When the researcher retells, it is the voice of the participant in the foreground, with the researcher using as closely as possible the field in the restorying process. Ollerenshaw and Creswell (2002) suggest that restorying involves “telling or retelling of the events related to the personal or social experiences of an individual” (p. 332). Cohen, Manion, and Morrison (2011) also suggest restories

> have a beginning, middle and an end, they may include critical moments and decisions, complicating factors, evaluation and outcomes characteristics of a narrative has having an abstract, orientation (context), complicating actions (sequences of events that decide the course of the narrative), evaluation (indicating the significance of the narrative and its main points), resolution (outcomes), and a coda (a rounding off of the narrative) (p. 553).

In the way restories may have a selected focus based on the criteria relevant for to the purpose of the researcher, for example relevant to this study, critical events, actions or decisions in relations to pedagogical reasoning with digital technologies. Cohen, Manion, and Morrison (2011) also suggest it is important to include direct quotations
from participants as “these add life to the narrative and often convey the point very expressively – without it being mediated or softened by the academic language of the researcher” (p. 553). For this study quotations are being added to every story.

The process Creswell (2015) describes follows three steps: the researcher starts with the transcription as raw data; they analyse key elements of the story that include the settings, characters, actions, problems and resolution; finally, they produce the restory by organising the key codes into a logical sequence of activity. The restory begins with the place (in this research - the classroom), characters (in this research – the teachers who use digital technologies), and then the events (in this research - pedagogical reasoning with digital technologies).

By beginning each case study in this way, the hope is to provide a realistic, valid thick description that explicates situated meanings (Geertz, 1973) and concrete detail (Bochner, 2000). The restory is given suitable detail to capture the essence of their teaching and retelling their story in enough detail for the reader to be able to come to their own “conclusions about the scene” (Tracy, 2010, p. 843). Tracy (2010) goes further to suggest that using stories helps “researchers engage in practices that will promote empathy, identification and reverberation of the research” (p. 844).

In the process of analysing the data, my participating teachers shared their experiences of using digital technologies in the classroom as stories of their practice. These stories were the basis of the data analysis. Once analysed for the aims of the research, in order to not lose the richness and uniqueness of each participants telling of their experiences, the presentation of the data analysis for each teacher begins with a restory (Creswell, 2015; Gay, Mills, & Airasian, 2009; Mulholland & Wallace, 2003). The emphasis of using this technique is on honouring the teachers and what they shared in their data. Bazeley (2013) suggests that it is “often easier for a participant to tell the story of an experience then to respond to questions, provide explanation or proffer opinions” (p. 201). In this study, there were no questions asked of the participants that used the term ‘pedagogical reasoning’. It was the interview tools stimulated by video of their teaching and by their creation of concept maps that facilitated these seven teachers to share their accounts. These restories provide a credible insight of how and why these teachers have pedagogically reasoned with digital technologies.
Trustworthiness of the study

There must be confidence in the quality and overall trustworthiness of the methodology and findings (Lincoln & Guba, 1985). Within the interpretive paradigm, the concept of trustworthiness comprising credibility, transferability, dependability and confirmability was posited by Lincoln and Guba (1985).

Credibility

Credibility in assessing trustworthiness refers the conduct of the research to ensure that the subject was accurately identified and described (Lincoln & Guba, 1985). Insider status allowed purposive sampling, which facilitated access to schools in order to undertake this research project. As an insider, the researcher was able to easily build a relationship of rapport and mutual trust with the participant teachers over the duration of this study. The video-stimulated recall and think aloud concept map interviews were conducted in the same manner for all settings. There was consistent use of the interview prompts and cues with all interviews completed by the same researcher. The digital portfolios were completed prior to the research and thus had been reviewed by an external assessor, confirming the validity prior to this study commencing. The external assessor was a teacher who was nominated as an ‘Accredited Facilitator’ as part of the Smart Classrooms Professional Development Framework. Without insider status, in teacher education and within the education system, the opportunity to access this rich data would have been missed. Understanding the structure of these two types of the digital portfolios enabled reliable evidence to be extracted and included in the data for this study.

A key characteristic of qualitative research is the researcher as a key instrument in the data collection (Creswell, 2013). The researcher has collected data from digital portfolios, interviewed participants using video-stimulated recall and think-aloud concept map interviews while they asking them to complete a concept map. Miles, Huberman, and Saldana (2014) suggested there are markers of a good qualitative researcher-as-instrument approach that includes the following points relevant for this research project. A researcher must have a good familiarity with the phenomena and setting under study. For this research, the researcher is a digital technologies experienced teacher who has worked in the state education system for
nearly ten years. The researcher had completed two digital portfolios, one as part of teacher education and the second as a Digital Pedagogical License as part of the Smart Classrooms Professional Development Framework. The process of developing these portfolios and the reflection on teaching practices enabled the researcher to gain a deep insight into the process of developing these two types of digital portfolios. For a number of years, the researcher has guided pre-service teachers prepare their teacher education digital portfolios.

Miles, Huberman, and Saldana (2014) suggested a researcher must have a heightened sense of empathetic engagement balanced with a heightened sense of objective awareness. Being a teacher who has grappled with using digital technologies in the classroom, the researcher understands the process and issues that teachers face when challenged to use digital technologies for teaching and learning. This understanding has enabled the researcher to be able to retell what the participants have shared in a realistic restory of authentic teaching practice.

Miles, Huberman, and Saldana (2014) recommend that researchers must have good investigative skills and prior to completing this study the researcher had developed extensive interview skills for research as a research assistant to be able to draw people out to discuss the important issues relevant for this study. Miles et al. (2014) recommend that researchers should be comfortable, resilient and non-judgmental. For this research project, the role of the researcher was to collect the data without passing judgment on the participant, their teaching or their content. In summary Miles, Huberman, and Saldana (2014) suggest that

*a savvy practitioner is often a better research instrument in a qualitative study: sharp, more refined, more attentive, people friendly, worldly wise, and quicker to hone in on core processes and meanings about the case* (p. 42).

**Transferability**

Transferability of the study is an important element in understanding if the study results can be transferred across a wider population. Guba and Lincoln (1989) reject generalisation but offer transferability referring to extensive and careful descriptions so that the reader can apply to study in to their own situation. Stake (2000) suggests that case studies that provide detailed description have sufficient evidence of transferability as:
Restorying has been used to present the data as explained earlier it is an approach which facilitates the provision of rich descriptive narratives of teaching practices to enable the reader to vicariously see how the participant teachers pedagogically reasoned with digital technologies. Stake (2000) added, “illustration as to how a phenomenon occurs in the circumstances of several exemplars can prove valuable and trustworthy knowledge” (p. 444). While perceptions and responses of the participants may not be representative of the perceptions and responses of other teachers, the data analysis may permit some readers to find personal relevance to the findings. In order to discover the degree of transferability of the conclusions, further research would need to be carried out with a wider and diverse population of teachers. No attempt has been made to generalise in this study, but an effort was made to obtain a variety of views by of a range of experiences in different school contexts, school levels and subject areas.

Confirmability

Confirmability is used as an element to inform the trustworthiness of research, another researcher could arrive at comparable conclusions given the same data and research context. Methods and processes throughout the research process are set out in the beginning of this methodology chapter. Analysis in this study included detailed accounts in terms of reconstructed stories. These accounts resulted after cross-checking within and across each participant’s data as well as checking alignment and accuracy of data from the interview and the participants’ digital portfolios.

The study also used data triangulation to increase the objectivity of the study by allowing various means of confirmability through the video-stimulated recall interview, think-aloud concept map interview and digital portfolios. Stake (2000) suggested the triangulation is expected to clarify meaning by identifying different ways the phenomenon is seen. For this study, the combination of the above sources of data provided different perspectives to clarify the meaning of pedagogical reasoning with digital technologies. Triangulation in this study has involved a range of data collection tools to enhance the study’s transferability and confirmability.
Chapter summary

This chapter explains and justifies the research design, the sampling approach and the data collection and analysis approach used for this study. An interpretive approach was adopted to examine how teachers pedagogically reason with digital technologies. A case study research strategy was selected to investigate how the seven teachers pedagogically reason with digital technologies and what influences them. The selection of the participants and the ethical issues surrounding this enquiry were presented. Data collection methods, which include video-stimulated recall interviews, concept maps, think-aloud concept map interviews and digital portfolios, have been described and justified. Data analysis has been explained including why and how the restories were considered an important factor in the presentation of the data.

In the following three chapters the participant case studies are presented. They are grouped based on career stage to understand how they pedagogically reason with digital technologies. Chapter 4 presents the three early career teachers – Donnatella, Drago and Viviana. Chapter 5 presents the two experienced teachers – Carmelina and Florentina. Chapter 6 presents the lead teachers – Alessandra and Marcelia. For each chapter, the research questions are focused on that career stage.
This chapter presents the cases of the first three of the seven teachers who participated in this research project. Donnatella was teaching at a secondary school located in a large metropolitan city, Drago was teaching in a primary school located in a large metropolitan city and Viviana was teaching in a secondary school located in a small town. All three were early career teachers and all three had changed careers into teaching after completing a graduate entry teacher preparation program.

For each of these three early career teachers this chapter presents a restory informed by the data, that captures the unique experiences of each participant’s use of digital technologies as an integral part of the pedagogy. The goal of the restories was to expose the realities of how these early career teachers pedagogically reasoned with digital technologies to answer the research questions:

*RQ1: How do early career teachers pedagogically reason with digital technologies?*

*RQ3: What influences early career teachers when they pedagogically reason with digital technologies?*

This chapter begins with Donnatella who was working at Milan State High School (SHS).
Case 1: Donnatella

**Background**

Donnatella’s first full-time teaching position was in Milan SHS, located in a lower socioeconomic suburb of a large metropolitan city. Milan SHS is over thirty years old with just over 600 students enrolled. Although a small school there are over 50 teachers employed at the school. A summary of the school statistics from the *MySchool* website are shown in Table 4.9 (for further details about ICSEA and *MySchool* refer to Appendix J). As a measure of socio-economic status, the school has an Index of Community Socio-Educational Advantage (ICSEA) value of 916/922 that is below the national average of 1000. This means that the school has the majority of its students from the bottom half ICSEA distribution, highlighting the relative educational disadvantage. ICSEA derives its value from a school survey where Milan SHS results suggest the majority of the parents are not educated beyond secondary school or have low socio-economic occupations. In terms of the student population, their NAPLAN³ results highlight there were few students in the top two bands in any

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³ NAPLAN – National Assessment Program – Literacy and Numeracy is an annual assessment for students in Years 3, 5, 7 and 9 conducted Australia wide every year. The test covers four domains: reading; writing; language conventions; and numeracy.
area, which is well below the national average (as displayed in Appendix J). An explanation of how the table was compiled from the MySchool website is included in Appendix J.

Table 4.9 - Milan SHS summary information from MySchool website for 2012-2013

<table>
<thead>
<tr>
<th>School Details</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Type</td>
<td>8-12</td>
<td>8-12</td>
</tr>
<tr>
<td>Location</td>
<td>Metropolitan</td>
<td>Metropolitan</td>
</tr>
<tr>
<td>Full-time equivalent enrolments</td>
<td>600-1500</td>
<td>0-600</td>
</tr>
<tr>
<td>Full-time equivalent teaching</td>
<td>50-100</td>
<td>50-100</td>
</tr>
<tr>
<td>School ICSEA value</td>
<td>916</td>
<td>922</td>
</tr>
<tr>
<td>ICSEA Distribution of students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom half</td>
<td>83%</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>17%</td>
<td>18%</td>
</tr>
<tr>
<td>Top half</td>
<td>Educational disadvantage</td>
<td>Educational disadvantage</td>
</tr>
</tbody>
</table>

Donnatella was qualified to teach three subjects for the ages 12 to 17 years: film and television, media and art and she had completed her post-graduate education studies in 2010. She began working at Milan SHS in 2011 and prior to this career change; she had worked in a variety of employment that did not use her undergraduate studies in art. Evidence of Donnatella’s teaching was obtained from the data collected including video-stimulated recall interview, think-aloud concept mapping interview and two digital portfolios. Donnatella had prepared a teacher education digital portfolio in 2010 as part of her teacher preparation that she updated in 2012. To understand how Donnatella pedagogically reasoned with digital technologies, this section begins with a restory of Donatella’s teaching practice reconstructed from the analysis of her data. This will then be followed by application of the data analysis to the two research questions.

Donnatella’s restory: Computer Studies

After one year at Milan SHS, and just before the holidays, Donnatella received an email from her department head advising her that she would be teaching Computer Studies for Year 10 students from the start of the following semester. Computer Studies was an elective subject where the students were taught and assessed how to use a particular software product. Many students selected the subject because they were allowed to use the computers (some thought this meant they could play computer
games). She had not taught Computer Studies previously; however she knew where to find the previous unit plan. She accessed the school on-line management system on her laptop and downloaded the unit plan and the assessment. She explained:

> It was practically empty. It had the title and the title said Photoshop and it was empty. Because it’s grade 10, currently according to the curriculum I need to just be getting them ready for the Year 11 and 12 (Do-1a-208).

The problem was there was little description of what the students actually did. As there were no curriculum documents to specify what needed to be taught, Donnatella was not sure what she needed to teach. She discussed this with her department head who recommended that she teach Adobe Flash, which was available at the school, and suggested that the students would be interested in creating an animation. Donnatella while not having used Adobe products previously, had previous experience of teaching software at the school. She explained her approach to teaching:

> I figure out what stages I want them to get up to...I’ll give them the direct instruction, then I’ll get them to do it themselves so I know that they know how to do it. Then apply it to the assessment. I try to make it as relevant to them as possible (Do-2a-300).

As she was teaching Adobe Flash for the first time she wondered what activities would be suitable for her students. Donnatella understood that if she did not engage them in learning she would have some behaviour issues in her room.

Donnatella searched the Internet to find suitable resources that she could use and that would be accessible and suitable for her students. She found a website with tutorials that she thought she could use for herself and her students. During the holidays prior to the semester beginning, she was able to go through all of the online tutorials to select the material in preparation for her class. She prepared a unit plan, student workbook based on the online tutorials and an assessment item for the students. When she finished she loaded her unit plan and assessment into the school management system. The workbooks contained a number of activities linked to the online tutorials that the students could complete independently in class.

When the term began following the holiday break, Donnatella found that she had been allocated the art classroom with a projector with pull down screen and a number of aged desktop computers located around the perimeter of the classroom. She had a storage space that was used to store art products that took up at least a
third of the front of the room. Her classroom was used as an art and technology
classroom and so consisted of standing height tables in the centre of the room,
computers around two walls and a set of lounge chairs positioned under the projector
screen. This teaching environment influenced Donnatella’s teaching and she
explained that she worked with students at the centre group of tables and moved
around the room when they worked on the computers.

It was the second day back after holidays and her class of thirteen students
arrived at the door for their regular fifty-minute lesson, the first of three for the week.
She had an informal approach for them to enter the room with their materials where
each student found a seat in front of a computer. Donnatella opened her laptop and
connected it to the projector. She asked the students to turn their computers on and
start the log in process. The students were familiar with using computers at their
school and proceeded to log into the system. While waiting, she completed her roll
using her laptop calling out names and marking attendance on the screen.

Donnatella had prepared an example – an animated chicken - for her first
lesson to show the students what they would be creating and she projected it on the
screen. She explained what they would be doing and handed out the workbook she
had prepared for the students. In the workbook, there were exercises and information
about the tutorials they could access with the task sheet and an assessment rubric
included on the back page. She asked the students to open the first page and log on
to access the online tutorial she had chosen. One student entered the web address to
find that it was restricted on her computer. The student notified Donnatella of the
problem. Donnatella reviewed the message and said that she would need to request
access for the students to use the website. She could not do this immediately; she
explained that they would need to watch her screen.

On her projected screen she showed the animated chicken she had created
with Adobe Flash, while she described the components of the chicken and the steps
she took to create it. She asked the students to open Adobe Flash on their computers.
One student complained that their computer was not logging on to the network.
Donnatella checked the computer and identified the blue LAN cable had been
unplugged from the rear of the computer. She plugged in the cable and advised the
student to try again before moving around the room, checking the students had opened
Adobe Flash. She had planned for the students to create a small object and design it to move it across their screen to introduce them to Adobe Flash. She demonstrated the process on her projected screen and asked the students to follow along on their computers, copying her actions. She provided brief instructions on what they needed to do, following the first activity in the workbook. The students began to work on the task while she moved around the room checking their progress. She explained that learning by doing was how she learnt to use Adobe Flash and most of the students were able to complete the task. Occasionally she had to remind them of what they should be doing by using the school’s behaviour management guide.

Donnatella asked the students to save their work on the network so they could continue in their next lesson. She demonstrated the saving process on the projected screen and then moved around the room helping students. She asked each student to record their name on their workbook and collected them to store in a locked cupboard. If she let them take their workbooks, she could not rely on them bringing it to the next lesson. She noted that all but three had completed the task with ease; the three had struggled to follow instructions in the workbook. She was unsure what digital technologies they had been exposed to in the past.

The classes continued over the following weeks. Attendance for some of the students was poor and so without regularly attending, these were unable to complete the tasks she had developed in the workbook. She had good and bad days where student behaviour was challenging Donnatella always applied the school behaviour management approach which required reporting of serious student behavioural incidents. Further, it was not unusual at the school, to have new students enrolled in her class during the semester - and for others to withdraw.

At the end of the semester she asked the students to complete a paper-based survey in which she asked them to provide feedback about her teaching (D-4a#2-St1). In reflecting after the unit was complete, she acknowledged that for the most part, students had engaged in the learning and that there were students who completed the assessment with ease while others struggled to submit anything. She described that she felt that she would have preferred to have designed her own tutorials instead of relying on the online tutorial website. She had learnt about using Adobe Flash and
how to teach with Adobe Flash in the classroom. She reiterated her frustration of not being able to access the tutorial website.

**RQ1: How did Donnatella pedagogically reason with digital technologies?**

There was evidence of the stages of pedagogical reasoning as explained in the theoretical framework, throughout Donatella’s restory and a summary is shown in Table 4.10. The stage of *comprehension* did not begin with a textbook or curriculum materials, but with the Internet as a source of information. She consciously made this decision given her need to become familiar with the topic. She found websites on the Internet that could help her understand what she had to teach. She knew her students would need materials that included in detail what they needed to do. To begin she needed to complete the online tutorials to help herself understand what she could teach.

Donnatella was able to move through the *transformation* processes of planning teaching and designing suitable assessment. The school required all plans and assessment to be stored centrally on the school management system. Donnatella understood the nature of the students she would be teaching. Thus she decided to teach Adobe Flash in a series of activities where the students built on prior knowledge to produce more complex animations. She took what she learned from the Internet websites and created a workbook providing the series of activities for the students to use in class. She knew to prepare the workbook in a paper-based form because of the limited skills of the students to complete an online version; students would not have the funds to print it for themselves.

Her *instructional* practices were selected in order to manage the students using the digital technologies in the particular classroom environment. She used a demonstration approach to show how to use Adobe Flash that was projected on the screen in the front of the room. She selected a follow along step-by-step teaching approach where she projected and explained what she wanted the students to do before moving around the room, working with students individually to ensure they completed the task from the workbook. The students’ computer screens faced the centre of the room. She demonstrated that she had a good understanding of Adobe
Flash when working with the students. One of the factors that Donnatella had no control over was that at times her laptop would fail:

"it crashes, I'm really lucky that it didn't crash then (Do-1a-356)."

Table 4.10 - Donnatella's pedagogical reasoning

<table>
<thead>
<tr>
<th>Pedagogical reasoning</th>
<th>Evidence from Donatella’s restory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Comprehension</td>
<td>Adobe Flash</td>
</tr>
<tr>
<td></td>
<td>No curriculum documents to guide content selection.</td>
</tr>
<tr>
<td></td>
<td>Tutorial website</td>
</tr>
<tr>
<td></td>
<td>Completed tutorials</td>
</tr>
<tr>
<td></td>
<td>Students wanted to play computer games</td>
</tr>
<tr>
<td></td>
<td>Motivated to select activities that she was interested in doing.</td>
</tr>
<tr>
<td>2 Transformation:</td>
<td>No previous planning and assessment.</td>
</tr>
<tr>
<td>Preparation:</td>
<td>Prepared unit plan and uploaded to school management system.</td>
</tr>
<tr>
<td>Representation:</td>
<td>Created workbook</td>
</tr>
<tr>
<td>Selection:</td>
<td>Link to tutorial websites.</td>
</tr>
<tr>
<td>Adaptation and</td>
<td>Prepared an assessment task sheet and rubric for marking.</td>
</tr>
<tr>
<td>Tailoring to student characteristics</td>
<td></td>
</tr>
<tr>
<td>3 Instruction</td>
<td>Not all computers worked.</td>
</tr>
<tr>
<td></td>
<td>Students log on issues/technical problems.</td>
</tr>
<tr>
<td></td>
<td>Used her laptop and projector for demonstrating</td>
</tr>
<tr>
<td></td>
<td>Move around the room to check student work</td>
</tr>
<tr>
<td></td>
<td>Online tutorial websites restricted.</td>
</tr>
<tr>
<td>4 Evaluation</td>
<td>Checked student progress by moving around the room.</td>
</tr>
<tr>
<td></td>
<td>Completed assessment tasks</td>
</tr>
<tr>
<td></td>
<td>Designed task sheet and assessment rubric.</td>
</tr>
<tr>
<td></td>
<td>Requested feedback on her teaching using a paper based survey.</td>
</tr>
<tr>
<td></td>
<td>Student had limited knowledge of using digital technologies.</td>
</tr>
<tr>
<td>5 Reflection</td>
<td>Access to websites was restricted</td>
</tr>
<tr>
<td></td>
<td>Students used the workbook to complete their work.</td>
</tr>
<tr>
<td></td>
<td>Students did not use the online tutorials.</td>
</tr>
<tr>
<td></td>
<td>Did not need to fully understand digital technology.</td>
</tr>
<tr>
<td>6 New comprehension</td>
<td>Check websites access for students.</td>
</tr>
<tr>
<td></td>
<td>Solve computers technology problems.</td>
</tr>
<tr>
<td></td>
<td>Needed to teach how to use technology.</td>
</tr>
</tbody>
</table>

Instead of asking questions to check the students were progressing, Donnatella asked the student questions to challenge their understanding. For example, she asked how they would perform certain functionality and then asked them to find an approach they could communicate to the whole class. Without giving them the answer, she asked them to suggest how she might change her example animation. She waited for their responses before guiding them to the result. A part of Donnatella’s instruction during the unit was troubleshooting problems with digital technologies, such as when
she investigated and found that the blue LAN cable was not connected to a student’s computer. This was a reality faced because other teachers used the classroom and for each of her lessons she needed to ensure that the computers were working. In most cases, her students identified any problems and she used her technological knowledge to resolve them. Over her time at the school, she had developed a very good knowledge of getting the computers back up and running to ensure there were working computers for students.

In terms of evaluation, Donnatella awareness of her students' learning was gained through checking for responses to her questions within the classroom. Students completed the tasks that were detailed in the workbook organised in a sequence to scaffold the students and to prepare them for the assessment. She explained:

> I have to think about things like that, then I also need to think about to teach them the program. I get all stages, I figure out what stages I want them to get up to. In terms of <Adobe Flash> what I wanted to be able to do without my help, like that chicken one. I’ll give them the direct instruction, then I’ll get them to do it themselves so I know that they know how to do it. Then apply it to the assessment. I try to make it as relevant to them as possible (Do-2a-300).

In the classroom, Donnatella continually moved around the room after delivering each set of instructions to ensure the students understood what she had asked them to do. Her evaluation included working with each student checking what they were doing and repeating her instructions several times. Donnatella designed their assessment – the creation of an animated dream car that needed a button, sound and an animation that will happen after the button (Do-1a-408) – so that it required the same tasks that they had been completing in the workbook activities.

Donnatella did not use a formal process of capturing her reflections after each unit or lesson. Evidence from her digital portfolio showed that as a pre-service teacher, Donnatella had captured her reflections after some of her lessons. Through the video-stimulated recall interview for this study, she shared some of her reflections from teaching this unit. Her main concern in her reflection was with the restriction that she encountered when accessing the tutorial website. Donnatella found the school restrictions on Internet limited her decisions when planning learning experiences and what she was able to use for learning. Another reflection was about her increased understanding of her students’ knowledge of using digital technologies. She observed
that most had mobile phones that were Internet enabled, however the students were not experienced in using them or the classroom computers for learning. Finally, she reflected that while she only learnt about Adobe Flash because she had decided to use it to teach this unit, she did not need to be an expert in order to effectively introduce the students to this software.

In the process of teaching this unit Donnatella experienced a number of new comprehensions. First, in order to use the tutorial website she not only needed to test it herself but she needed to test if students could access the website. Through the problems that emerged, she developed a very good working knowledge of the computers in her room. Lastly, she came to better understand her students’ level of confidence and competence in using digital technologies. She could not assume that all Year 10 students could use digital technologies for learning.

In analysing the data collected for the development of Donnatella's restory, elements of her pedagogical reasoning could be synthesized. She showed that she was able to understand the content and the reason she was teaching it. She had transformed the materials into a format suitable for her students and it was important to her that the content was interesting to engage the students. She was able to explain how she managed the class, how she taught the content, how she communicated with students and how she got them to do their work. She linked the current work to their assessment and she asked the students for feedback on her teaching through a survey. Donnatella did not have a formal process for reflection but key elements of her reflection were captured in discussing her teaching with the researcher and she was able to describe the new comprehensions that she had gained in teaching her students, the content and developing her materials. Throughout her restory, Donnatella highlighted many of the influences that enabled her or restricted her from using digital technologies. The next section answers the third research question to understand what influenced Donnatella when she pedagogically reasoned with digital technologies.

**RQ3: What influenced Donnatella when she pedagogically reasoned with digital technologies?**

In reviewing Donnatella’s data there were many themes mentioned that described what influenced her when using digital technologies. A summary of the
influences is shown in Figure 4.15. This model was developed and explained in Chapter 3. To begin, Donnatella’s external influences are discussed before moving to the internal influences.

Figure 4.15 - Donnatella’s influences

**External to Donnatella**

When looking at Donnatella’s external school influences there were many barriers highlighted in her data. Donnatella worked at Milan SHS, which had a low socio-economic student population. There were digital technologies available in many classrooms but the digital technologies were old and unreliable and the student’ held little regard for the equipment. Many of the teachers who used her classroom were not as vigilant in checking and fixing problems with the equipment and Donnatella had become very good at solving problems in order to enable the students to be able to use them.

She found that many of the students in her class were not regular attenders as they had other commitments for vocational education; excursions; or they were absent
from school. There are often instances where schools in low socio-economic areas become aware of opportunities for their students, which had not been foreseen. As a result, students changed to another opportunity offered - sometimes in the community. For some this involved time away from the classroom and when they returned they needed to catch-up and continue with their studies.

Availability of adequate and reliable digital technologies was out of Donnatella’s control. For teaching this unit, the only space available did not have enough computers for the number of students but the irregular attendance provided the solution, as often there were enough computers for students present. However to understand how the availability of digital technologies could influence successful learning, Donnatella explained how she had used digital cameras in the past:

_We don’t really have cameras; I bought my own camera so I’ve asked parents to donate their old 3.5 megapixel cameras. I have myself about six, this school has 10 but at any given time, probably only three will work because the batteries aren’t charged (Do-1a-320)._  

Student access to the Internet was strictly managed centrally which meant her students were unable to access the online tutorials that she wanted to use. Donnatella had access to the centrally managed school management system that was used to access student details and her planning materials.

**Internal to Donnatella**

A summary of Donnatella's professional knowledge gained from analysing her data highlighted the array of professional knowledge she used in teaching. This summary is shown in Table 4.11.

Donnatella had recently completed her graduate studies in education and so would have been exposed to: education contexts (KB6); education purposes (KB7); the most recent curriculum initiatives (KB3); and content (KB1). She completed her practicum experience in two schools and had worked in Milan SHS since graduation where she had gained an insight into low socio-economic secondary students and their characteristics (KB5). She was new to teaching, to her school and teaching this topic but she managed to prepare a unit that engaged the students in learning Adobe Flash. She understood her learners and their characteristics in order to manage the class and motivate them to complete the assessment.
Table 4.11 - Donnatella's knowledge base

<table>
<thead>
<tr>
<th>Knowledge base (KB)</th>
<th>Evidence from Donnatella's restory</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB1: Content knowledge.</td>
<td>Adobe Flash for Computer Studies Completed online tutorials to learn how to use Adobe Flash. Recent graduate qualified to teach technology related subjects.</td>
</tr>
<tr>
<td>KB2: General pedagogical knowledge.</td>
<td>Prepared unit plan and assessment. Used laptop to project computer screen for a follow along demonstration. Prepared a workbook Collected workbooks and stored them.</td>
</tr>
<tr>
<td>KB3: Curriculum knowledge.</td>
<td>Recent graduate and therefore exposed to the latest curriculum documents in her teaching areas.</td>
</tr>
<tr>
<td>KB4: Pedagogical content knowledge.</td>
<td>Not taught Adobe Flash in the classroom. Follow along demonstration Online tutorials</td>
</tr>
<tr>
<td>KB5: Knowledge of learners and their characteristics.</td>
<td>Completed two practicums are secondary schools. Students wanted to use technology</td>
</tr>
<tr>
<td>KB6: Knowledge of educational contexts.</td>
<td>Practicum experience Worked at Milan SHS</td>
</tr>
<tr>
<td>KB7: Knowledge of educational ends, purposes and values.</td>
<td>Teach students something that would engage them in learning. Teach digital literacy skills.</td>
</tr>
</tbody>
</table>

She has shown she has used a variety of pedagogical strategies (KB2) that incorporated the use of digital technologies. She used the school management system to access the previous and store her unit plan. She prepared a workbook of activities that the students could complete in class and managed the physical storage of the workbooks to ensure students had them for her class. Donnatella was lacking the content knowledge (KB1) to know the best pedagogical strategies to teach the content (KB4) but she still decided on an effective approach for teaching with technology. Using a follow along demonstration with a supporting workbook was effective for teaching the students to use Adobe Flash. The demonstration in class, the workbook and online tutorials were effective for teaching new software but there was a problem in that the online tutorials were not written for high school students. In order to teach this unit a second time, she shared that she would need to find better tutorials or write them herself.

Not included in the knowledge base was evidence of her range of knowledge of digital technologies. This included: accessing and uploading planning materials in the school management system; using the Internet to access learning resources and using
Donnatella had used digital technologies prior to teaching and had a personal motivation and interest to use digital technologies in her teaching. She explained:

I think my skills, enthusiasm, and interest in this subject plays a lot in, what is my structure, what is my subject about, what I can do, and what I’m interested in, and how to be a better teacher of it (Do-2a-105).

She explained how she allowed her students to use their personal digital technologies even though it was against school policy:

It’s so difficult because there’s no laptops to use and the phones are so amazing. They use them for research, but as well the kids listening to music helps them zone out everything else (Do-2a-359).

While the school culture was against the use of mobile phones in the classroom, Donnatella encouraged her students to use their digital technologies to aid in working. She was able to confidently use digital technologies for teaching with developing her understanding in the process of teaching. Donnatella was confident in problem-solving technological problems when they arose. She understood how digital technologies were managed at her school and had asked for extra and an upgrade of the digital technologies in her classroom.

Donnatella held beliefs that focused on student centred learning. These beliefs continued in her pedagogy using digital technologies. She believed she should engage students in learning and so selected digital technologies that would interest them. She believed that students were capable of using digital technologies. She also believed that it was important to not assume that this would be ‘natural’ for all her students. This meant for her that teaching the basics of particular digital technologies was still important. The socio-economic background of her students compelled Donnatella in her planning and teaching, as she believed disadvantage should not impact the opportunity for learning and success at school.
Case summary

In summary, as an early career teacher, Donnatella’s data reflected both the professional and personal aspects that impacted her commitment to and ability to teaching with digital technologies. From an external perspective, she had many barriers that made using digital technologies difficult in her classroom and school. Internally she had a strong knowledge base including her knowledge of teaching with digital technologies. Her professional mindset for using digital technologies was influenced by her previous experience of using digital technologies, her interest in using digital technologies and her beliefs about her students and their interest in using digital technologies. Next Drago is introduced, as the second early career teacher where he is described in a primary school setting.

Case 2: Drago

Background

Drago was in his second year of teaching in Rome Primary School (PS), teaching a Year 7 class. In his first year, he had taught a Year 5/6 multi-age class. Each class consisted predominantly of high performing and gifted students in both years. Rome PS is located in a southern suburb of a large city. The school statistics obtained from the MySchool website are shown in Table 4.12 (for further details about ICSEA and MySchool refer to Appendix J). The school is over thirty years old and the school had close to 600 student enrolments and almost 50 teachers employed. Two other participating teachers (Carmelina and Alessandra) included in this study also
taught at Rome PS. This school has a policy to develop eLearning classes but not all students have access and this will become clearer as the cases are presented.

On the MySchool website the school ICSEA value was reported as 1131 (2012) and 1127 (2013), which is well above the national average. The school has over 85 percent of its students from the top half ICSEA distribution. This reflects the relative educational advantage evidenced by the majority of the parents’ occupations and education beyond secondary school level. The school does have nearly half of its student population (41%) with a language background other than English. An explanation of how the table was compiled from the MySchool website is included in Appendix J.

Table 4.12 - Rome PS summary information from MySchool website for 2012-2013

<table>
<thead>
<tr>
<th>School Details</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Type</td>
<td>Prep-7</td>
<td>Prep-7</td>
</tr>
<tr>
<td>Location</td>
<td>Metropolitan</td>
<td>Metropolitan</td>
</tr>
<tr>
<td>Full-time equivalent</td>
<td>600-1500</td>
<td>600-1500</td>
</tr>
<tr>
<td>Full-time equivalent teaching</td>
<td>0-50</td>
<td>0-50</td>
</tr>
<tr>
<td>School ICSEA value</td>
<td>1131</td>
<td>1127</td>
</tr>
<tr>
<td>ICSEA Distribution of students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom half</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td>Top half</td>
<td>88%</td>
<td>85%</td>
</tr>
<tr>
<td>Educational advantage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for loan</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For their NAPLAN results, the students in the top two bands have achieved higher than the national average (as shown in Appendix J).

To gain an understanding of the digital technologies available at the school, Drago described the school:

*Our school is equipped with a 30 computer ICT lab and all students receive weekly lessons with our ICT specialist teacher. Each classroom has a pod of 4 computers, an interactive whiteboard and data projector. Digital devices, such as cameras, microphones, visualisers and microscopes are available for loan through our Resource Centre (Dr-4b-c).*

Along with the above digital technologies available in the school, Drago’s classroom was well equipped with a range of digital technologies including a small number of old desktop computers, a projector and whiteboard along with his school supplied laptop. He used a virtual classroom that he had set up in the learning management system and maintained a regular booking in the computer lab. In particular, Drago’s Year 7 class is an eLearning class where each student has their own laptop.
As with Donnatella, the evidence of Drago’s teaching was obtained from the data collected through a video-stimulated interview, think-aloud concept mapping interview and two digital portfolios. Drago had prepared a Teacher Education (TE) digital portfolio in 2010 as part of his postgraduate studies in education and a second digital portfolio in 2012 as a Digital Pedagogical License (DPL). The TE digital portfolio was formatted to provide responses to teacher professional standards with a selection of evidence from teaching experience in practicums included to support the discussion. Drago’s DPL on the other hand was specific to two items that he chose to explain his use of digital technologies’ teaching practices. To understand how Drago pedagogically reasoned with digital technologies, this chapter begins with a restory of Drago’s teaching reconstructed from his analysed data.

Drago’s restory: Teaching in two Year 7 classrooms

Drago sat at his desk and contemplated what he would teach the students in the next Science unit. Drago had agreed to teach all of the Year 7 students – this comprised of his and one other class - the same science topic. He would swap his students with the other teacher when it was time to teach Science. In preparation, he had already downloaded the state based Science curriculum materials including the unit plan, lesson plans, resources and assessment. He reviewed the materials and decided what he wanted to achieve with the Year 7 students at Rome PS. He needed to update some of the resources and adjust the assessment, to align with Rome PS’s priority of differentiated learning for all students. He finalised his preparation and emailed the draft version of the unit plan for the information of the other Year 7 teacher. The unit would begin when they returned from holidays. Drago explained:

A key part of the unit was allowing multiple methods of information gathering and communication delivery. Students had the opportunity to learn and create through face-to-face discussions, video, audio, an electronic discussion board and written text (digital, print and handwritten). The unit also allowed varied research methods, including Internet, video and peer discussions (Dr-5b-e8).

Three weeks later at the start of the new term Drago was ready to teach Science to his Year 7 eLearning class. The break had ended and his students had returned to the classroom to begin their lesson. Drago waited for them to settle into their allocated seats and open their laptop computers. His class of Year 7 students were very familiar with Drago’s teaching and knew that he would have already sent
them an email with the details of what they would be doing for the day. They knew the routine to open the email ready to go through the email as a group.

Drago moved to the interactive whiteboard and wrote the questions that they would be focusing on for the next lesson – *What are some animals that survive in the desert? How do they survive?* He used his laptop to open the virtual classroom to project on the whiteboard to show the students the task sheet that he had uploaded. He described the assessment for the Year 7 Science unit. It required them to create a creature that suited its environment with a focus on their descriptions of the physical and behavioural adaptations that allowed the creature to survive in the environment.

To begin the Science lesson, he prepared a MSPowerPoint presentation explaining what they would be doing for the lesson. He wanted them to find an animal in a desert environment and discuss why it could survive in that environment. He reminded the students of what they had to complete and the timeframe. For this lesson they needed to email a draft of their work to him at the end of the lesson. They needed to complete an MSWord document using the structure he described in the MSPowerPoint. The students worked on exploring desert animals using their laptops to research on the Internet and to prepare their MSWord document. Drago moved around the room while the students worked on the activities. They asked for his assistance when they required help and as he moved around the room he saw that one student had found an animal. Drago discussed the animal with the student and asked the students to share it with the class, using his laptop to project the image to the whole class. Drago asked the students to stop working while they viewed and discussed details about the animal. Drago posed a question to the class as a starting point of a conversation – “why do you think this animal is suited to its environment?” Drago explained:

*This class, given the nature of them, they're real question askers. ... so they'll ask minute questions before they'll start things...As you can see, they're very much into answering questions as well (Dr-1b-67).*

The class was noisy with many students participating in the conversation, asking and answering their own and Drago’s questions. Some worked quickly on their computers searching for answers while others discussed the features of the animals they had found in comparison to the one projected on the screen. After the conversation the students returned to working on completing their task.
He stopped the class when they had five minutes remaining. He asked the students to email him a copy of their MSWord document so he could check and provide feedback before the next lesson. He had prepared an online science quiz that he wanted the students to answer before the lesson ended. He had designed the quiz with five questions in the virtual classroom where he was able to capture their understanding of the key features of the desert environment. These students were familiar with quizzes in this format and completed it before their break. Most students had finished by the time the bell rang and one by one they shuffled out of the room.

After the break, it was Drago’s time to swap classes to teach the same lesson to the other Year 7 class. This was the first time that Drago had taught this class and he described it as:

*It’s a traditional non-laptop class. When I started that unit, they were at the point where most of them weren’t logging on to the computer on a regular basis ... It was right from that really, really basic point of not having those skills* (Dr-2b-33).

The classroom was set up similar to his classroom, with a projector, interactive whiteboard and a few aged desktop computers at the back of the room. Drago had booked the school laptop trolley for the lesson, as he planned to follow the same delivery with the same activity for these students as he had completed with his eLearning class. He rolled the laptop trolley into the room and asked each student to collect a laptop. He sensed their excitement as they collected the laptops and set them up on their desks. The laptops came to life and the students entered their student ids into the initial log in screen. Some were successful and were ready to start the lesson but the majority experienced problems with the laptops, their student ids or their passwords. Drago moved around the room trying to resolve problems in order to start the lesson. Some he could help, for the others he asked them to sit with someone who was ready. Time had slipped away and Drago was late in starting the lesson, as the setup had taken longer than he expected.

Using his laptop, Drago opened the same MSPowerPoint presentation he had prepared and displayed it on the whiteboard. He rushed through the slides to arrive at the activity he wanted them to complete. He explained what he wanted them to do and instructed them to begin the activity. Most were able to open a web browser and search for an animal but the room was noisy and the students without laptops seemed
The students took longer doing the activity than Drago anticipated and he needed them to complete the activity before the end of the lesson. As with the previous class, he wanted them to create an MSWord document to answer the same questions about the animal that they had found. He displayed the questions on the whiteboard; however he then realised that not all students had access to MSWord. He quickly changed his plan directed those students having difficulty to write the questions and their answers into their science notebooks. So overall, the students in this class continued to work with laptops, pens and notebooks as they completed the activity. Drago asked the students to hand their science notebooks in so that he could review their work before the next lesson. He wanted to see the quality of their work to determine if he needed to spend more time on this activity, as it would be the basis for their assessment.

Later that day, Drago opened his email to review the Science work sent by his eLearning class of students. He quickly reviewed each of MSWord document and added a positive comment as feedback for each student. He saved a copy of their work and returned the MSWord document via email so they would be able to continue working on it in the next lesson. These students were used to this feedback process. Drago reflected that most of the students had written at least a page to answer the questions and some had included images. He was confident that they would produce good work for the assessment.

He looked at the pile of Science notebooks that he had collected from the second class and quickly reviewed each one adding a positive comment. He took a digital photograph of each students work to save it for future reference. Drago thought that most students had attempted to answer the questions but their answers had limited wording and they were filled with spelling and grammatical errors. Some of the students had duplicated other students’ work because they were working together. He was concerned about the quality of their work and how he could assess it fairly in comparison to his eLearning students.

Drago decided to review the assessment item he had planned before giving it to the students. He had planned for all students to complete a MSPowerPoint but explained:
With the other class, due to access to computers, it was really difficult. I was intending to do it electronically but I just couldn’t access the computers enough for those students to be able to do it electronically. A lot of them had to revert to doing it pen to paper... It wasn’t just the access to the computers but the time that it took them to do the task on the computers was probably four times as long as what it took my class to do it on the computers (Dr-2b-21).

As it was taking too much time for the second class to use the laptops, Drago changed his approach for the second class. He explained:

what I ended up doing is I ended up printing everything out for the other class and they physically cut out the parts and stuck them down. So, they did the same activity, but what I’m really getting at is in the end, the volume of writing, just the appearance, but the volume of writing that they actually got from their heads out onto something I could assess. When I looked at my class it was just massively more (Dr-2b-37).

A few weeks later the students had finished and submitted their assessment. His eLearning class submitted their assessment by email and the second class submitted their Science notebooks, the assessment item being the last completed task. Drago had completed marking all of the student work before moderating his marking with the other Year 7 teacher. He was concerned with the results because for the eLearning class, the quality of the student work was higher. Drago explains with reference to his A-E assessment scheme:

what I found was how much they wrote about it was very, very different. I had a student in here, who’s usually a D for most things who ended up actually getting a B on it (Dr-2b-49).

For students that submitted written responses:

And there’d be times when the handwriting itself would be so bad he would have to go back and check with the kid, and the kid couldn’t remember (Dr-2b-61).

In thinking about his eLearning students:

It was only last Monday that I actually saw the breakdown across the board and I thought, “oh I’m going to have to answer to this” (Dr-2b-74).

Teaching both of the classes highlighted the difference that digital technologies had been for student learning. He reflected that eLearning meant that he reviewed more work to be able to award better marks for the eLearning students.
He explained that his relationship with students’ parents had changed since teaching an eLearning program, as many of the parents were reading his daily emails to understand what was happening in the classroom.

I’ve had some high expectation parents who have turned around and been asking me less. The ones that would normally be in my ear, what do they do here, what are they doing there, and I know one in particular will go through everything with a fine tooth comb, and instead of her coming in and saying to me, “I don’t understand what they’re doing with this or that, can you explain more about this?” She’ll just say, “Oh I saw this, this, and this” ... So, she knows exactly what we’re doing (Dr-2b-98).

Technology allowed him to make his teaching visible for the parents to understand what the students were doing and when assessment was due.

After reading about Drago’s restory, elements of his pedagogical reasoning with digital technologies were shared and can be explored in the next section, which attempts to answer Research Question 1.

**RQ1: How did Drago pedagogically reason with digital technologies?**

A summary of Drago’s pedagogical reasoning with digital technologies is shown in Table 4.13. As an early career teacher, teaching science to Year 7s was a new experience. He understood the importance of teaching and learning in science education and could demonstrate this when negotiating the unit with the other Year 7 teachers.

To develop his comprehension, Drago began with the curriculum materials available to him for his planning. Drago had taken the lead in developing the unit and he needed to ensure that the learning and evaluation used digital technologies to meet the expectation of his Year 7 eLearning class. As he was to teach this also to the non-eLearning class, he decided that he would teach them similarly so that these students would also experience the digital technologies.

Drago’s transformation began with preparation by critically reviewing the online curriculum materials to understand what he was required to teach and decide how it would be taught. The validity and suitability for teaching was already established because of the source of the materials. The experienced teachers who had been chosen across the state to construct these materials to support the teaching and
learning of Year 7 science; had been directed to ensure the new digital technologies were embedded. For his purpose, Drago needed to review the materials and decide if they were suitable for both his class and the other class. He wanted to select an approach that used digital technologies for teaching Science.

Table 4.13 – Drago’s pedagogical reasoning

<table>
<thead>
<tr>
<th>Pedagogical reasoning</th>
<th>Evidence from Drago’s restory</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Transformation:</td>
<td>Critically reviewed the curriculum materials. Virtual classroom Online quiz</td>
</tr>
<tr>
<td>Preparation</td>
<td></td>
</tr>
<tr>
<td>Representation</td>
<td></td>
</tr>
<tr>
<td>Selection</td>
<td></td>
</tr>
<tr>
<td>Adaption and Tailoring to student characteristics</td>
<td></td>
</tr>
<tr>
<td>3 Instruction</td>
<td>eLearning vs non-eLearning Multiple teaching approaches Daily email to students. eLearning - Students confidently used digital technologies. Other class – not confident and competent users of digital technologies Emergent and incident learning Change for students writing not typing.</td>
</tr>
<tr>
<td>4 Evaluation</td>
<td>Moved around the room to check for student understanding. Questioning to create conversations. Automatically marked quiz in the virtual classroom. eLearning - Email MSWord documents Other class - Students to hand in their workbooks so he could check their understanding</td>
</tr>
<tr>
<td>5 Reflection</td>
<td>Be prepared for students that don’t use technology for learning. eLearning enabled students to provide better work for assessment and obtain better marks. Using daily emails was a good communication strategy.</td>
</tr>
<tr>
<td>6 New comprehension</td>
<td>Students wanted to use digital technologies for learning. Students need to be taught how to use digital technologies. Student would do more with technology when taught to use it for learning. Students who use technology for learning have an advantage over the students that don’t. Digital technologies enable emergent and incidental learning.</td>
</tr>
</tbody>
</table>

In adapting and tailoring the materials, as explained Drago had two classes to consider: first, the eLearning class and the other class where the students did not regularly use digital technologies for learning; and second, the class that did not regularly use digital technologies. The second classes lack of experience in using
digital technologies was only evident after teaching both classes when he decided during teaching that he had to change his approach. He needed to use two approaches of each lesson, one where he could use digital technologies freely and the other with limited use of digital technologies.

Drago had already begun his instruction through email. He used email to explain what they would be learning. He described how he constructed his email:

*I will write what we’re doing that day in an email to the students and it’s got two columns. My planning goes on one side, their work goes on the other side. And, that means they’ve got everything they need to do for the day. They can go ahead and do extra if they get extra time (Dr-2b-82).*

This explicit teaching could not be done in the same way for the non-eLearning class. They were not familiar at all with the approach Drago normally takes with his Year 7 students. So in this way, the instructional approach for each class was very different because of access to digital technologies for learning. Drago planned to use digital technologies for both classes but:

*with the other class, due to access to computers, it was really difficult. I was intending to do it electronically but I just couldn’t access the computers enough for those students to be able to do it electronically (Dr-2b-21).*

Drago was in the second classroom before he realized that he needed to switch to an approach that didn’t need the students to predominantly use digital technologies for learning. This change emphasises Drago’s ability to transform during instruction in the classroom while teaching. This quick decision process enabled the second class to continue with the activities without disruption. From the observations of the researcher, Drago did not treat this as a ‘panic point’ where his technological plan failed but he seamlessly switched to a more teacher directed approach for that class. In this way, he demonstrated his ability to transform his teaching while teaching.

For his eLearning class, he used email to communicate details of the work that the students needed to complete and the timetable for the day. This enabled Drago to give his students some sense of ownership over their learning. When the need arose, Drago liked the opportunity for what he termed “emergent and incidental learning”. He explained:

*A big thing that I don’t think is really discussed enough is emergent and incidental learning. That’s situations where something comes up in class and you can just say, “Well find out more about that. Go”. I don’t know enough*
about that, you don’t know enough about that, let’s find out something together, which in traditional classroom is very, very difficult. You can’t just trundle them off to the library and hope there is actually information about that particular topic there (Dr-2b-15).

Digital technologies enabled Drago to answer questions that would normally not be answered within the classroom at the time of the question. He demonstrated to his students how he used the Internet to find answers. Drago used these opportunities for open dialogue between him and the students, to discuss the answer and make explicit the relevance for learning. In doing this, he was modelling for them how to interpret the content and by articulating to them his thinking he was modelling for them how to interpret and decide on the relevance of what they found. Often teachers’ processes remain hidden to the students with the teacher deciding ahead of time the content and resources needed during the lesson, and trying to anticipate the types of questions the students would ask. For Drago’s eLearning class, his knowledge and preparation of the content and resources was not the boundary for learning. Showing his students during the lesson how he was able to find answers, then encouraging them to participate in deciding the relevance, he was demonstrating how digital technologies can be used to make learning more meaningful.

Drago used a variety of approaches to evaluate student learning. Inside the classroom he used in-class questioning and moving around the room to check on student progress. For one class he used digital technologies to check for student understanding in multiple ways within the classroom: for example using online quiz and sharing student work through email. Drago did not need to mark the online quiz as the students received immediate feedback. Their responses were captured in the virtual classroom and could be reviewed anytime by the student, Drago or their parent. He was able to use the virtual classroom to capture a history of student progress that could be used in deciding grades for their report card. The formal assessment was provided as part of the curriculum materials. For the non-eLearning class and its teaching environment, Drago needed to modify his preparation and his teaching. The requirements of the assessment task did not change. The presentation format did change because of the different access to digital technologies of the both classes. The difference in the quality of the work from the two classes called for close reflection from Drago.
Drago shared many anecdotes that described his *reflections* and *new comprehensions* from teaching this Science unit. It was a great opportunity for his pedagogical growth around how digital technologies impacted on student learning in delivering the same teaching and learning for two different class contexts. Particularly important was his awareness that his eLearning students delivered better quality work with fewer errors giving them an advantage over the students who were not using digital technologies for learning. He reflected that it was not easy to use digital technologies when the students and the classroom itself are not prepared to use them. He learned that he could change approaches mid lesson when he realized that it was not going to work for the second class of students. He believed that using email to communicate teaching and learning requirements enabled the students to become more responsible for their learning. This changed the role he played in the classroom from teacher to facilitator where he was able to move around the room giving each student individual feedback or facilitating the whole class to investigate further information on the Internet. Through digital technologies, he could provide more comprehensive information to parents through the use of digital technologies and their access to digital technologies.

**RQ3: What influenced Drago when he pedagogically reasoned with digital technologies?**

In analysing Drago’s data there were many influences mentioned and a summary of Drago’s influences is shown in Figure 4.17. To begin, this section described Drago’s external influences including his school and the wider education system before moving to his more personal internal influences in terms of his professional knowledge and professional mindset.
Figure 4.17 – Drago’s influences

External to Drago

At Rome PS Drago had the support of two teacher colleagues who formally supported teachers in the use of digital technologies. These teachers had previously taught his students the year before, and so the class was familiar with using digital technologies as part of their learning. Drago described how many parents were actively involved in their children’s learning and it was not uncommon for parents to contact him for information about their children.

Drago was issued a laptop with a suite of software that he could use for teaching and learning. Drago had shown evidence of using many of the state supplied educational resources including: the learning management system; state based central website for educational resources; a wiki tool; school management system; and the curriculum materials. In addition he used a variety of other educational websites to enhance learning in his classroom where the school had subscribed to these educational websites. Each website required the teacher to manage student work
which enabled the teacher to view student statistics of the students' progress through the work.

**Internal to Drago**

A summary of Drago's knowledge base is shown in Table 4.14. During his recent teacher preparation program, he would have been exposed to the most recent curriculum initiatives (KB3) and content (KB1) for teaching in a primary school setting. He completed his practicum experience in two schools where he gained insight to primary students and their characteristics (KB5) and since graduation he had been at Rome PS.

Drago has used a variety of pedagogical strategies (KB2) that incorporated the use of digital technologies. Drago was able to use digital technologies to share his pedagogical thinking about teaching Science with students through his daily email to them. He encouraged his students in using digital technologies to capture their learning within and outside of his classroom.

Drago was able to access prepared curriculum materials for the unit and this included planning, assessment and resources, which captured the PCK (KB4) of the teacher who prepared the unit. He was able to extend on their PCK, by modifying the planning documents to include more use of digital technologies to suit the needs of his eLearning class. In another example, Drago used email to inform his students of what and how they were going to learn. He did not need to spend time in class explaining what they would be doing as the students were able to read what he wanted them to do. As he wasn't instructing from the front of the classroom his class teaching time focused on facilitating them through the learning materials. When he had to instruct the non-eLearning class, he had to adjust to being more flexible about the dominance of digital technologies for these students' learning and assessment.
Table 4.14 - Drago’s knowledge base

<table>
<thead>
<tr>
<th>Knowledge base (KB)</th>
<th>Evidence from Drago’s story</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB1 Content knowledge.</td>
<td>Year 7 Science unit  Science content: Animals and environments  Recent graduate qualified to teach in a primary classroom.</td>
</tr>
<tr>
<td>KB2 General pedagogical knowledge.</td>
<td>MSPowerPoint for teaching  Communicating via daily email  Use of the virtual classroom.</td>
</tr>
<tr>
<td>KB3 Curriculum knowledge.</td>
<td>Completed teacher preparation  Curriculum materials.</td>
</tr>
<tr>
<td>KB5 Knowledge of learners and their characteristics.</td>
<td>Completed practicum at two primary schools.  Knew his students wanted to use digital technologies.  Knew their parents wanted them to use digital technologies.  Students need to be taught how to use digital technologies.</td>
</tr>
<tr>
<td>KB6 Knowledge of educational contexts.</td>
<td>Whole class instruction  Collaborating with teaching peers.  Accessed school and state education systems.</td>
</tr>
<tr>
<td>KB7 Knowledge of educational ends, purposes and values.</td>
<td>Used digital technologies for teaching and learning.  Encouraged his students to use digital technologies effectively.  Demonstrated how digital technologies could be used.</td>
</tr>
</tbody>
</table>

He had prepared an MSPowerPoint presentation that he was able to use to explain what the students needed to do. During class time, he used his laptop to explore and answer questions allowing for opportunities of emergent and incidental learning. In terms of his TPACK (KB4), Drago shared an interesting story of using digital technologies. As explained he used his laptop to explore and share answers to questions. Before having a laptop connected to the Internet, those questions would remain unanswered because it was not practical to move the students to the library, with limited resources, to explore and find the answers to their questions. Drago used his TPACK to determine new ways of using digital technologies to evaluate student work. He used online quizzes, in the learning management system, to check for student understanding and was able to access their results to analyse their understandings and misunderstandings. He had a regular routine where his eLearning students shared their work through email which allowed him to review student work.
anywhere and at any time and have a copy of their work at multiple points in time to see their progression. Students were able to share their work, feedback and results with their parents.

For the categories KB6 and KB7, Drago was new to teaching and still in the process of developing his knowledge of learners and educational contexts. He didn’t need to investigate and set up these tools, others had already made them available so he could simply learn and then use. Teaching with digital technologies had an influence over his knowledge base in all categories. The next section presents a discussion of the influences of digital technologies on Drago’s professional mindset that emerged in analysing his data.

Drago had used a variety of digital technologies in his previous careers before teaching and although being a new teacher, he was able to confidently use a range of digital technologies for teaching and learning. Drago worked in a school where there were few technological problems, enabling him to use digital technologies without disruption and Drago had the confidence and technical skills to be able to solve technological problems if they arose.

There were many belief themes about students and the use of digital technologies that emerged from the data analysis. Primarily, Drago believed that learning needed to be relevant for students to engage. He explained “having the students perceive the work as being relevant is a key part of ensuring that it is engaging” (Dr-5b-e8). He wanted to teach them skills that he believed would serve in their future:

I believed that learning these skills is vitally important...I think that if students don’t learn to make the most of digital communication tools then they will be disadvantaged educationally, recreationally, socially and in their work opportunities (Dr-5b-e21).

Drago also believed that students wanted to use technology in their learning and he believed that his eLearning class preferred using digital technologies instead of pen and paper. He believed, after teaching the two different classes that he got more from his students because they used their digital technologies compared to the second class that could not use the same digital technologies for learning.
Case summary

This section introduced Drago as the second early career teacher of the seven participating teachers in the study. His restory described his pedagogical reasoning with two different classes. For Drago, digital technologies changed the teaching and learning landscape in his eLearning class. Digital technologies allowed Drago to begin his teaching outside of the classroom and change his teaching within the classroom. As evidenced in the teaching of his eLearning class, Drago became both a teacher and facilitator for learning and used digital technologies to communicate his instruction for the classes.

Drago used digital technologies to capture the progress of the student work in the eLearning class. As a result, these facilitated his timely assessment and feedback of these students’ work. This of course was not possible with his ‘repeat’ teaching of the topic to the other class. Drago’s restory provides a means to analysis how his knowledge and confidence of the digital technologies enabled him to effectively provide successful experiences. Importantly the specific context of his teaching for this study facilitated capturing his professional reflections on the unfair advantage that digital technologies provided his eLearning students after teaching the same content to two very different classes.

The next section introduces Viviana, who is he the last of the three early career teachers to be discussed.

Case 3: Viviana

Figure 4.18 - Viviana
Background

Viviana’s first teaching position after graduation from teacher preparation was in Genoa State High School (SHS). She was qualified in business education subjects and Mathematics after career changing into teaching after many years working as an accountant. She completed her postgraduate education studies in 2010 and started working in 2011. Evidence of Viviana’s teaching was obtained from the data collected including video-stimulated interview, think-aloud concept mapping interview and digital portfolio. Viviana had prepared her digital portfolio in 2010 as a requirement of her teacher preparation studies. The digital portfolio was designed to provide responses and examples of evidence mapped to the teaching professional standards.

The school statistics from the *MySchool* website are summarised in Table 4.15 (for further details about ICSEA and *MySchool* refer to Appendix J). Genoa SHS is located in a small town on the outskirts of the capital city. The school was small with just less than 600 students enrolled and just under 50 full-time equivalent teachers. The school has an ICSEA value of 933 that is well below the national average of 1000. The school has over 70 percent of its students from the bottom half ICSEA distribution, highlighting the relative educational disadvantage. As Genoa SHS was a high school only the Year 9 NAPLAN results were available (as shown in Appendix J). As a comparison to the national average there were few Year 9 students in the top two bands and those students’ results reflect they are well below the national average in all subject areas. An explanation of how the table was compiled from the *MySchool* website is included in Appendix J.

**Table 4.15 - Genoa SHS summary information from *MySchool* website for 2012-2013**

<table>
<thead>
<tr>
<th>School Details</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Type</td>
<td>8-12</td>
<td>8-12</td>
</tr>
<tr>
<td>Location</td>
<td>Provincial</td>
<td>Provincial</td>
</tr>
<tr>
<td>Full-time equivalent</td>
<td>0-600</td>
<td>0-600</td>
</tr>
<tr>
<td>Full-time equivalent teaching staff</td>
<td>0-50</td>
<td>0-50</td>
</tr>
<tr>
<td>School ICSEA value</td>
<td>933</td>
<td>907</td>
</tr>
<tr>
<td>ICSEA Distribution of students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom half</td>
<td>70%</td>
<td>87%</td>
</tr>
<tr>
<td>Educational disadvantage</td>
<td>29%</td>
<td>13%</td>
</tr>
<tr>
<td>Top half</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational disadvantage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To understand how Viviana pedagogically reasoned with digital technologies, this section begins with a *restory* of Viviana’s teaching practice reconstructed after analysing her data. Viviana is described teaching mathematics to Year 10 students in Genoa SHS, with many of her students the most behaviourally challenging in the Year 10 cohort.

**Viviana’s restory: Year 10 Mathematics**

Viviana arrived at school early, as she needed to attend an early Mathematics department meeting to find out what she would be teaching in Mathematics the following semester. She had already taught Year 10 Mathematics the previous year and she knew this class would be a difficult class, as she has been assigned one of the lower achieving Year 10 Mathematics classes. The approach for teacher allocation was to assign the better classes to the qualified senior mathematics teachers to work with the students to move them through to the more difficult mathematics. Viviana, like a few other new teachers, were allocated the remaining classes with the objective to teaching a more simplified version of mathematics to comply with the state mandatory requirement of all students passing one semester of mathematics between Year 10 to 12.

The meeting started at the regular time and the Head of Department explained the work that he had done to prepare the materials for Year 10 students. With state curriculum materials, he had reviewed and prepared all unit plans, worksheets and assessment items for the Year 10 students. He handed out the exam he had prepared and the Year 10 mathematics teachers began reviewing and discussing each task. The Head of Department, along with a few other teachers, had the brighter students and so the students would easily complete the required content in the timeframe. For Viviana, she was thinking that most students she would have in her class, would be challenged with the exam and would not be able to understand the questions therefore making their already challenging behaviour more difficult to manage. The Head of Department concluded the meeting reassuring Viviana and the other new teachers that they were free to modify the learning materials to suit their students in order to prepare them for the exam.

Viviana used the materials and the exam to determine how best to teach her unit. She prepared a MSPowerPoint presentation to cover the whole unit based on [continue...].
what she thought she could achieve with her students. She reviewed the state based curriculum materials to find resources that she could incorporate into the MSPowerPoint to “break it up” (V-2c-50). She explained,

  *It would be a funny clip or it could be like a mind puzzle or it will be a math puzzle (V-2c-74)*.

In explaining why she used MSPowerPoint she described how it helped in planning:

  *I found it easier and it helped me plan my lesson, at the beginning when I was doing it, it helped me plan my lessons so I knew exactly what I was doing. I was sort of more structured and I felt more confident but obviously that I’ve been getting used to teaching I don’t need it as much (V-1c#1-116)*.

Later that week, she arrived at her Year 10 Mathematics classroom to meet the students before their regular seventy-minute lesson, the first of three for the week. The students were waiting outside the door and only four of them were prepared with their books and pens to enter the room. She shouted for the other students to get their materials, enter the classroom and find their regular seat. The prepared group sat in their regular seats to the right of the classroom while the remaining students entered the room in a rowdy manner and found seats for their lesson. As a result of a few particularly disruptive students, starting the lesson took longer than Viviana had planned. She opened her laptop and marked the roll and she noticed that one of her most challenging students had not arrived, as he was usually late. She knew he would create a disruption when he entered the room as he was returning to school after a week long suspension.

Her classroom was filled with aging desks and chairs set out in three rows. A data projector had been installed with a pull down screen that was in front of the whiteboard, making it difficult to use both, simultaneously. There were no student computers and Viviana carried her laptop to each class. There was a cupboard in the room that had been placed there to store new student laptops but for over six months the IT technician had not set them up. She wondered how they would cope on the school Wi-Fi as it was notorious for being extremely slow. There were plans to upgrade the bandwidth but the service provider kept postponing the work. Viviana was keen for her students to use the laptops in her other classes but not mathematics as she feared they would be a distraction.
Viviana opened the MS PowerPoint presentation she had prepared for the lesson. The first task was to run her warm-up as her introduction with the students. They were familiar with her mathematics warm-up, she projected the questions onto the whiteboard and allowed the students a few minutes to solve the problems. She explained that they were:

very basic tasks, basic adding, subtracting, multiplication. The kids aren’t very up to date, the kids aren’t very smart in mathematics, they don’t know their times tables, they can’t add up in their heads, they’re very reliant on calculators. I’ve started taking it back down to lower level math warm ups, just to start getting them to use their brains rather than relying on a calculator (V-1c#1-44).

The ‘ready’ students worked on completing the ten questions while the others organised themselves, some had pens and books others not. Viviana moved around the room repeating orders to get them to complete the work. The noise in the room decreased as the students worked through the questions. A student suggested one of the answers was wrong and proceeded to explain why. Viviana checked the response and agreed. Viviana explained:

purposeful error yes, just to see who picks it up and who doesn’t pick it up and they can challenge me, I allow them to challenge. Sometimes I won’t have an error, but the majority of the time I do put an error up there whatever it is... when I put the answers up they’ll often just sit there and try and work out where my error is. Not every time but sometimes I have a little error in there (V-1c#1-97-98).

The two groups worked very differently, one group worked on the questions with little noise or disruption while the challenging students completed very little of the warm up. Viviana knew that even the quiet students might not be engaged with their Maths work, because, some when given the chance, would secretly complete their art class work unless she moved around the room checking progress. About ten minutes into the seventy-minute lesson, a late student arrived at the door where he announced his reason to the whole class, interrupting Viviana while she was talking. Viviana asked him to get his materials and find a seat in the room. As he sat down he decided to hit another student with his book and a brief scuffle broke out between the students. As this was ground for removing him from the class, Viviana immediately wrote him a behaviour note and asked him to sit at the back of the room by himself. She warned that another incident would mean that he would need to leave the room.
Viviana’s MSPowerPoint presentation included links to YouTube videos that explained mathematical content. She was introducing a new topic and she had decided to use some videos to help explain the concept. About twenty minutes into the lesson she reached the point to show the first video. She opened her MSPowerPoint presentation and clicked on the link to the video, going through the various sign in processes. YouTube displayed on the screen but the video did not load. The Internet was slow and the video would not play, she tried again but nothing happened. She looked at the class and given the nature of the students she could not spend time trying to ‘fix’ the problem with her digital technology and so decided to continue with her MSPowerPoint ignoring the YouTube video. As she didn’t close her YouTube Internet window, about ten minutes later, a male voice began speaking over the classroom speakers interrupting the class but the very American voice kept stopping and starting while the YouTube video was continuing to load. She quickly closed her Internet window to stop the noise.

Viviana reminded the students that they would be tested on the work in the exam in the following week. Most of the students copied the work into their books while the challenging students kept interrupting Viviana instead of completing their work. She finally decided to send the most vocal to the schools ‘Refocus Room’, following the school behaviour management. She asked the three questions:

*What are you doing? What should you be doing? What happens if you disturb or distract my class again? (V-1c#1-436).*

She completed the form and sent him out of the room. He was experienced with the process and left without arguing. She continued working through the MSPowerPoint ensuring the students completed each question and had written down the answers in their books.

Most of the students followed all her requests and completed all of the work, while the challenging students maintained a continuous dialogue discussing or repeating what Viviana was saying or noises to interrupt the class. Viviana continually moved around the room checking progress and reminding of consequences. She was careful not to be drawn into an unrelated conversation with the challenging students. It was difficult and she explained:
Because they’re not understanding the work; they’ll try and find something to have a discussion about (V-1c#1-343).

For the duration of the class, she recorded names of the disruptive students on the whiteboard, as a reminder that she would follow up at the end of the class.

The class ended and Viviana asked those challenging students whose names were written on the board to stay behind. The other students packed up and left the room and headed to their next class. Viviana packed her laptop, all the cables she used and her teaching materials into her backpack. She explained to the disruptive students that as a penalty, they were to meet her on her playground duty at the break to do litter duty.

RQ1: How did Viviana pedagogically reason with digital technologies?

A summary of Viviana’s pedagogical reasoning is shown in Table 4.16. Viviana was able to begin her pedagogical reasoning using the materials that had been prepared by her Head of Department. The materials were prepared to the curriculum requirements. At her school, it was standard practice for her Head of Department to prepare all of the assessment for the Year 10 Mathematics classes. Her first step in pedagogical reasoning was to comprehend what she was to teach. She didn’t begin with a textbook or high-level curriculum goals, as she was given all of the teaching materials and the assessment that she needed to tailor to suit her students. She understood the importance of teaching mathematics for her Year 10 students. She was a recent graduate and had studied mathematics as part of her teacher preparation.

She understood that she would have a number of challenging students in her class who had failed mathematics in the past. As a result, she knew these students would struggle with the materials. By using a MS PowerPoint presentation, she could face her students instead of working with her back to the class, while she wrote on the whiteboard. Not only did she need to comprehend the mathematics her students needed to cover, though her comprehension focused on understanding her students in order to engage and manage their behaviour in the classroom.
Table 4.16 - Viviana’s pedagogical reasoning

<table>
<thead>
<tr>
<th>Pedagogical reasoning</th>
<th>Evidence from Viviana’s restory</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Instruction</td>
<td>Laptop, projector and speakers Wi-Fi Implement school behaviour management approach. Record names on the whiteboard. Move around the room to check on progress. Not engage when the ‘challenging’ students provoked her. Noisy classroom. Ensured all the material was covered.</td>
</tr>
<tr>
<td>4 Evaluation</td>
<td>Moved around the room to check for student understanding. Used assessment supplied by her Head of Department. The use of the video was not a good idea.</td>
</tr>
<tr>
<td>5 Reflection</td>
<td>The MSPowerPoint worked well. It is not easy to teach mathematics to students that don’t want to learn. Technology can fail.</td>
</tr>
<tr>
<td>6 New comprehensions</td>
<td>Can’t use YouTube videos in that classroom.</td>
</tr>
</tbody>
</table>

As she had been given all of the materials her transformation consisted of creating strategies that would suit her particular students, thus she started planning MSPowerPoint presentations to teach her students. She selected the most relevant and simplest materials to teach her students and MSPowerPoint enabled her to embed YouTube videos and photos that offered a different approach to explain the material. She explained:
I try to use videos as much as possible. Every topic that we do every year I try at least to have one video in there (V-1c#1-404).

She could have selected using paper-based tasks or completing tasks from a textbook. She chose strategies for presenting on a screen, demonstrating tasks and having her students write all of the work in their notebooks. Her priority was to cover all of the materials in the teaching timeframe in order to prepare her students for their exam. In finding suitable videos, the state curriculum materials contained links to videos and other teaching materials that she could use.

For her instruction, Viviana used the digital technologies available to her to teach this topic; however the students themselves would not have access to computers. She used her laptop, MSPowerPoint, the data projector and speaker system set up in her classroom. She needed to carry all of her materials to the classroom and set them up for each lesson. She had access to the school Wi-Fi network but knew it was unreliable in her mathematics classroom and this was confirmed by attempting to open the YouTube video during the lesson. She knew the Internet was unreliable in that classroom but still felt it important to include YouTube videos in her lesson. She explained how she “normally have it preloaded as well” (V-1c#1-472) but that caused problems too in that she had to log in and in many cases it attempted to re-download the video. She knew that if there were problems with accessing the resources she was prepared to just ignore it and move on to the next slide in her presentation. As she had a large number of challenging students, her focus was on managing their behaviour. She used a teaching strategy where she projected the tasks on the screen for the students to write and answer the questions in their notebooks.

Viviana’s teaching approach was to explain materials in manageable amounts. She showed and explained each question before she moved around the classroom checking on student progress. For most students she ensured they were writing the information down. For the challenging students, she would remind them of the task, check that they were working and try not to engage in their distractive talk. As a result of the latter students who would consistently interrupt the class with their chatter and noise, she did not have the option of spending time with each student to ensure they understood what they were doing or allow them to participate in the class discussions. Her evaluation during instruction was limited to checking progress because of the
behaviour of her challenging students. For their formal assessment, the students were scheduled to complete a paper examination the following week. The content and her approach were dictated by the exam content and what she could cover in class with students. Her personal evaluation concerned the failure of the YouTube video during the lesson and her satisfaction of successfully managing student behaviour.

As her reflection, Viviana thought that the MSPowerPoint was an effective presentation strategy, as it allowed her to face the students in order to manage their behaviour. She described how she used the warm up activity to prepare the students for learning and the use of the MSPowerPoint freed her from writing on the whiteboard so that she could move around the room to check on student progress. Her planning was captured in the MSPowerPoint (number of slides and time on each slide) to ensure she covered all of the content in the lesson, even with the interruptions from the challenging students. Her new comprehensions from the lesson focused on using YouTube videos in the classroom, as she needed to think of a better approach if she wanted to use video to help explain mathematical concepts.

The next section answers the third research question to understand what influenced Viviana when she pedagogically reasoned with digital technologies.

**RQ3: What influenced Viviana when she pedagogically reasoned with digital technologies?**

A summary of the influences that emerged from Viviana’s data analysis is shown in Figure 4.19. To begin Viviana’s external influences from her school and the wider education system that have enabled or restricted her from using digital technologies are discussed before moving to her internal more personal enablers and barriers for using digital technologies.
Figure 4.19 - Viviana's influences

External to Viviana

Viviana’s data analysis highlighted many themes regarding the external influences at her school. Many of her students were challenging and not interested in learning mathematics. As seen in the restory, Viviana used the school behaviour management approach to ensure the students behaved in her class and she even evicted one student from the class during the lesson. In addition to the data on her students used in the restory, Viviana had also explained in her video-stimulated recall interview that from her previous experience with parents she knew that many were not interested in the educational outcomes of their children nor did they know how to effectively handle their behaviour. She shared how quite a few of the students were involved in legal proceedings/family court issues. As a result, student attitude to learning and their low level of motivation to learn were major influences on her planning her lessons.
The availability of digital technologies in her school and in particular within her classroom, were limited. The classroom did have a data projector and a pull down screen, but because it covered the whiteboard this did not allow for both to be used simultaneously. The classroom was filled with old damaged furniture, which did not make a welcoming learning space. Viviana experienced problems with the school Wi-Fi network when she attempted to download the YouTube video.

She was issued a laptop with applicable software for her use as a teacher. An IT technician who was employed by the school supported the laptop. Viviana explained, in her video-stimulated recall interview, that at the beginning of the year a large number of student laptops were purchased but had been sitting idle for many months waiting for configuration. The teachers were keen to use digital technologies but were concerned how the students would use them and disagreed with the students taking the digital technologies home (V-1c#1-292). Viviana shared that some of the mathematics teachers wanted to know how she was using the digital technologies for teaching.

Because she had said that she had never used power points in math, she just used the white board. She wanted to see what I used it for, I explained what I was using it for and she now starts, she now uses it...She said that she, “Now realizes that it does help her get through more work.” She’s pretty IT savvy or she knows everything, web pages and stuff that I have no idea about (V-1c#1-125-126).

Viviana shared in her video-stimulated recall interview, an external influence not reflected in the other teachers’ data analysis of how her supervising teacher, while on her final teacher preparation practicum, demonstrated how she used digital technologies for teaching. This practicum school had run lunchtime sessions for teachers, where she was able to learn how to use some of the digital technologies available at that school. Viviana had multiple external influences that enabled or prevented her from pedagogically reasoning with digital technologies, while the next section presents her internal influences that emerged in the data analysis.

**Internal to Viviana**

A summary of Viviana’s knowledge base is presented in Table 4.17. Viviana recently completed her teacher preparation where she was qualified to teach Mathematics to Year 10 and she had access to the state curriculum materials to extend on her content knowledge (KB1) as well as her curriculum knowledge (KB3).
mathematics, she taught using MSPowerPoint and she found by preparing MSPowerPoint presentations (KB2) she was able to teach the content and maintain her position where she faced her students instead of having her back to them while she was writing on board. In the restory it was clear that she did not use MSPowerPoint has her only presentation tool because when she wanted to demonstrate to the class how problems were solved (KB2) she lifted the screen and wrote on the whiteboard. She had a number of challenging students in her class and so it was very important that she understood how to implement the behaviour management approach (KB2) in her school. As an effective pedagogical strategy she regularly moved around the room to check on student progress (KB2). She needed to view her students’ work, as many would not do any work unless she was checking. She explained that she had some art

Table 4.17 - Viviana’s knowledge base

<table>
<thead>
<tr>
<th>Knowledge base (KB)</th>
<th>Evidence from Viviana’s restory</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB1 Content knowledge.</td>
<td>Recent graduate qualified to teach mathematics to Year 10. State curriculum materials.</td>
</tr>
<tr>
<td>KB2 General pedagogical knowledge.</td>
<td>Prepared MSPowerPoint presentation. Important to face her students while teaching.</td>
</tr>
<tr>
<td>KB3 Curriculum knowledge.</td>
<td>Recent graduate and therefore exposed to the latest curriculum documents in her teaching areas.</td>
</tr>
<tr>
<td>KB4 Pedagogical content knowledge.</td>
<td>Used warm up activity to begin lessons with purposeful error.</td>
</tr>
<tr>
<td>KB5 Knowledge of learners and their characteristics.</td>
<td>Completed two practicums are secondary schools. Worked previously with lower aptitude maths students at her school. Understood the behaviour management approach</td>
</tr>
<tr>
<td>KB6 Knowledge of educational contexts.</td>
<td>Whole school approach for teaching Year 10 Mathematics. High school.</td>
</tr>
<tr>
<td>KB7 Knowledge of educational ends, purposes and values.</td>
<td>She wanted to teach her students mathematical/numeracy skills. She wanted to teach with digital technologies.</td>
</tr>
</tbody>
</table>
students in her class and without checking what they were doing they would end up drawing art instead of doing the mathematics work.

She used her MSPowerPoint with embedded video to effectively teach mathematics (KB4). From her warm-up activity through to the content she presented, it her use of her PCK and her TPACK in teaching mathematics is evident. She reviewed and selected the most appropriate state curriculum materials that incorporated the use of digital technologies, in terms of YouTube videos that she could embed in her MSPowerPoint. From the state curriculum materials, she was able to identify the questions that she could use with her students. The materials also assisted her with recognising some common misunderstandings that student experienced in learning mathematics. She shared how she would even refer to a mathematics textbook to find questions that were suitable for her students. In many of her lessons she had included a purposeful error in her MSPowerPoint with the hope that the students would engage in the materials and then challenge her with a different solution.

Viviana had previously taught mathematically challenged students at the school and was familiar with their attitude and motivation. She had worked at Genoa SHS from graduation and had taught some of the more challenging students at the school (KB6) in other subjects. She understood the need to have well-developed behaviour management approach in order to manage the behaviour in her classroom. She was familiar with the purposes and values of education and she wanted to teach student maths, and with a special interest in numeracy skills and financial literacy skills (V-1c#2-79), to prepare them for their future (KB6). She used digital technologies in her previous career and wanted to demonstrate good use of digital technologies for her students. The next important internal influence was her professional mindset

Viviana had used digital technologies prior to teaching and therefore she was able to confidently use a range of digital technologies in her teaching. She was confident in using the available digital technologies and problem-solving simple technological problems if they arose. She was confident in requesting help from support staff and making recommendations for digital technology use. She described in her video-stimulated recall interview how she was a leader in using digital technologies for teaching mathematics and influenced other teachers in the Mathematics department (V-1c#1-125-126).
In her teacher education digital portfolio she explained as part of her teaching philosophy, her motivation for teaching

_to share my knowledge and experience with young adults and ignite the passion for them to become lifelong learners (V-4c-p4)._

Viviana had career-changed into teaching after working in accounting. Viviana engaged her students with the use of a warm-up exercise, which was effective as evidenced by even the disruptive students becoming focused to find her purposeful error. She explained that she always left one mistake in the answers and gave the students a goal of trying to find it when checking their answers. Viviana explained:

_I keep it in their math book yes, it’s not something I mark or judge them on. Occasionally every couple of weeks we’ll discuss how they’re going with the warm ups and when I notice that they’re finishing them faster I will increase the complexity of the sums (V-1c#1-53)._  

This represented Viviana’s goal of engaging students in learning. She could have easily just followed the alternative approach used by some her teaching peers which was using worksheets handed out in each class. She decided to use digital technologies for the presentation of her mathematics content both as a management strategy as well as for student engagement.

**Case summary**

This section introduced Viviana as the third of seven teachers included in this thesis. Viviana, like Donnatella, worked in a difficult school where access to digital technologies was problematic and a low priority for teaching and learning. There was evidence of Viviana’s pedagogical reasoning with a heavy emphasis on the use of digital technologies. She was required to understand and then transform her understanding into a form to engage her students in learning mathematics. She understood her challenging students as she prepared a MSPowerPoint presentation.  

For other teachers in the Mathematics department, using a digital tool was not common teaching practice.

There were many influences that emerged from the analysis of her data. From an external perspective, like Donnatella, she had many barriers at school but enablers within the education system she was employed. Internally, she had evidence of all components of the knowledge base for teaching including her knowledge of digital
technologies. Her mindset for using digital technologies was influenced by her previous experience of using digital technologies as an accountant, her interest in using digital technologies in the classroom and her understanding her students.

**Chapter summary**

In this chapter, case studies of Drago, Donnatella and Viviana, the early career participating teachers were presented. All three were new to teaching after changing careers into teaching and completing their teacher preparation. All three were successful in gaining fulltime employment after graduating. Each case begins with a restory reconstructed from their data to examine the influences of digital technologies on their pedagogical decisions. These three restories provide insights about their pedagogical reasoning, their knowledge base for teaching and their professional mindset and the influences over teaching with digital technologies. All three worked in the same state education system but their school and classroom contexts were very different. Drago taught in Rome PS where some teachers had been encouraged to use digital technologies for over twenty years while Donnatella and Viviana both worked at lower socio-economic schools where disadvantage impacted upon their use of digital technologies and facilitated their management of behaviour, rather than, the learning. For both, digital technologies enabled them to manage the learning in their classrooms and without digital technologies their teaching would look very different.

For each early career teacher, elements of their pedagogical reasoning emerged through the analysis of their data. All three participating teachers covered aspects of their comprehension where they used technology to access or obtain the content they taught. All three showed how they transformed their content for learning for their students. Drago and Viviana were able to use the state curriculum materials as a starting point and their preparation involved selecting what would be appropriate for their class. Viviana was given the materials but she revisited the state curriculum materials to find resources that she could use in her MSPowerPoint presentation. As there were no curriculum documents for the teaching of Computer Studies, Donnatella was not able to use state curriculum materials and needed to develop her own suitable content for her students.
All three used digital technologies for teaching. A distinctive feature was that Donnatella and Drago enabled their students to use digital technologies for learning. Viviana used digital technologies for teaching mathematics to allow her to move around the room rather than writing on the whiteboard with her back to the class. In contrast, Donnatella used digital technologies as demonstration approach where students could follow and replicate the work as she explained it while projecting onto the screen. Drago used digital technologies for instruction but moved beyond projecting what he wanted them to do. He used it to enable the students to extend on their work or explore something new, moving learning from the expected to the unexpected while teaching them Science.

All of the teachers studied used questions, discussions and physically moving around the classroom to gauge student understanding. Donnatella and Drago used digital technologies for evaluating student work but Drago needed to resort to paper-based assessment for one of his classes. He found that for his eLearning students, they completed more and better quality work with the use of digital technologies in comparison to the other class. He reflected how he realised that it benefited them when marks were distributed. For Donnatella, digital technologies allowed her to capture student work on the school network that she could use for assessment, as she could not rely on her students to complete the assessment and had to use what work she had available.

All teachers showed elements of their reflection when interviewed for the video-stimulated interview. None had adopted a formal approach for capturing their reflections, but Drago had prepared a digital portfolio where he had reflected on teaching two units of work. Both Donnatella and Viviana showed evidence of new comprehensions that were included in their restory, including how they could not rely on the digital technologies provided in their school.

All three raised a variety of external and internal influences in the use of technology. The key external influences were around them in their schools. There were significant barriers including access to digital technologies, student ability and attitude, their teaching peers and availability of digital technologies. There were many computer systems available at their school and over the Internet. They all had completed teacher preparation that introduced them to how digital technologies could
be used for teaching. Only Viviana shared that while on her practicum experience her supervising teacher shared her pedagogical reasoning with digital technologies.

All three were able to show evidence of their knowledge base for teaching. An important observation was how digital technologies were used to access many of the materials to help develop their knowledge base. All three showed elements of their PCK and TPACK in teaching with digital technologies. Donnatella showed how to teach software to students, while Viviana showed how she used MSPowerPoint and the Internet to teach mathematics. Drago had one of the most interesting examples of TPACK where he explained the value of emergent and incidental learning that using the digital technologies enabled. He was able to use his laptop and data projector to help answer student questions. In addition he was able to share work and to enable learning anywhere/anytime for his students with the use of the virtual classroom in the learning management system.

To conclude, all three teachers expressed a confidence and experience of using digital technologies. All three had changed careers to become teachers and they had used digital technologies as part of their previous work. All three used digital technologies as part of their personal lives and had a personal motivation to use digital technologies in teaching. All three were motivated to extend their teaching with the use of digital technologies: Donnatella in using Adobe Flash to engage students in learning a new software tool; Viviana using MSPowerPoint to visually improve her mathematics instruction; and Drago wanting to teach his students about science. As members of their school, all three were informally influencing and being influenced by other teachers at their schools by sharing their teaching experiences.

The next chapter introduces and examines the experienced teachers – Carmelina and Florentina.
CHAPTER 5: THE EXPERIENCED TEACHERS

This chapter

This chapter presents the cases of the next two teachers who participated in this research project. Both of these experienced teachers work at two differing schools and both teach in primary classrooms. Carmelina’s school is over 20 years old and Florentina’s school is under 5 years old. Both teachers are experienced teachers with over 40 years of teaching experience between them.

For each of these experienced teachers, this chapter presents a restory informed by the data, that captures the unique experiences of each participating teachers use of digital technologies as an important part of their pedagogy. The goal of the restories was to explore the experiences of how these experienced teachers pedagogically reasoned with digital technologies to answer the research questions:

RQ1: How do experienced teachers pedagogically reason with technology?

RQ3: What influences experienced teachers to pedagogically reason with technology?

This chapter begins with Carmelina who was working at the same school as Drago - Rome PS.

Case 4: Carmelina

Figure 5.20 - Carmelina
Background

Carmelina has over twenty-seven years of teaching experience. She has been a classroom teacher in Rome PS for most of her career and has held a variety of technology related leadership roles in the school during this time. A description of Rome PS has been provided in Drago's background to his case. The key point about Rome PS is its provision to certain classes, of full resourcing associated with eLearning. It is not universally provided to all students. Carmelina had been interested in using digital technologies from when it was first introduced in her school and she explained when given access to her first computer, she

\[
\text{took it home one Christmas and played with it and sort of learned what I could do with it and how to be, how it could support kids (C—2d-69).}
\]

At the time of the research project, she was not considered a lead or appointed senior teacher in her school. She was a half time classroom and specialist technology teacher.

Evidence of Carmelina’s teaching was available through analysis of her video-stimulated interview, think-aloud concept mapping interview and her digital portfolio. Carmelina prepared a digital portfolio for her employer's purposes, in 2007, which included two items of evidence. This chapter begins with two restories of Carmelina’s teaching as she performs the dual roles in Rome PS as a technology specialist leader and as a teacher in an eLearning classroom.

Carmelina’s restory #1: A technology specialist lesson

At home, Carmelina checked her email on her laptop before getting ready for school. She was about to start a day of back-to-back lessons with Prep classes with students aged 4-5 years old. She does this in her role as a technology specialist leader for the school, running half hour lessons with approximately twenty learners at a time.

She had received an email from one of her Year 6 classroom teachers seeking help to revise an assessment to incorporate the use of technology. The teacher was preparing his digital portfolio and needed help with planning his evidence for inclusion in his portfolio. Carmelina decided to access the state education website to find an example to be able to show the teacher in her morning break. She accessed his last
unit plan through the school management system to understand how he taught the unit the previous year.

The new computer lab was booked for the whole day by Carmelina, but first she needed to set up the laptops. For protection, each night they are packed away in a laptop trolley and every morning the first teacher to use them is expected to set them up. The Prep students did not yet have the independent skills to confidently set up their laptops. She didn’t have enough time in the first lesson to organize the students to set them up ensuring they had: i.e. power; a working mouse; logged on to the network; and opened on the MSPowerPoint that she has prepared.

![A view of Carmelina's PowerPoint](image)

**Figure 5.21 - A view of Carmelina's PowerPoint**

To prepare for the Prep classes, she prepared her MSPowerPoint presentation (shown in Figure 5.21), downloaded all of the learning objects (as eBooks) from the state education website and set them up on the school network. She explained what she was trying to achieve:

*I was trying to use digital devices to support the reading profile of this school. One of their focuses is to develop reading skills, whole-school program, and ICT is a driver or tool that you can use in that. I was especially trying to show the teachers how you can use ICT to support what it is that they’re doing, which is reading. This strategy was a good one for reading groups, so that’s why I did it this way. I did it in a PowerPoint as a collection. One of the teachers has actually taken that and done their own groups, so that was what I was hoping to achieve. It’s also giving the children skills (C-1d-15).*

She was teaching reading skills to Prep students for this week after discussing with their class teachers how she could assist them with the use of digital technologies in
the specialist technology lessons. Some of the teachers treated the lessons as an extension to their students’ literacy learning and extended on her digital technologies in their own lessons. Other teachers treated these lessons as specialist technology lessons in the same manner as other specialist lessons. They sent their students to the computer lab while digital technologies were not used extensively in their regular classrooms. Regardless of how they used digital technologies, she explained that her approach to deliver specialist technology lessons was

*basically look at which classes are having an assessment or something that they need help with and I’ll go in like I’m doing blue screen photography with Year fives (C-1d-325).*

It was already 8.30 a.m. and the first group of students were due to arrive. She had done this many times and has the process organized into a quick routine. The students arrived at the door and were ushered into the room under the guidance of their teacher aide, as their regular classroom teacher was allocated student free time for the duration of this lesson. Each student was allocated a computer and requested to find their personal headsets from the basket that the teacher aide had carried from their classroom. The students quickly found their seats when Carmelina instructed them to watch the electronic whiteboard. The students watched the whiteboard as she explained what they would be doing during the lesson. She also demonstrated opening the eBooks using the MSPowerPoint links. The activity she described meant the students independently accessed the eBooks and listened to the audio recording while reading along with the words on the screen.

The students listened, but not all were focused on what Carmelina was saying. Some were distracted with their headsets and the laptops in front of them. To begin she asked for all students to move their mouse and open the eBooks of their choice. Most were capable of completing this task without support. Carmelina moved around the room checking and assisting the students who appeared to have problems. She moved from student to student checking what they were doing and encouraged the students to continue with another eBook. Students were free to select the stories they wished to access and could move from one to the next with a few quick clicks. Carmelina explained that she always left
some form of choice. Not always possible, but by giving them the choice of at least what they’re going to start with is really important I think for engagement with little people (C-1d-89).

Some students had a few problems and their peers moved around to help solve their problems before seeking support from Carmelina.

I firmly believe that we need to teach children...they need to be able to problem solve. They need to be able to say, ‘Okay, this isn’t working. What do I do?’ (C-1d-72).

Even at a young age these students were keen to help each other. She explained:

They’re very good at helping each other, and that’s why sort of buddying them up is a really good idea, because they do help each other. They don’t think anything of it. I’m really quite proud of this class because at the beginning they found it very tough and quite confronting (C-1d-85).

It was late in the teaching year with all of the students familiar with the computer lab and the use of the laptops. The students had not been taught specifically how to use MSPowerPoint, however, Carmelina had used it multiple times as a tool to link to other technology resources.

At the end of the lesson, Carmelina instructed the students to pack their headsets and return them to the teacher aide. The students prepared to leave the room by moving into a line near the door. Under instruction from the teacher aide, they thanked Carmelina for her lesson and moved off as the next group was waiting outside. Carmelina quickly moved around the room to return all screens to the MSPowerPoint. The next group of students was invited into the room and the same process was repeated for each of the eight classes.

Carmelina’s restory #2: Year 5 learning contract

Carmelina decided to plan her next unit as an integrated learning contract for English and mathematics, where students would negotiate their learning approach and what they wanted to achieve being recorded in their own learning contract. This was with her Year 5 eLearning class that she shared teaching with Alessandra (see Chapter 7: The lead teachers). The learning contract was designed to include a variety of tasks that the students would complete individually, as a group or as the whole class. Some activities incorporated the use of online learning websites; e.g. Mathletics;
SpellingCity; and Braintastics. The level at which each student worked at was negotiated with Carmelina when the students signed their learning contracts.

She had not used MSOneNote previously and decided that it would be a good tool for use for the learning contract. Carmelina knew that her colleague Alessandra was able to give her a quick lesson and talk her through the problems of using OneNote for learning. She decided that she needed to learn more:

I experimented with OneNote and then worked through the Atomic Learning tutorials to get a more detailed understanding of the software. I created a master of the major work we were to cover in the month... Although the master took many hours to put together, once it was complete I had all the major resources and tasks in the one place and ready for the classwork. The contract was also very effective for limiting the online sites the students were accessing. As students would be using different digital tools at different times, I was mindful of structuring online content and having website links already sorted to help keep the children focused and limit the potential for accessing inappropriate sites (C-5d-e39).

As she had a diverse range of students with a majority acknowledged as gifted and talented, she wanted to use an approach that allowed them to move at their own pace. Her school had implemented a differentiated learning approach as their pedagogical framework where all teachers were required to set multileveled learning for all students. She thought that through the use of learning contracts she could achieve this for her eLearning class. Her class was an eLearning class and the only class of its type for the year level.

The unit she prepared was an integrated unit offered across all three Year 5 classes. The other classes planned to include some digital strategies but as a class, Carmelina had the ability to provide a wider range of resources and response tools. Carmelina was conscientious to ensure that the laptop was extensively used as part of learning. Being the only laptop class in that year level, she was responsible for enhancing the teaching and learning of the year level curriculum through the use of the student laptop. She explained how the digital technologies supported her use of the Learning Contract:

the use of digital technology allows for differentiation very effectively with the use of open-ended software, websites and apps. As a teacher it can be difficult to organise the digital resources in a way to be shared by all students. Digital work can also be problematic to mark and have handed in. OneNote collects work samples and makes it very easy to add comments and edit suggestions. A
Some of the resources she used were easy to set differentiated levels for students.

It was the first day for the next teaching period and the students were keen to hear about the new unit and the learning contract. Carmelina explained her approach to introduce the unit:

A whole class explicit teaching lesson (40 min) was given to introduce the class to OneNote. As I strongly believe in purpose driven learning I showed the children my master of the contract and explained how we were going to use it to differentiate their learning. As our class is very used to differentiation they could comprehend quickly why we were using this software. I gave a modelled lesson of creating a OneNote notebook – I showed them a tabbed notebook and explained OneNote was exactly the same but in a digital way and as we could cut and paste pictures and documents into a physical notebook we could do the same with the digital version. I explained it would make keeping their documents and work organised much easier.

The students had not used MSOneNote before and were keen to start to prepare their learning contract. Carmelina left the students “to explore MSOneNote and to create a MSOneNote notebook for their own personal use. Most chose to create a personal journal/diary” (C-5d-e79). She introduced the learning contract using her electronic whiteboard. She gave them an explanation of each section but decided to keep it brief, as there would be more time to explain each topic when it was covered.

The students were given time to work on their learning contracts while Carmelina supervised what they were doing as:

the class rule for the contract that the students were required to choose an English and maths based task before a game based task (C-5d-e22).

They continued to work on their learning contract until the lesson time had ended. She was glad that the students engaged with the learning contract and they could see the rewards of completing their work. She explained how she asked the students to:

fill in the timetable to select the activities they would like to work on. We discussed some important rules they need to consider such as maths or English task before a game related task. They could not repeat the same task in that day e.g. Ziptales, and they needed to have their timetable complete before starting on the activities (C-5d-e87).

There were many tasks that were completed in the following month. Students worked together, in pairs and small groups and consulted with Carmelina when they
required help. Carmelina used whole class instruction to introduce new tasks and the students made regular appointments with her to discuss their progress. She maintained a class blog in the virtual classroom. She explained why:

*This unit was designed to hands on as interactive as possible. Our class online learning community was instrumental in providing a platform for sharing ideas and extending experiences. The virtual classroom included a blog where the children posed questions about the content they were learning and other children answered the question or posed their own questions in response. Some children also used it to comment on their own learning (C-5d-e21).*

Using their child’s student id, parents posted questions, as they were seeking clarification about a task their child was required to complete. Students were responsible for the completion of their work they had planned in their learning contract. Some completed their formalised work at home to be able to use class time with their peers for the other activities.

Carmelina used various methods to assess the students for their understanding or misunderstanding. She had taught the students to regularly send her a copy of their MSOneNote page to enable her to be able to review, collect and provide feedback. She used the statistics from the Mathletics, SpellingCity and Braintastics to check on student progression. She explained how she used each student’s MSOneNote learning contract when the student completed various tasks, because:

*MSOneNote collects work samples and makes it very easy to add comments and edit suggestions. A page can be sent via email or comments added in text boxes next to a digital print out of the work (C-5d-e31).*

Sharing her satisfaction that:

*MSOneNote has been so successful particularly in the eLearning setting I have already planned next term’s maths investigation in MSOneNote and will have the children scan all written work into the notebook in order to “hand in” the notebook as their assessment piece (C-5d-e103).*

She reflected how the learning contract changed her role in the classroom from instructing the students how to use MSOneNote to complete each task to facilitating students through the completion of the tasks. Carmelina shared her reflection:

*Having a master <template> of the work proved invaluable as I could spend the majority of my teaching time supporting the children and not on sending, saving distributing or creating the resources for the class (C-5d-e40).*

She observed that students worked effectively with the learning contract
The learning contract gave to students a focus and they were not distracted with the digital technologies.

Carmelina’s role as technology specialist teacher meant that other teachers often sought advice on how to use digital technologies in the classroom. She described how the other Year 5 teachers were curious as to how the class had completed the tasks and asked Carmelina to give a demonstration. She showed them the learning contract and described how she was using MSOneNote. She showed examples of the students’ work and discussed what she was going to use it in the next unit. She shared with the other teachers that she had learnt:

> MSOneNote itself proved to be a very successful tool to differentiate the learning tasks, however on reflection I would have introduced the MSOneNote contract as a smaller learning experience initially such as a maths investigation. The children of all levels found MSOneNote very easy to interact with and I had only to give one specific lesson on MSOneNote before they were using it effectively (C-5d-e101).

These two restories provide detail of Carmelina’s pedagogical reasoning with digital technologies. Using both restories and all other data analysed, the next section responds to answer Research Question 1.

**RQ1: How did Carmelina pedagogically reason with digital technologies?**

Carmelina’s pedagogical reasoning from her restories is summarised in Table 5.18. After teaching for many years in a primary school setting, Carmelina would have developed an extensive understanding of the subject matter, purposes and ideas within and outside the discipline. In her teaching, Carmelina used a variety of digital technologies to comprehend what she needed to teach. She accessed important documentation online via websites where she could download content for her planning and resources that her students could use. At her school, she had access to a variety of digital tools that she could use for teaching and learning including Mathletics, SpellingCity and Braintastic. Her comprehension included negotiating with the year level teachers the content they were all going to use and then adapting to suit her eLearning students. It was important for her to use digital technologies in her
Table 5.18 - Summary of Carmelina's pedagogical reasoning

<table>
<thead>
<tr>
<th>Model of pedagogical reasoning and action</th>
<th>Evidence from Carmelina’s story #1 – A technology specialist lesson</th>
<th>Evidence from Carmelina’s story #2 – Year 5 Learning Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Transformation: Preparation Representation Selection Adaption and Tailoring to student characteristics</td>
<td>Selecting appropriate eBooks for students. Set up MS Powerpoint with 8 stories. Tested that eBook links worked in the school environment.</td>
<td>Set up the virtual classroom - blog. She set learning contract template. Tested all of the links worked in classroom.</td>
</tr>
<tr>
<td>3 Instruction</td>
<td>She used multiple teaching approaches including: teacher centred presentation using her electronic whiteboard; and student centred PowerPoint presentation with eBooks. She had routines to set up the computer lab before class and to ensure that the technology was ready for the students to use. Peer support.</td>
<td>Multiple teaching approaches. Used blog. Classroom set up for group work and the use of laptops. She taught the students to regularly back up their work to the school intranet.</td>
</tr>
<tr>
<td>4 Evaluation</td>
<td>She moved around the room to check on student progress. She asked questions where students were encouraged to answer by raising their hands.</td>
<td>In class questioning to check for student understanding. Email learning contract for feedback. Appointments with students to check progress. Matheletics, SpellingCity and Brainstastic statistics.</td>
</tr>
<tr>
<td>5 Reflection</td>
<td>The need for specialist technology lessons. Students were capable of using digital technologies for reading eBooks.</td>
<td>Students liked using OneNote. Carmelina found OneNote suitable for teaching and learning. She thought that the learning contract included too many tasks and next time she would design something simpler.</td>
</tr>
<tr>
<td>6 New comprehension</td>
<td>Young students are capable of using technology. Young students are able to solve their technology problems. Young students will help each other to solve their technology problems.</td>
<td>She would use OneNote for the next mathematics unit.</td>
</tr>
</tbody>
</table>
Much of Carmelina’s *transformation* work was in creating the MSOneNote template with a suitable range of activities using different digital technologies and testing all worked for the students. She needed to set up student accounts in the educational websites the school subscribed to. She set up the virtual classroom and the class blog. She used the learning contract to provide detailed instructions for her students to understand what they were doing and why they were doing it. By sharing the MSOneNote, she was externalising her pedagogical thinking for her students, their parents and her peers to understand her learning goals. This was made available because of her *selection* of digital technologies. By capturing her thinking her students could see the relevance in their learning and the big picture of what she was trying to achieve. Her key message for the use of digital technologies was purpose, as digital technologies should not be seen as separate to teaching and learning but part of teaching and learning. It is not ‘added on’ or ‘integrated’ but a critical component of her teaching.

Even though her school gave priority to using digital technologies for teaching and learning, she described how there were still some teachers that saw digital technologies as a separate aspect to their teaching. They believed that student learning to use digital technologies was a separate skill to their learning of subject areas, and had come to rely on Carmelina to teach these skills in the technology specialist lessons. Carmelina succeeded in engaging her class of Year 5 students to use digital technologies as a natural part of learning about a topic. Feedback from them and their parents highlighted their enjoyment in what she used. This was most evident at the beginning of the year, when parents were given the opportunity to enable their children to participate in an eLearning class, as there were often more parents that applied than there were places available. Carmelina selected *instructional* strategies that allowed students to work independently. Her digital technologies allowed her to be able to check their work in class and for assessment. There was still a need for her to use whole class instruction but the majority of work was completed where Carmelina’s role was as facilitator allowing her to spend more individual time with each student. Students were encouraged to book appointments with her when they wanted individual feedback about what they were learning. Her room was not
designed for her to stand up the front but to be able to move around working with individuals or groups of students.

Carmelina used digital technologies to assist in evaluating the students inside and outside of the classroom. Her evaluation during instruction included checking for student understanding in their learning contract, discussing at an interview or moving around the room checking progress. Students used their learning contracts to negotiate their tasks, to obtain feedback from Carmelina where she would add comments as suggestions. Their learning contracts were also used as evidence for making assessment decisions. She explained that the student could email a page where Carmelina could review the page within the classroom or elsewhere after the lesson.

It was important for Carmelina to teach students to be able to problem solve any digital technologies' challenges. She appreciated the amount of work she had invested in setting up the learning contract as she could spend more time supporting students and not doing their tasks for them. The learning contract clearly laid out what the students had to do and what to do if they encountered any problems. Carmelina used her technology specialist lessons to add digital technologies to other teachers’ assessment. She worked with teachers to understand how to use digital technologies in their assessment requirements – such as negotiation with students who wished to incorporate digital technologies into their assessment.

Carmelina shared many reflections in her digital portfolio data item. The use of digital technologies was dependent on setting-up the access to educational websites and the identification of suitable activities to ensure learning objectives were met. The learning contract was the first time that Carmelina had used MSOneNote and in order to use the software with her students, she invested time in learning how to use the software. The creation of the learning contract was not simply adding technology to an existing unit, as Carmelina used her knowledge of the unit to determine how she could use MSOneNote to facilitate differentiated learning. She reflected that the unit was a success but for some learners she would have designed the tasks with more detail. She embedded the learning of the digital technologies within her activities to not overwhelm the students with learning a new digital technology. She acknowledged
that in the future she already had a template set up and could easily modify it the next
time when she decided to use a learning contract.

Carmelina reflected on access issues, which she experienced when using
digital technologies. She experienced problems accessing YouTube in the classroom
because it was blocked for students. Carmelina suggested to her students that
YouTube was good for videos that showed how to use MSOneNote and as it was
blocked at school she suggested that the students access videos from home. She
knew that because of how her class had been constituted, this was not impossible for
them to do. She also reflected on learning about her students and what digital
technologies engaged them and identifying ways they could be used in the classroom.
She reflected how her eLearning students were capable of managing their own
learning and that her young Prep students were capable of using MSPowerPoint to
access eBooks.

Carmelina shared her *new comprehensions* where her focus was on using
digital technologies in teaching and learning. She learnt that she could not assume the
students knew how to use digital technologies and she needed to build their confidence
to be able to solve their digital technologies issues. She learnt that some students did
not contribute on a class blog because of their poor literacy issues and so she needed
to allow them different opportunities to participate. Carmelina learned that her strategy
of embedded eBooks in MSPowerPoint worked well in assisting students to improve
their reading skills and that some teachers were interested in using her idea back in
their classroom. Most importantly she learnt that students liked using digital
technologies, which she had designed as part of their learning.

From her data analysis there were many influences that have enabled
Carmelina to use digital technologies, these will be elaborated in the next section in
answering Research Question 3.

**RQ3: What influenced Carmelina to pedagogically reason with
digital technologies?**

From Carmelina’s data analysis, there were many influences that emerged as
shown in Figure 5.22.
External to Carmelina

At her school, the previous Principal had been a key instigator in starting Carmelina’s digital technologies’ learning journey. Then, the current Principal supported releasing Carmelina, for half of her teaching time, to continue in her technology specialist-teaching role. In her role as specialist technology teacher she provided support to other teachers within her school. Some teachers considered her technology specialist lessons as separate to their teaching. She mentioned how she learnt about OneNote by using the Atomic Learning tutorials that she accessed through the learning management system.

Carmelina was described working in a classroom and computer lab that were both fitted with an electronic whiteboard, data projector and Wi-Fi access. The school had a new building, which housed a new library and dual computer labs. The computer labs were used for Carmelina’s specialist technology lessons and when not occupied by Carmelina, other classes could book the rooms online. There were a
sufficient number of reliable laptops for use and they were stored securely in a purpose built laptop trolley that could be wheeled around the school for classroom use. From her school, as for all teachers, she was supplied a laptop with preloaded software for her to use for teaching and learning. Carmelina used external online learning resources that her school had arranged site licenses for class use.

Carmelina shared that she had participated in a limited number of digital technologies’ focused professional development over the years with much of her knowledge of using digital technologies developed from implementing digital technologies as part of her teaching. She had not undertaken any further formal studies in education or information technology. She was an early participant in her employing authority’s Smart Classrooms Professional Development Framework by completing her Digital Pedagogical License in 2007 and then mentored other teachers in completing their certification. She explained that for many years she had delivered informal professional development covering digital technologies available for teachers in her school.

She understood that her students wanted to participate in the eLearning class and that as parents had to pay a financial levy to participate in the eLearning class, parents expected that their child would be using digital technologies for learning. She described that the statistics from the learning management system and the educational websites, highlighted that her students engaged in learning outside of school hours.

**Internal to Carmelina**

A summary of Carmelina’s knowledge base is shown in Table 5.19. From many years of teaching primary school students, Carmelina has a comprehensive understanding of the literacy and numeracy curriculum (KB3) and content knowledge (KB1). From teaching many students she has a well-developed knowledge of primary school students and their characteristics (KB5). She has used a variety of pedagogical strategies (KB2) that involved and relied on the use of digital technologies. Carmelina’s pedagogical knowledge has grown with her use of digital technologies in teaching and learning.
Table 5.19 - Carmelina's knowledge base

<table>
<thead>
<tr>
<th>Knowledge base (KB)</th>
<th>Evidence from Carmelina’s restory #1 – A technology specialist lesson</th>
<th>Evidence from Carmelina’s restory #2 – Year 5 Learning Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Content knowledge.</td>
<td>Reading skills for Prep students. Knowledge of reading tasks completed in the classroom. eBooks for teaching reading.</td>
<td>English and Mathematics for Year 5 MSOneNote for teaching and learning Online educational websites</td>
</tr>
<tr>
<td>2 General pedagogical knowledge.</td>
<td>Electronic whiteboard for demonstration. Students work independently MSPowerPoint / eBooks Encouraged peer support to solve computer problems</td>
<td>Learning contract Online educational websites Blog - discussion board in learning management system Electronic whiteboard for demonstration. Independent work Appointments for checking progress.</td>
</tr>
<tr>
<td>3 Curriculum knowledge.</td>
<td>Literacy – improve reading Collaborates with other teachers in developing learning materials.</td>
<td>Mathematics English State curriculum materials</td>
</tr>
<tr>
<td>4 Pedagogical content knowledge.</td>
<td>Used eBooks in MS PowerPoint to help develop students reading skills She negotiated with classroom teachers to add technology on to the work they were doing in the classroom</td>
<td>OneNote as learning and teaching tool Embedded content in OneNote Student negotiation</td>
</tr>
<tr>
<td>5 Knowledge of learners and their characteristics.</td>
<td>Students may or may not be able to read Students like to help each other solve problems.</td>
<td>Differentiated learning Parents eLearning</td>
</tr>
<tr>
<td>6 Knowledge of educational contexts.</td>
<td>Prep Primary school</td>
<td>Year 5 eLearning Primary school</td>
</tr>
<tr>
<td>7 Knowledge of educational ends, purposes and values.</td>
<td>Digital literacies</td>
<td>Digital literacies eLearning</td>
</tr>
</tbody>
</table>

Not only did she need to know general pedagogical strategies but she also needed to know about the software and systems that had become available to her. Her pedagogy was not lost to the classroom but captured within the school management system, MSOneNote, the learning management system, and MSPowerPoint. She could reuse the content to teach the same content again in her
technology specialist lessons or her students could return and revisit the content to review what they were taught. Digital technologies enabled Carmelina to change her teaching from teacher centred to student negotiated and she acted more as a facilitator for learning. She used digital technologies to communicate the direction for learning and was then able to change her physical practices in the classroom to be able to more personally interact with students.

Carmelina used digital technologies to record her formal planning, as a virtual classroom and to communicate student work (KB4). Much of her planning was captured in the digital technologies, whether that was word processing in formal unit planning or the digital technologies that her students used to complete their work. A key message from the use of digital technologies was that her TPACK was captured in the digital technologies for her students, their parents and her peers to be able to access at any time. Carmelina was able to demonstrate her TPACK by showing how she innovatively used MSPowerPoint as a pedagogical tool for students to access eBooks and as a presentation tool on her electronic whiteboard. She did not need to teach her young Prep students how to use MSPowerPoint but used it because of its simplicity as a starting point to access the eBooks. In her second example, her TPACK concerned the use of MSOneNote for a learning contract. Carmelina prepared a learning contract template that students edited in preparation for negotiating their work for the unit. Carmelina used her digital technologies to check progress within the classroom, provide feedback, tracking work and as evidence for grading.

Carmelina used a variety of digital technologies within the classroom as part of her instruction including an electronic whiteboard, laptop, data projector, virtual classroom in the learning management system, MSOneNote, MSPowerPoint, eBooks, state education websites, Mathletics, SpellingCity and Braintastics. Her instructional approach was heavily influenced by the use of digital technologies, and in her school, the digital technologies were reliable enough that she did not change her approach. In the final two knowledge bases (KB6 and KB7), Carmelina had taught for over 27 years and would have a deep understanding of her education context and the purposes of education. She was influenced in using digital technologies from within her school, well before state and national policies were endorsed for teachers to use digital technologies.
From the data analysis, Carmelina is a strong advocate for the use of digital technologies in the classroom, and that the use of digital technologies has influenced her teaching. This passion for digital technologies led to her taking on the two roles she performed in her school. Her commitment facilitated the school’s decision to continue funding to support these roles over a number of years as they were reviewed on an annual basis. Carmelina has a strong belief about the use of technology in the classroom where her technology specialist lessons were designed to extend on classroom learning rather than just teaching the students’ digital skills. The important message was that of purpose. Carmelina believed that her technology specialist lessons needed a purpose for learning. She worked with other classroom teachers to identify opportunities to add technology to the students’ learning experiences or as part of their assessment. She believed that the students who had been given the opportunity to participate in eLearning class compared to their peers in the same year level, were experiencing improved learning experiences and outcomes. Their actions demonstrated their motivation to be in the class as they were engaged and confident users of their digital technologies.

Carmelina had shown she has the confidence in using digital technologies in teaching and learning. She was not afraid or reluctant to learn more, for example when she started using MSOneNote. She had identified a teaching and learning need and sought from digital resources a possible tool for communicating and collaborating with her students. Carmelina explained how student choice was an important consideration for her in planning differentiated student work, as it allowed for her students to work at their own level. She explained:

A digital device is a tool a learner uses to research, investigate, collaborate and share ideas and creations. The software, apps and websites are the medium in which these are created and shared. The device is only as good as the hand attached, in order to create, collaborate and use the digital device to its best, the learner must be given choice in how the learning is created and shared (C-5d-b14).

Through the use of the learning contract and her eBook presentation, she allowed her students the choice of what they wanted to learn. The digital technologies enabled her to be able to monitor their progress from within and beyond the classroom. Using digital technologies enabled Carmelina to move her classroom beyond the four walls
and using virtual classroom allowed her students to use their digital technologies to access learning anytime/anywhere.

Carmelina believed that students, even the very young, were capable of using digital technologies and able to solve their technological problems before calling on her for help. The learning contract enabled her eLearning students to independently plan their work and share their ideas. She believed that students did not need to learn digital technologies separately and to some extent she disguised it so that students were not overwhelmed with the introduction of new software. After many years of teaching, Carmelina had developed the confidence of using digital technologies for teaching and learning.

**Case summary**

This section introduced Carmelina as the first of the two experienced cases studied in this thesis. Carmelina worked in a school where access to digital technologies was an important consideration for teaching and learning. There was evidence of Carmelina’s pedagogical reasoning in teaching two types of lessons described in her restories: a specialist technology class; and an eLearning class. For her specialist technology lessons she taught all students at the school for a half hour lesson each week and some teachers used this to extend on their student learning with digital technologies, while others treated it as a separate lesson and skill development which were not related to the students’ learning in their classroom. For Carmelina’s regular class, she described how she implemented a learning contract as a way to differentiate learning for her eLearning students. Her professional mindset and knowledge base emphasized her reasoning for redesigning her teaching and student learning with digital technologies.

Next, Florentina is presented as the next experienced teacher who also is described in a primary school setting.
Case 5: Florentina

**Background**

Florentina had worked in primary schools in Australia and England for over 15 years and had developed an understanding of various educational contexts. She was transferred into Florence PS because of her experience in teaching and her willingness to mentor early career teachers. Florentina has been a classroom teacher in Florence Primary School (PS) from the time it first opened just over five years ago and is located in the hinterland of a regional city. The school statistics from the *MySchool* website are summarised in Table 5.20 (for further details about ICSEA and *MySchool* refer to Appendix J). The school was constructed on a new site and has just over 600 student enrolments with fewer than 50 full-time equivalent teachers employed at the school.

As Florence PS was located in a newly developed suburb with most houses under five years old, the school has an ICSEA value of 1022 that is above the national average of 1000. The school has over 57 percent of its students from the top half ICSEA distribution, highlighting the relative educational advantage where a majority of the parents have high socioeconomic status occupations and are educated beyond secondary school. In terms of student statistics, the students were achieving higher results than the national average on their NAPLAN assessment in Year 3 but move more towards the national average in Year 7 (as shown in Appendix J). An explanation of how the table was compiled from the *MySchool* website is included in Appendix J.
Florentina has had a long interest in using digital technologies in her classroom and completed further studies in understanding how to use educational technology. In Florence PS, Florentina was both an experienced teacher and a digital technologies mentor for her fellow teachers. At the time of the study, there were a large number of early career teachers working at the school.

For this study, data was collected from her experiences of teaching in her Prep classroom at Florence PS and her digital portfolio that she prepared in 2010 with five items of evidence that described a range of teaching experiences. Florentina’s data from her video-stimulated recall interview, think-aloud concept mapping interview and her digital portfolio were analysed where themes emerged that described her pedagogical reasoning and the internal and external influences she experienced when she pedagogically reasoned with digital technologies. This case begins with a restory of her teaching practice from her Prep classroom.

**Florentina’s restory: Science in a Prep classroom**

Florentina entered her room early because she needed to prepare for the videoconference lesson with the class from another school. She needed to set up the data projector and log on to the computer to start her videoconference session before the students arrived. She had organised to join another class this morning to allow the students to ask questions about the photograph the other class had posted on the blog the week before. She had already run the lesson where her students had determined some questions to ask the other class. Even though they were a preparatory class (4-5 year old students) they were joining the Year 5 students (10-11 year old students)
Florentina had designed a project to look at the active learning processes for investigating environments. Two key areas that she was looking at were ‘becoming aware’ and ‘exploring’. It was expected that, with support, each student could make personal comments about pictures of their school or home environment. They could investigate features of a range of familiar environments and share personal ideas about them. This was in line with the curriculum materials for preparatory students in Queensland.

She decided to use the wiki space that she had created in previous years instead of the state early learning curriculum. In the unit ‘Investigating environments’ the main question asked was what their school looked like outside their classroom door. Florentina set up an online wiki project to join her class with other classes across the state. They could post messages and photographs on the wiki to share information about their school. Florentina had used her professional network of teachers to invite other teachers to participate in the project and she had been lucky to find a number of other classes that were willing to join.

One by one, the students with their parents arrived at the room to unpack their bags and place their lunch in the designated area before finding a seat on the mat. They were young students with the youngest just four and half years old. It was the first term and this was their first year at Florence PS. The students were new to the school but they were already familiar with her morning routine and found a space on the mat in front of her. Once they were all seated and the last parent had left the room, she announced to the group that today they would be joining another class online through the videoconference. Each week, for the last three weeks, the class had posted a photograph and text explanation on the wiki and when it could be arranged they used a videoconference to connect with the other class. The class was able to use the videoconferencing tool, to virtually meet with another class to ask and answer questions regarding the material they had posted on the wiki.

Florentina explained to the students that they would be joining the other class just after they had finished their “Munch and Crunch”, where the students eat some
fruit from their lunches before the classwork started. The students sat on the mat eating their fruit and chatting while Florentina checked that the videoconference session displayed on the interactive whiteboard. The screen was waiting for the other class to join in. She opened up Google maps and entered the address for the other school. Once the school was found, she opened up the street view to show the students what the school looked like. While they were eating she kept flipping between the two screens, hoping that the other class would join in. She used her computer and a digital camera to provide a real-time view of her classroom but was waiting for the other class to join in before sharing the image. A few minutes went by and there was still no class so Florentina decided to send the teacher an email to check if there was a problem. She asked the students to finish their ‘munch and crunch’, returning their lunchboxes to their bags and return to the mat.

Florentina quickly decided upon trying a new approach. They were talking about maps as the topic, and so she decided to allow the students to determine their own version of a map. She pointed out a variety of tools in the room they could use. There were blocks to create a map on the floor, there were whiteboard markers the students could use to draw on the whiteboard, and there was paper that the students could use to create a map. She asked the students to select what they would like to do and asked them to move to where the materials were available. Each group was formed and the students started creating their maps working individually or in small groups. The group on the floor were busy creating a sophisticated wooden layout with blocks. There were four students at the electronic whiteboard drawing lines with the whiteboard marker. The final group were sitting at the table using paper to draw lines for their map.

While the three groups were busy with their maps, Florentina decided to check the status of the videoconference session. She telephoned the other teacher to find out what happened. There was no answer and she left a message for the teacher to contact her when they could. She left the videoconference session open on her computer hoping that they would be able to join soon. A little while later, the phone rang and the teacher explained that they had a school evacuation drill and so were not able to participate this morning. Florentina cancelled the active videoconference session she still had running on the electronic whiteboard. When it closed, she moved around from group to group to check what they were doing. She suggested to the
group on the floor with the timber that they create a racetrack as a map and that they would be able to test it with the BeeBot. For the group at the electronic whiteboard, she decided to change from the street view to map view to give them a map to trace. For the group working at the table she moved around commenting on the maps they had drawn on the paper.

![Image of Florentina's class testing BeeBots with timber map]

**Figure 5.24 - Florentina's class testing BeeBots with timber map**

She called the three groups together on the mat, to talk about the different activities that they had been doing. She asked the group that were at the table to explain the maps they had created. She asked the students on the whiteboard what they thought of the Google map. The final group had created quite an elaborate wooden layout on the floor as shown in Figure 5.24. She gathered all the students around their timber construction and handed the students two BeeBots to race on the racetrack. She challenged them to race the BeeBots and who could program their BeeBot to get to the end of the track first. They placed the BeeBots on the track and pressed start. The BeeBot moved around the track while the students pressed the buttons to control their direction. The whole class were focused on what was happening as the BeeBots moved around the track. They had not used the BeeBots many times this year and some students wanted to have a go, others suggesting programming routines and the remaining students watching the progress. The room was noisy with the students contributing, others chatting and overall lots of laughter. Florentina was encouraging and managing participation by offering suggestions,
encouraging participation and giving feedback to the students. When it was time, she asked them all to tidy up what they were doing and return to the mat.

Returning to the mat, Florentina introduced the next task she wanted them to do, but first she had to pick two students who were going to take the daily photograph for the wiki. The students were keen to volunteer and she selected two students. She explained to the class that they needed to take a few photos of what it looked like outside their classroom door. She explained to the students that they would need to use the iPod and ensure that they took care of it. They were familiar with the iPod and knew exactly what to do. The two students exited the room to take the digital photograph.

The two students discussed the photographs they wanted to take. Each took a turn with the iPod and used the camera to take a digital photograph. They took a small number of photos and then re-entered the classroom. Florentina asked the students to operate the iPod with the visualiser. They discussed each photo and the two students decided which was the best photo to represent what they wanted to share that day. Florentina connected the iPod to her laptop to upload the photo to the wiki space. She asked the students for the description that she should record with the photo. The students explained what they thought the description should be while she typed the description beside the photo.

She asked the students to return to the mat and opened the state education website where she accessed a countdown timer that she could display on the electronic whiteboard. She explained that they had twenty seconds to discuss what they had learnt. She added 20 seconds to the timer and hit start. The students talked to their buddy while Florentina watched over their conversations and when the timer reached zero she told the students that their time was up. She complimented some of the students for how well they had managed the conversation and relayed some of the things that she had overheard from the students near her. She asked the students to share any great conversations they had had.

Later that day, she had planned to give a professional development session for a small group of teachers. She emailed a reminder for the teachers before reviewing the state education website content for the topic. The goal of the session was to introduce the use of a virtual classroom for each year level. She reviewed her email.
and responded to a question from a ‘restart teaching’ teacher. She was facilitating an online program where for teachers who wanted re-enter the classroom after an extended absence from teaching. She did not design the program but was nominated as a facilitator and mentor.

Throughout her restory is evidence of the elements of her pedagogical reasoning with digital technologies and these are explored in the next section to answer Research Question 1.

**RQ1: How did Florentina pedagogically reason with digital technologies?**

A summary of Florentina’s pedagogical reasoning is shown in Table 5.21. Florentina has a comprehensive understanding of a wide variety of digital technologies that can be used in the classroom. For her comprehension, she began with the state early years’ curriculum but she had developed her own specific curriculum that was suitable for her young students and her approach to using digital technologies. As she had taught young learners for many years, she had an advanced understanding of the educational purposes and goals for teaching young learners. In the past, she had created and maintained a wiki space that was developed as part of an online project that she wanted to use with her class.

For her transformation, she decided to use the approach, which she had used previously, that linked to an online wiki project that she had developed. She had created an online wiki space where classes from around Queensland could join in and discuss the school environment. They didn’t need to be the same year level, as their teachers could identify how the project could fit with their curriculum needs. She explained the purpose of the project:

*I have been working with a colleague for two years developing a collaborative project to engage students as they prepare for the NAPLAN writing task in an online project … We are committed to providing teachers and their students in regular worthwhile digital experiences. Classes across Queensland have been communicating daily, getting to know each other and practising appropriate netiquette behaviours. Each class has a goal to develop persuasive writing pieces that are posted online for a buddy class to critique. They have control over the location, the presentation form and the quality of interaction that occurs (F-5e-b).*
Florentina decided to use what she believed offered a better learning opportunity for her students. For her, it had worked in the past. She had prepared materials to market to teachers across the state and organised for other teachers to join. In her preparation for the lesson, she had organised the videoconference session.

Table 5.21 – Summary of Florentina’s pedagogical reasoning

<table>
<thead>
<tr>
<th>Model of pedagogical reasoning and action</th>
<th>Evidence from Florentina’s restory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Comprehension</td>
<td>Understanding digital technologies: videoconference, email, BeeBots, visualiser, iPod and apps, state education website and the wiki tool. Young learners. Science curriculum for young learnings - ‘Becoming aware’ and ‘Exploring’. Online wiki project.</td>
</tr>
<tr>
<td>2 Transformation: Preparation</td>
<td>Unit plan for science. Online wiki project – set up including advertising to other teachers. Videoconference. Personal technology (iPods and visualiser).</td>
</tr>
<tr>
<td>Selection Adaption and Tailoring to</td>
<td></td>
</tr>
<tr>
<td>student characteristics</td>
<td></td>
</tr>
<tr>
<td>5 Reflection</td>
<td>Disappointed videoconference do not go as planned. Changed from planned lesson to another activity. Students created an interesting map on the floor and then enjoyed programming BeeBots to travel through the timber map.</td>
</tr>
<tr>
<td>6 New comprehension</td>
<td>Young learners are capable of using digital technologies – BeeBots and iPod. New way BeeBots can be used in the classroom.</td>
</tr>
</tbody>
</table>

Florentina had explained in her video-stimulated interview, how she included her own personal digital technologies for use with the students: she had a few iPods, her own iPad and a visualiser that she used in the classroom. To enable the students the simple task of taking a photo, she allowed them to use her iPod and then share their photos on the visualiser. Florentina had worked out how they could be used at
her school for example how the iPod could be connected to her school computer to share the photos on the wiki and how to connect her visualiser to her computer and to be able to switch with ease between devices while teaching.

In her preparation for teaching, she drew upon what she had covered in a previous lesson to identify questions that her students could ask on the videoconference. Her students could not yet read or write and so she used various teaching strategies suitable for young learners to identify the questions that they could ask. She had also communicated with the other teacher multiple times to share what she wanted to achieve for the lesson and determine what they wanted from the lesson. Florentina had undertaken many preliminary activities in order to undertake the videoconference with the other class.

Florentina needed to set up the videoconference before the students arrived in the classroom as arrival time involved a routine to ensure the students were ready to begin learning. When they were seated on the mat, she instructed them to eat their “munch and crunch” while she checked if the other class had joined the videoconference. In the short timeframe, she checked many times if the connecting class was ready. Each time there was no response, but before the students finished and packed away their food, she changed from what she had planned to an impromptu activity, to allow her time to contact the other teacher. Her experience made an easy transition to redirect the students into three activities that aligned to what she wanted to achieve for the lesson. She allowed the students their own choice as to which activity they were able to do. She explained:

> Some things you just can’t plan for, like our not being able to get in. It was a shame on one hand, but on the other hand we went off and did something that was worthwhile (F-2e-291).

Florentina used verbal teaching evaluation strategies to check for student understanding working with individual, groups and the whole class. She encouraged her students to share their thoughts and experiences throughout the lesson. She complemented them when they did participate and watched over them while they worked together. Florentina did not have a formal system for reflection but through her interviews she alluded to some of her reflections and new comprehensions. She commented that she was able to switch from her planned to the unplanned because of the resources available in her classroom. She noted that she had not thought about
the use of BeeBots until she saw the elaborate layout the students had constructed on
the floor and decided that she could use it as an approach to bring all of the students
together at the end of the activity. She shared how her young learners were able to
use the iPod with ease and she thought that many of them had been exposed to digital
technologies at home. An important reflection that demonstrated Florentina’s
commitment to knowing her students was reflected in her comment:

I don’t think in all my years of teaching I’ve ever taught the same content twice
(F-2e-896).

The next section presents the themes that emerged from the data analysis to
understand what influenced Florentina when she pedagogically reasoned with digital

technologies.

**RQ3: What influenced Florentina when she pedagogically reasoned with digital technologies?**

In analysing Florentina’s data there were many influences highlighted some of
which are synthesised in her restory, and a summary of those influences is shown in
Figure 5.25.

**External to Florentina**

Florence PS was only five years old, and Florentina was transferred into the
school when it first opened. Being a new school, it was purposely designed with digital
technologies. There were electronic whiteboards and data projectors in all classrooms
and a reliable Wi-Fi across the school. All classroom teachers were supplied with a
laptop with suitable software for use in their classroom. The Principal had been open
to investing in new digital technologies including a small number of new (at the time of
opening) desktop computers in each room as well as the development of a green room
with movie editing capabilities on iMac computers in the library.

As Florentina was interested in using digital technologies for teaching and
learning, she was keen to use the digital technologies available to her. She had
managed to organise for the school to buy a set of BeeBots, which were stored in her
classroom. She provided her own digital technologies for the students to use and
provided evidence through her teaching of the effectiveness of using these digital
technologies learning to influence what digital technologies might be purchased in the
future by the school. She found that her students were familiar and keen to use her digital technologies and were capable of using a range of digital technologies at a very young age. She found she could engage young learners in her online project and allowed them to take digital photographs that she shared in the online wiki. Florentina had a laptop provided by the school and she shared how she used the state education systems available through the Internet.

![Figure 5.25 – Florentina’s influences](image)

**Internal to Florentina**

Evidence from her restory has been mapped to the knowledge base as shown in Table 5.22. For her content knowledge (KB1), she had developed and refined the unit from previous years to know what worked and didn’t work with her young students and feedback from other participating teachers. From many years of teaching young primary school students, Florentina would have developed a comprehensive understanding of the early years’ curriculum (KB3) focus on ‘becoming aware’ and ‘exploring’. After teaching this unit over many years, she had moved beyond the walls of her classroom to collaborate with other teachers in differing year levels across the state. To invite other teachers she had prepared materials in order to ‘market’ the unit...
to other teachers and as part of the process she upgraded the platform she was using. Using her professional network she was able to recruit other teachers to participate in the project. On this occasion we saw that when her plans failed, Florentina was able to quickly change the focus to building maps in the classroom. To extend on their learning she added the BeeBots to challenge the group working with the timber. She knew that the students would engage with the BeeBots without having to explain the programming requirements.

Table 5.22 – Florentina’s knowledge base

<table>
<thead>
<tr>
<th>Knowledge base</th>
<th>Evidence from Florentina’s story</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 General pedagogical knowledge.</td>
<td>Digital technologies: videoconference, email, BeeBots, visualiser, iPod and apps, online wiki. Munch and Crunch. Mat. Pedagogical tools located in the classroom e.g. timber blocks.</td>
</tr>
<tr>
<td>3 Curriculum knowledge.</td>
<td>State early years curriculum ‘Becoming aware’ and ‘Exploring’.</td>
</tr>
<tr>
<td>4 Pedagogical content knowledge.</td>
<td>Online wiki project – videoconference, digital photographs, iPod, visualiser. Three alternative activities.</td>
</tr>
<tr>
<td>5 Knowledge of learners and their characteristics.</td>
<td>Prep. Digital literacies - young learners.</td>
</tr>
<tr>
<td>6 Knowledge of educational contexts.</td>
<td>UK and Australia primary schools for over fifteen years. Mentor early career teachers. Mentor teachers returning to teaching.</td>
</tr>
<tr>
<td>7 Knowledge of educational ends, purposes and values.</td>
<td>Early years. Digital literacies.</td>
</tr>
</tbody>
</table>

From teaching for many years, she has developed a deep knowledge of primary school students and their characteristics generally (KB5). For her specific students in this class, she knew that they were interested in using technology and were keen to use the tools that she had provided (the iPod, BeeBots and the visualiser). Florentina used a variety of pedagogical strategies (KB2) that could be confined to the design of engaging and extending activities that are student centred. It wasn’t the digital technologies but the school timetable that interfered with Florentina’s plans, as she wasn’t able to run the videoconference. She was easily able to redirect the
students to another set of activities while waiting. When she found they were not going to attend she was able to use the redirected activity as their main activity for the lesson. She had been teaching for over 15 years and was motivated to use digital technologies in teaching and, therefore, improve the digital literacy of her students (KB7).

Evidence of Florentina’s TPACK (KB4) was shown in her use of the online wiki as a tool to learning about different environments. She had young students that could not read or write but she was able to use a visual tool that allowed their participation in collecting photographs and verbally sharing descriptions with the class. She had used this approach many times for varying aged students and so knew how to engage them in the project. She did not rely on the digital technologies supplied at the school but added her own digital technologies. She didn’t spend large amounts of time explaining how to use the digital technologies but allowed her students to show her their knowledge. To ensure all students could see the photo, she had used her visualiser where the students simply had to show the iPod under the camera for it to project onto the wall. This encouraged the selected students to discuss the picture, improving their presentation skills and the remaining students to talk about the picture when Florentina asked them to share what they had learnt after discussing the image with their peers. Extending on her work in the wiki she planned to use the videoconference to connect with another class.

Florentina’s data analysis provided rich insight of her technological pedagogical content knowledge or TPACK where she created her online wiki project, posted and discussed digital photographs and scheduled a videoconference that enabled students to share not only photographs of their school environment but they could join classrooms to discuss the environment. With digital technologies the students experienced a new way of learning about different environments from classrooms across the state. With the versatility of this project, the other teachers were able to map it to any part of their curriculum while Florentina mapped this project to her curriculum objectives where students were ‘becoming aware’ and ‘exploring’. It was the combination of digital technologies that enhanced the project, She explained:

*without ICT the experience of communicating with buddies...would have taken weeks. The opportunities for language and cultural exchange via the Internet and email using a project room as the focal teaching resource meant that our*
interactions were almost immediate and most definitely engaging and worthwhile for the students (F-2e-896).

Her TPACK was enacted at other times as shown in the restory, for example when she used the state education website to display the countdown timer on her electronic whiteboard and when she asked the students to race the BeeBots around the wooden track.

Florentina has a strong commitment to incorporating digital technologies for teaching and learning. She explained that her interest started when:

my first real insight into the potential power of the web was stumbling across a NASA site which demonstrated minute by minute how the world looked from the moon. We were able to watch the day passing by - literally! A real life event to explain an abstract learning concept to Year 3s … to complement curriculum and we also discovered how much fun it could be to invite travel buddies from other countries into our classroom (F-5e-c6).

In working with young students she believed they were capable and wanted to use digital technologies for learning. She did not need to spend a great deal of time explaining how to use digital technologies, as her students she knew and had access to digital technologies at home. She took advantage of this exposure

I attempt to provide opportunities to follow through with learning experiences that include the digital tools they have lying around at home and by which they are surrounded in most other environments. There is potential there to create a passion for learning that motivates students to engage through accessing their prior knowledge by tapping into the networks they create naturally as they interact both in and away from school (F-5e-b1).

She explained that her students already had skills in using digital technologies. When another teacher had to teach her class she shared:

the P.E. teacher had to come in and cover me while I did something else and he was going, the five-year olds were showing him how to use the iPod. He didn’t know, he was a P.E. teacher and didn’t use the technology (F-2e-637).

Her personal motivation to use digital technologies was influenced by her Masters degree in education technology and also her personal interest and use of digital technologies. She was not afraid to share her personal digital technologies with her students, as a testing ground for justifying new digital technologies for the school and to demonstrate the potential of digital technologies for other teachers. She was involved in mentoring other teachers at her school in the use of digital technologies through informal professional development sessions; she was a member of the school...
technology committee; and led the set up of her online wiki project. In offering professional development at her school she explained:

*I encourage staff to explore the power of the tools at their disposal for engaging students in digital learning experiences, e.g. The Learning Place, Blackboard and Curriculum Exchange as well as various pieces of equipment - video cameras, Qwizdom, Nintendo Wii (F-5e-c2).*

She had helped other teachers complete their digital portfolios, offering tips and tools, online examples including her own digital portfolio. For this, she was nominated as an accredited facilitator in reviewing and assessing teacher digital portfolios as part of a state professional development program. Florentina was well connected through social media and her professional network consisted of many state, national and international digital technologies using teachers. She explained:

*I have an extensive personal learning network with whom I interact online daily through Twitter, Facebook (professional as well as social), Nings and recently Google Wave. I share, contribute to discussions, engage in virtual world un-conferences, I'm learning to build as well as interact in virtual worlds (F-5e-b9).*

Connecting with other technology educators enabled her to share her professional experiences with a range of audiences, she explained

*connecting with educators and extending my network has led me to speaking in a range of settings, presenting and interacting with a diverse range of people (F-5e-b11).*

In the last five years Florentina had invested in building her professional network wider than her school and was recognised as a digital technology leader in her region.

**Case summary**

This section examined Florentina as the fifth of seven teachers included in this thesis. Florentina worked with young students where she had an abundance of digital technologies available for teaching. There was evidence of Florentina’s pedagogical reasoning with digital technologies in what she demonstrated in the classroom. Florentina was able to use digital technologies to connect her students with other students across the state for both synchronous and asynchronous learning. She had become familiar with the tools offered through state education system and was mentoring other teachers to adopt digital technologies in their teaching. Florentina shared many influences that enabled her to use digital technologies in her classroom. Her Principal not only acknowledged Florentina for her use of digital technologies in
teaching but how she mentored other teachers to use digital technologies in their teaching and learning.

Chapter summary

This chapter has introduced Carmelina and Florentina as two of the four experienced teachers studied in this thesis. Both teachers have many years of teaching experience in primary school settings. They worked in schools where digital technologies were available for use in teaching and learning. Both had Principals who encouraged their use of digital technologies, and for them to support other teachers in using digital technologies for teaching and learning. This chapter included three restories that emerged from the data analysis. Carmelina was described using an integrated learning contract that was implemented using MSOneNote and using MSPowerPoint for young students to access eBooks. Florentina was described using the online wiki project, which she had developed for her and other classes to access and join through videoconference anywhere in the state. From these restories, an understanding of their pedagogical reasoning emerges where each element of their pedagogical reasoning was impacted with the use of digital technologies.

There were many internal and external influences that Carmelina and Florentina shared which helped or hindered them in using digital technologies. A key internal influence, which they both demonstrated was their professional knowledge base for teaching, where their technological pedagogical content knowledge or TPACK was key. Both expressed strong commitment to using digital technologies in teaching and learning. Both worked with younger students and demonstrated their belief that young learners were capable and motivated to use digital technologies for learning. There were important external influences in their schools and education system that enabled them to use digital technologies for teaching and learning, including support within their schools and their school system, resources within and external to their schools, training and professional development, parents and their investment in the student digital technologies and student use of digital technologies. So the system and school context emerges as critical to these teachers’ pedagogy in these two settings.

It can be seen that, for both teachers, their knowledge and confidence to incorporate digital technologies have been influenced by their beliefs about the value of
digital technologies for learning and the external support. As a result, these have in turn, influenced the growth of their knowledge base for teaching, and hence, their pedagogical reasoning. The next chapter introduces the final two teacher cases in this thesis, the experienced and 'lead' teachers - Alessandra and Marcelia.
CHAPTER 6: THE LEAD TEACHERS

This chapter

This chapter presents the final two of the seven participating teachers. Both are primary trained teachers described in two different classrooms: Alessandra teaching English to Year 5 students at Rome PS and Marcelia teaching history to Year 7 students at Venice College. Both teachers have been instrumental in changing how digital technologies are used in their schools. Both teachers have over ten years of experience and were working in technology leadership roles within their schools. Both shared stories of how the work they were doing with digital technologies was changing the learning landscape at their schools. Alessandra described how she had set up an eLearning program and Alessandra was involved in the implementation of a Bring Your Own Device (BYOD) program across her whole college.

Using the data collected through the study, a collection of restories about these teachers use of digital technologies, as integral to their pedagogy, is presented. For Alessandra there are two restories describing how she created the eLearning classroom and then how she taught in her eLearning classroom. For Marcelia, there are three restories describing how she was observed teaching, how she taught young students to produce a Claymation movie and finally how she had been involved in the implementation of a BYOD program at her college. The goal of these restories was to understand how these lead teachers pedagogically reasoned with digital technologies to answer research questions:

RQ1: How do lead teachers pedagogically reason with digital technologies?

RQ3: What influences lead teachers when they pedagogically reason with digital technologies?

This chapter begins with Alessandra.
Alessandra has been teaching at Rome PS for approximately ten years and at the time of this research project she was teaching a Year 5 eLearning class. It was her second year with the class and the second year that an eLearning class was offered at her school. A description of Rome PS is provided in Drago’s introduction in Chapter 4.

Alessandra initiated the eLearning class where students used their own parent-purchased but school supplied laptops. The class was a mix of students including high achieving students working beyond their year level, special needs (high functioning) and students where English is their second language. As an eLearning class, Alessandra’s classroom had a variety of digital technologies including an interactive whiteboard with data projector, a networked printer, a small number of ‘aged’ desktop computers and her laptop. Alessandra had developed and maintained a virtual classroom for her class in the state learning management system.

On graduation, Alessandra had initially been unsuccessful in finding a permanent teaching position. As a result she found employment as an education consultant working for a variety of technology related businesses. After building a strong relationship with the Rome PS Principal (as her customer) she was invited to work at Rome PS as a teacher. Over her 15-year teaching career at Rome PS she has taught classes from Prep to Year 7.

She developed extensive skills in using digital technologies over her non-teaching and teaching careers. As a result she was appointed to lead her school in the
use of technology. Along with a half time teaching role, Alessandra is the school designated technology coordinator and is responsible for the management of network issues, contract technical staff, troubleshooting at a school level and liaising with state technical services (A-5f-r). Throughout her description of her technology journey she listed many opportunities where she has developed and led professional development at her school –

_I also investigate staff professional development needs and devise training that is suitable to their learning requirements and styles (A-5f-r)._}

Alessandra shared her teaching role with Carmelina (from Chapter 5). That is, she taught the class for half of her time, while the other half of her time she was the technology coordinator at her school.

Evidence of Alessandra’s teaching was gathered through a video-stimulated recall interview, think-aloud concept mapping interview and her digital portfolio. Alessandra had prepared a digital portfolio in 2006 as part of the _Smart Classrooms Professional Development Framework_ and it provided three items of evidence to facilitate rich insights into Alessandra’s pedagogical reasoning with digital technologies

**Alessandra’s restory #1: Starting an eLearning program**

After attending a conference, Alessandra had heard of how other schools has implemented an eLearning program and she was interested in starting one at Rome PS. After discussing the idea with her school ICT Committee, she decided that it was time to discuss the matter with the Principal. It was mid-way through Term 3 and Alessandra organised a meeting with the Principal with the intention of obtaining agreement to set up a new laptop learning class for Year 5 students for the following year.

At their regular monthly ICT meeting, the Principal listened to her proposal and recommended that she talked to a few other schools to gain an understanding of the requirements to set up a class. Alessandra left the office with a sense of excitement, as she had been given support to find out more and a recommendation of two other schools she could contact. Her Principal requested that she discuss the idea with the staff at the next school meeting before organising one for the parents to determine if they were interested in an eLearning program. They agreed that the beginning of Term 4 was an ideal time to organise a parent information session. Later that day at the
afternoon staff school meeting, she explained what the ICT Committee had decided regarding a laptop learning class with her intention to running an eLearning class with the next cohort of Year 5 students in the following year.

Following the Principal’s recommendation, Alessandra compiled a list of questions to ask the two schools, as she wanted to gain an understanding of what they went through in establishing eLearning. Both schools were primary schools with laptop classes that had been running for under two years. Alessandra was particularly interested in how they managed the invitation to parents and what the participation rates were like. She wanted to know what laptops they purchased, how they managed and set up the hardware and what software they would recommend. She also wanted to know what feedback they had received from parents. From both schools she collected examples of their invitation and agreement information. She made a list of the software they used. She took photos of the student laptops and asked how they organised the purchase.

Later that evening she accessed a teacher distribution list for each of the ICT and eLearning communities that she was a member and asked a few questions of her colleagues in these. She received a number of responses with examples and suggestions. She decided that she should find a suitable source for the laptops to determine the approximate cost to provide to parents. She prepared an Expression of Interest (EOI) form that she would distribute on the night. She sent a copy of the letter and her presentation to her Principal to obtain feedback.

After visiting each Year 4 class and advising the students of her intention for a new eLearning class, as well as advertising in the school newsletter, the parent information night arrived where many parents had replied to the invitation, interested in participating in the program. From the newsletter, parents knew there would be a cost involved. She explained the process for the EOI and offered them an EOI form and explained that they had two weeks to lodge their EOI. Later that evening, she added a new page to the school website, where the new page explained the new eLearning approach, answers to typical questions and a copy of the EOI form.

By the due date there were 43 EOIs lodged with the school office with a further seven received the following day. As the seven were received late, they were assigned to the waiting list. Alessandra convened a meeting to review the EOIs and
determine the best approach to decide who would be offered a place in the class. She emailed the current Year 4 teachers and asked them to meet with her, Carmelina and the Principal to review the applications. The student’s academic, social, behaviour and learning needs were discussed. Students with special needs were included. Alessandra prepared an email to the parents of the successful students. Unsuccessful students were added to the waiting list. Only 28 of the 43 students were accepted into the class. She sent an email shown in Figure 6.27 to all parents who submitted an EOI.

![Email to all parents who lodged an EOI (A-5f-e)](image)

By the end of the year, all accepted parents paid their deposit and Alessandra coordinated the purchase of the laptop computers. The laptops were delivered the week before school started the following year providing time for her to set them up for student use before the year started. As this was a new approach to teaching, she was able to purchase new classroom furniture that was more suitable for an eLearning environment as well as an electronic whiteboard and projector with all set up completed in the week before the start of the school year. As the school had a new
When the laptops arrived, Alessandra requested the creation of all students IDs and assigned each a new password. She printed out each one to give to the students on the first day. She allocated them to the new virtual classroom and created a folder for each on the school network. She set up the new ABTutor software on her computer and for each of the laptops as she planned to use it to control their screens when she needed to. From state school management system, she accessed their student details including information concerning their special needs to understand her students before they started the year. Finally she set up her Internet based reward system – ClassDoJo. She explained how she used the ClassDoJo as a behaviour management tool as she would add good points to students that were working and add bad points to those students who were not working. Alessandra explained the ClassDoJo:

“That’s just an online behaviour management thing. I only started this term and it just makes a difference. Even just flicking it up on the screen, it's changed within the first couple of weeks how they came into class, how they've settled and gotten themselves organized because it’s visual (A-1f-259).”

She was ready to begin teaching her new eLearning class with her new digital technologies.

During the following week, the new Year 5 students – some with their parents entered the classroom excitedly. Each student had a designated seat; on each desk was their new laptop computer. Then the students were asked to open their computer bag and place their laptop on their desk. Alessandra explained the rules and care requirements for their new laptops. The consequence of any intentional damage was explained: removal from the class to a non-eLearning Year 5 class and they would not be able to participate in the eLearning class for the rest of their time at the school. On the interactive whiteboard Alessandra demonstrated how to log on to the network with her laptop. Alessandra moved around the room helping the students set up their laptop and she asked the students who had finished to help their peers to ensure all were ready before she moved to her first planned eLearning activity. For the next few days, she continued with small interactive activities to introduce the students to the laptops and to MSOneNote. She rehearsed and practised starting, accessing and
closing the laptop multiple times as she wanted to build their confidence and skills for using their laptop before they started their regular class work.

**Alessandra’s restory #2: English in an eLearning class**

Alessandra accessed the state curriculum materials on the secure website to download the English unit. During the previous year, she had prepared a similar unit but as new state curriculum and her previous unit had not been prepared with an eLearning class in mind she needed to prepare a new unit plan that would incorporate the use of the student laptops. For the English unit, Alessandra decided to focus on an ethical dilemma, where the students completed a range of activities including reading, brainstorming and then finally planning and developing a movie that portrayed an ethical dilemma.

She was familiar with using MSOneNote as a teacher and decided that she could use it as a tool with her students. She created her MSOneNote template and copied all of the lesson materials into the template. She added instructions and extra spelling activities as the school used Spelling City. To help students, Alessandra included all of the curriculum materials in her OneNote template. She explained that:

> Actually I set up all of the units for the term, I set it up in advance and with the state curriculum material units it’s got all of the resources in it. I can download and stick them in MSOneNote and it’s basically lesson, one, two, lesson three...we use it like a virtual workbook (A-1f-126).

She preferred this approach to planning as

> it’s a lot of set up time, but it saves me so much time throughout the term because I don’t have that ongoing week-to-week planning (A-1f-144).

Alessandra knew from previous experience that she needed to check the students had access to the resources such as particular websites. She had decided to use MSOneNote because it enabled the students to collaborate without the constraints imposed on the tools available through state education systems. The limitation was that students were unable to access their shared MSOneNote files at home.

The first activity she termed ‘Reading Stamina’ with the students completing 10 minutes of reading before every English lesson. Students were grouped by their reading level and each student selected a book from a range of possible titles. As they worked in groups, each student was responsible for reading a book and deciding on
four questions about the book that they could ask the other students. The book was then passed around the group and each student read and answered the four questions in a shared MSOneNote file. Once all members of the group had read the book, they had a group meeting where their answers that were recorded in MSOneNote were shared and discussed. It was normal for all of the students to read a book each week. Alessandra explained her intention for the activity:

_They read and then they spend ten minutes using the questions and they go onto the shared MSOneNote and they record against a rubric how well they read and they have to answer one of the questions or ask one of the questions as per for the group. Then on Friday, that’s when they all come together. They look at their joint MSOneNote that they’ve done all the questions on and they then can see everybody’s questions and they have a chance to talk about them and discuss them and just get into that deeper level of the book (A-1f-331)._

Alessandra used MSOneNote as it allowed her to easily communicate what she wanted them to learn and in a format that they could easily edit to add their work. Her instructions were included in the learning materials,

_I have everything set up on MSOneNote for them at the beginning of each unit, everything on there is exactly the same as what they’ve got on theirs (A-1f-61)._

As students could see the work that the class had done in MSOneNote if a student was away or unable to complete their work in the allotted timeframe, they could complete it later at school or home. She also included more work for the students who needed a greater challenge.

After the reading activity had finished, the students were asked to return their books to the box and open their laptops in preparation for the next task. While they were organising themselves, Alessandra opened the AnswerGarden website on her laptop with the image projected onto the electronic whiteboard. While they were reading, she had created the AnswerGarden question that was displayed on the screen. The students knew the process of opening AnswerGarden to be able to post an answer to her question. Alessandra moved around the room checking the students were logged into AnswerGarden. She noticed that one student had the wrong software open on their laptop, and, she warned them that she was about to open ABTutor, the screen control software, that she used to manage what they could do on their laptop. She opened her ClassDoJo on her iPad and allocated some points for the students that were ready to start the activity.
She asked the students to post what they thought an ‘ethical dilemma’ meant on the class AnswerGarden webpage as shown in Figure 6.28. They were restricted to using a few keywords and they could post as many times they wanted with all post immediately projected on the electronic whiteboard. Some students were fast in posting their thoughts with students chatting as more words appeared on the screen. Alessandra liked using AnswerGarden as it allowed some of the quieter students the opportunity to participate anonymously because:

*using things like Answer Garden where they can quickly get their ideas down by the laptop allows those kids who won’t put their hands up, who won’t speak up in a discussion to get their ideas out there and share them (A-1f-577).*

The lesson focus was on defining what an ethical dilemma was to lead the students into planning a movie where they would demonstrate their understanding. Alessandra offered the students a range of ideas that they could use to prepare their movie. She explained that she wanted to introduce them to Scratch as a tool to produce their movie but she had not used Scratch before and she completed some of the tutorials over the holidays. Scratch was a relatively easy tool to use with lots of support on the website and through user communities. Prior to starting the unit, she ensured that the Scratch website was made available through the school network.

While this class was described as the “eLearning class”, this did not mean that Alessandra and the students spent all day using the laptops for all teaching and learning. She explained, that

*they end up using it probably, roughly about 40 percent of the day. Sometimes they’ve got it open, they’ll do a bit of research, a bit of writing, a bit of group work or something. It’s just so handy to have (A-1f-60).*
TECHNOLOGICAL PEDAGOGICAL REASONING - THE DEVELOPMENT OF TEACHERS' PEDAGOGICAL REASONING WITH TECHNOLOGY OVER MULTIPLE CAREER STAGES

Chapter 6: The lead teachers

Alessandra used MSOneNote to collect work in order to assess her students. She explained:

*The shared OneNote files are great because I can go on there and I can write comments on for them; that’s a really interesting question, why did you write this, or whatever. When they’ve got the ones for the units of work, at the end of the unit they copy the OneNote onto the server and I collect it down and that’s how I mark them (A-1f-362).*

She updated the virtual classroom with the overview of the unit and assessment so that parents could access the learning management system to understand what their child was learning. Alessandra reflected that digital technologies had changed the way that she interacted with her students. She explained that she

> never gets any questions. You don’t get kids coming up and saying well what do we do, I don’t get the questions - What am I supposed to do? (A-1f-336).

Students always had work to complete and

> if they finish ahead of time, they have extra things that they can create and I don’t have to give instruction (A-1f-342).

These two restories provide an insight into Alessandra’s teaching practices. Throughout her restories are descriptions of how she pedagogically reasoned with digital technologies. In the next section discusses her pedagogical reasoning and responds to Research Question 1.

**RQ1: How did Alessandra pedagogically reason with digital technologies?**

Drawing from the two restories the evidence of Alessandra’s pedagogical reasoning with technology is summarised in Table 6.23. After teaching in a primary school setting for over ten years she had a strong knowledge and understanding of the required curriculum and knowledge and experience of effective teaching strategies.
Table 6.23 – A summary of Alessandra’s pedagogical reasoning

<table>
<thead>
<tr>
<th>Pedagogical reasoning</th>
<th>Evidence from Alessandra’s restory #1 – Starting an eLearning program</th>
<th>Evidence from Alessandra’s restory #2 – English in an eLearning class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Comprehension</td>
<td>Students/Parent want to use digital technologies.</td>
<td>English studies - Learning ethical dilemma.</td>
</tr>
<tr>
<td></td>
<td>Digital literacies.</td>
<td>Spelling.</td>
</tr>
<tr>
<td></td>
<td>Identifying eLearning laptop classrooms needs.</td>
<td>State curriculum for Year 5 English.</td>
</tr>
<tr>
<td></td>
<td>Selling idea for eLearning classroom to Principal, parents, students</td>
<td>ClassDojo/AnswerGarden/OneNote.eLearning.</td>
</tr>
<tr>
<td></td>
<td>and other staff.</td>
<td></td>
</tr>
<tr>
<td>2 Transformation:</td>
<td>eLearning.</td>
<td>MSOneNote – State curriculum materials for Year 5 English.</td>
</tr>
<tr>
<td>Preparation:</td>
<td>Changing pedagogical approach.</td>
<td>OneNote - communication, collaboration and assessment tool.</td>
</tr>
<tr>
<td>Representation</td>
<td>New technologies.</td>
<td>Check student access.</td>
</tr>
<tr>
<td>Selection</td>
<td>Parents purchase laptop.</td>
<td>Reading Stamina.</td>
</tr>
<tr>
<td>Adaption and</td>
<td>Balancing technology with non-technology usage.</td>
<td></td>
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<tr>
<td>Tailoring to</td>
<td></td>
<td></td>
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<tr>
<td>student characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Instruction</td>
<td>Setup classroom.</td>
<td>MSOneNote for teaching and learning.</td>
</tr>
<tr>
<td></td>
<td>Wi-Fi/Bandwidth.</td>
<td>Moving around the room to provide more individual support and</td>
</tr>
<tr>
<td></td>
<td>Testing for student access.</td>
<td>checking progress.</td>
</tr>
<tr>
<td></td>
<td>Projector/Electronic whiteboard.</td>
<td>Using ClassDojo while teaching.</td>
</tr>
<tr>
<td></td>
<td>Change behaviour management.</td>
<td>Using Interactive whiteboard for teaching.</td>
</tr>
<tr>
<td></td>
<td>eLearning.</td>
<td>Using AnswerGarden for brainstorming.</td>
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<tr>
<td></td>
<td></td>
<td>Teaching students how to use their laptops.</td>
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<tr>
<td></td>
<td></td>
<td>Reading Stamina.</td>
</tr>
<tr>
<td>4 Evaluation</td>
<td>Using digital technologies to produce assessment and provide feedback.</td>
<td>Reading Stamina.</td>
</tr>
<tr>
<td></td>
<td>Share student work.</td>
<td>Weekly group meeting.</td>
</tr>
<tr>
<td></td>
<td>MSOneNote.</td>
<td>MSOneNote.</td>
</tr>
<tr>
<td>5 Reflection</td>
<td>MSOneNote to enable reflection.</td>
<td>Group activity was successful – students engaged in group work and</td>
</tr>
<tr>
<td></td>
<td>Less questions from students/parents.</td>
<td>in reading many books to keep pace with the group.</td>
</tr>
<tr>
<td></td>
<td>Access to MSOneNote.</td>
<td>Alessandra had tried the group activity with reading roles but</td>
</tr>
<tr>
<td></td>
<td></td>
<td>it failed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OneNote was more effective than EdStudio/Virtual classroom but</td>
</tr>
<tr>
<td></td>
<td></td>
<td>was restricted because it was not online.</td>
</tr>
<tr>
<td>6 New comprehension</td>
<td>Students are able to effectively use MSOneNote for learning.</td>
<td>The virtual classroom was effective for parent access.</td>
</tr>
<tr>
<td></td>
<td>eLearning.</td>
<td>OneNote can be used for teaching and learning.</td>
</tr>
</tbody>
</table>

Victoria L Smart, Doctor of Philosophy
Griffith University, 2016
Evidence of her *comprehension* began with her understanding the value of and her interest in using digital technologies for teaching and learning. The comprehension reflected in the restories described two perspectives of what it means to use digital technologies in her school. Her first restory described the processes in starting a new eLearning class where her comprehension entailed understanding her teaching context. This was important as she needed to know what eLearning meant for the school, for the Principal, the staff, the students, and to the parents who would need to pay a levy to participate in the eLearning program. Moving to an eLearning class would change and challenge the teaching practices that she had comfortably used for a number of years.

The second restory provided an insight into how she used digital technologies in her new eLearning class when she used MSOneNote and other digital technologies for teaching English. Comprehension not only entailed learning the content but also learning how to use these digital technologies with her students or repurposing them for teaching and learning. She used the online tool SpellingCity to manage students spelling, ClassDojo as an effective behaviour management tool and AnswerGarden as a tool for brainstorming where all students were given the opportunity to participate anonymously. She shared the state curriculum materials for English in her MS OneNote files unlike other teachers that would keep the materials for teacher only use.

The analysis of the data that constructed the first restory highlighted how she would *transform* her future teaching. Transformation for eLearning would include reviewing the state curriculum materials and her previous planning to refashion for use in an eLearning class and this would include her pedagogical approaches to incorporate using digital technologies. Every aspect of her planning would need to be reviewed to ensure it utilised the available digital technologies and the eLearning laptop for learning. As an eLearning tool, Alessandra used MSOneNote as a communication, collaboration and assessment tool. For the reading task she used MSOneNote as a tool for collecting and sharing student work. One major challenge to using the Internet within a state school was the access available through the state managed Internet with many sites blocked for student access. Alessandra needed to check every website to ensure students could access the website in order to complete work. As part of her duties to manage the school ICT environment she was able to arrange for access to websites if she found they were blocked.
Also the first story highlights changes to her future instructional practices that an eLearning environment would demand. In order to offer an eLearning class she needed to change what was available in her classroom including Wi-Fi, data projector, electronic whiteboard and furniture. Before using any resources she needed to ensure they were accessible or they worked in her classroom. Teaching with digital technologies impacted how she managed the students’ behaviour and in the case of teaching she used the ClassDojo to be able to award students for good behaviour and make it visible to the students and it could be shared with their parents via email.

From the second story, it is evident how Alessandra used MSOneNote as a major teaching tool for the unit. Students were able to see what work they needed to do and how it mapped to the curriculum. They had templates available to help guide them in what work they needed to complete, which included with solutions for them to be able to check their work. Digital technologies enabled them to manage their own learning as they could see the complete unit within MSOneNote and could access it within the classroom or outside the classroom from their laptop. Alessandra commented that the students no longer asked what they should be doing as they had work to cover and extra work they could complete if they were finished. It was all included in MSOneNote. Alessandra instructed what she wanted them to achieve in the lesson and guided them to OneNote where they would complete their work.

Digital technologies enabled Alessandra to change how she interacted with the students in the classroom. She did lead from the front of the room at times; to use the electronic whiteboard from her laptop. She could project the ClassDojo or AnswerGarden screen onto the electronic whiteboard so all students could see the results. The classroom was clearly a different learning and teaching space with laptops in front of every student. This enabled her to move around the room to spend time supporting and encouraging students individually rather than directing the whole class from the front of the room. When students were a little slow in opening a website or became distracted by some other program on their laptops, she would use ABTutor which enabled Alessandra to control every laptop in the room. It enabled her to project one image on all laptops or shutdown one laptop if a student was not complying. This proved an effective behaviour management tool also.
Her use of use AnswerGarden was a valuable instructional tool for visual brainstorming where the students could contribute and see all contributions on the electronic whiteboard.

*It gives them that chance if they're not a confident kid to put something down anonymously, but they also look at each other's screen and it becomes a discussion point. I find that in the laptop class I get so much more discussion about the topic happening just incidentally than I do in other classes because they'll talk to each other (A-1f-689).*

Clearly, far from resulting in a passive silent classroom where students just work on their computers in isolation, which is often associated with using digital technologies to teach, Alessandra’s eLearning classroom was characterised by students working with each other, excitedly sharing what they were doing on their laptops and brainstorming ideas with each other. This was due to her pedagogical philosophy, which she ensured was sustained when she incorporated digital technologies. She explained she was

*a big believer in it's not natural for kids to sit and be absolutely quiet and work in isolation...I much prefer the opportunity to discuss things and as long as it's on topic and they learn so much from each other (A-1f-731).*

Alessandra did not teach the use of technology as a separate learning activity instead she mixed the learning of new digital technologies into completing tasks.

*All you do is you show them for a little bit and you'll come back the next day and the kids will be starting (A-1f-869).*

Students used their digital technologies at home to connect with each other to further explore content that they could share with the class, as

*they'll come back to school because they want to show off what they've created. How do you do that? They're sitting there before school or Skyping each other at home (A-1f-905).*

She didn’t have introductory lessons on using MSOneNote to prepare her students but immersed them using MSOneNote for teaching and learning. She modelled how she used digital technologies by projecting what she was doing for all students to see. They were able to follow along learning how to use their digital technologies along the way. They were free to take their laptops home to explore the software available to them and with access to the Internet they could use any of the resources to extend their learning.
In many primary school classrooms reading is taught as a process where students read alone, read to each other and read to an adult (teacher, teacher aide or volunteer parent). When reading to an adult, they are asked questions to provoke their understanding of the text. Engagement in the process comprises the students' confidence in reading and what they are reading. Alessandra used MSOneNote as a tool for the students to ask and answer questions about what they were reading but the questions and answers were for their peers. To obtain a deeper understanding of their texts, the students identified questions that they posed to their peers. Students became deeply engaged in reading the texts to ask rich questions and the readers equally became engaged in the texts to find the answers. They were given the opportunity to discuss the questions and answers at a weekly meeting. She explained how it engaged a student high level learning needs:

...with this MSOneNote reading he's in there and he's actually written out the main idea of what he's read and he's done his question just about every single time. Then at the end of the week I think it gives him and others in that group a focus because they're sharing as they have five minutes each to share the book that they're reading and what they've done and go through the questions that they have written and why they thought they were important (A-1f-343).

In evaluating her students and her effectiveness in teaching, Alessandra used digital technologies to capture and review their work at any time. As the MSOneNote files were not available online she needed to copy files to and from the network where she could add comments as feedback for students. In many cases, she requested her students to email their completed MSOneNote page where she could review their work.

I can sit there at home in front of the TV and flick through their MSOneNote and just get a feel for how much of it they've done, what sort of level questions they are, how deep their thinking is about the topic. That helps make that on balance judgment especially when you get those kids where you look at all the different assessment pieces, if you've got four or five for on unit and you go gee it's really between a B and C. That helps make that judgment just seeing that (A-1f-415).

Although she was very open with her teaching materials, she was cautious in sending assessment home to be completed out of school hours. She explained a previous experience:

<Carmelina> and I were called out a couple of years ago and were being called to task with a parent because the child did the assessment task at home. It was clearly not their work. They couldn't even read it back. Yet the parent was
claiming that it was and why didn’t we give them the mark that they deserved
(A-1f-439).

The use of digital technologies enabled students to complete work at school or home with an individual focus on the tasks that she set wanted them to completed. Her assessment was designed to be able to capture a true reflection of the students’ work. Students completed their work using digital technologies and Alessandra used digital technologies to collect various examples of student work in order to make grading decisions. Digital technologies made it easier to collect multiple views of student work, review student work because it was in a typed electronic format, and provide feedback by adding comments to MSOneNote documents that were emailed back to the student. A full history of interaction associated with the assessment process for an individual student was available to share with parents and support grading decisions. Alessandra used peer mentoring to motivate and engage students in reading. Students were able to manage their progress and were accountable to their peers in their weekly meetings. They were able to develop a deeper understanding of their reading texts and their understanding was assessed when Alessandra could access their shared OneNote files and when she met with them when she needed to gather evidence of their work for grading.

Alessandra provided some insights into her reflection and new comprehensions through the data analysis of her digital portfolio. Her reflection was mainly an internal process based on her history of interaction with her students and the records kept in MSOneNote she was able to reflect on her teaching over the duration of the unit. Many of her new comprehensions were based around the use of digital technologies in the classroom. She shared how she had moved from using a virtual classroom with her students because of the time managing/approving the students use of the virtual classroom and that it was slow to use on the school network. She moved to MSOneNote even though it was not online. Therefore it was important to ensure files were in the correct location in order to have them accessible when needed. She found that the students that participated in the class were responsible enough to care for their laptops, to go beyond what she was teaching them and used digital technologies to communicate with each other for the benefit of learning outside of the classroom.

Both of Alessandra’s restories provide a view of her pedagogical reasoning with digital technologies, where her first restory describes how she was setting up a new
eLearning classroom to use digital technologies and the second restory described Alessandra in the new eLearning classroom teaching with digital technologies. In changing to a new eLearning approach, she was required to comprehend a large number of new digital technologies that she wanted to use in her classroom. The next section looks at the influences that Alessandra has highlighted in her restories for answering Research Question 3.

**RQ3: What influenced Alessandra when she pedagogically reasoned with digital technologies?**

Alessandra highlighted many influences in her restories that are summarised in Figure 6.29. The discussion on influences begins with the external influences of school and education system. Following the external influences the discussion moves to looking at the internal influences of knowledge and mindset.

![Figure 6.29 – Alessandra’s influences](image_url)
External to Alessandra

Alessandra was employed as a teacher in Rome PS because of her background using of educational digital technologies. Alessandra had been a member of the ICT committee for many years and as a member had a significant influence on the investment of digital technologies within the school. The school had an abundance of digital technologies with a newly completed eLearning building that included the library and dual computer labs. They had purchased multiple laptop trolleys that could be used within the computer lab or rolled to a classroom. They had also obtained site licenses for a number of educational web based tutorial systems for example Braintastics, Mathletics and Spelling City.

Alessandra shared her teaching load with Carmelina, which freed her to manage the digital technologies within the school. This role entailed an internal role of managing the network and offering professional development internally to teachers to an external role of liaising with the various technology stakeholders within the education department and other outside suppliers. She was responsible for identifying, purchasing and then installing all software for the eLearning laptops. She had access to the state educational systems, school management system, the education materials website and the learning management system. She was the school liaison between the department and the school for any issues regarding these systems. In her role as ICT Coordinator she was part of multiple distribution lists where she could ask questions and share experiences with other state school across the state. Alessandra’s role was to mentor other teachers in use of digital technologies and provide an environment where digital technologies could be reliably used as part of teaching. Her position in the school and the professional relationships she had developed with stakeholders influenced how and what digital technologies she was able to use for teaching and learning.

As shown in Alessandra’s first restory demand for places in the eLearning class were high with parents were not afraid to pay the large eLearning fee for their children to participate. Demand for better quality teaching using digital technologies was important to the Principal and parent population. As the Principal was an early adopter of digital technologies, one aspect of better teaching translated to improved practices of teaching with digital technologies.
Internal to Alessandra

Throughout Alessandra’s restories there are many examples and explanations that describe her professional knowledge base for teaching and this is shown in Table 6.24. After working for over ten years as a primary school teacher, she would have developed a good understanding of the curriculum (KB3) and content (KB1) for teaching English in a state primary school classroom. To begin, she used the state curriculum materials as her starting point before selecting the best approaches and adding extra for teaching her eLearning students.

More recently with the introduction of the eLearning class, she needed to understand how to use an array of educational digital technologies. From MSOneNote, ClassDoJo, Answer Garden and Scratch, she needed to understand how to use these digital technologies before considering using them in her classroom. She needed to understand how to use the physical technology in her classroom from her interactive whiteboard, the data projector and her laptop and how they could be connected together for teaching. She needed to understand how to access websites that were used for managing spelling progress and then managing the student results to effectively tailor spelling programs for each student and how to access other websites that she used in her classroom, for example, AnswerGarden and the ClassDoJo. She had a wide knowledge of the digital technologies available to her for teaching and learning.

Alessandra had knowledge of the pedagogical strategies (KB2) for managing and organising her students as evidenced in her restories. She used the ClassDoJo to manage student behaviour and she used MSOneNote for teaching and learning. She used ABTutor in the early stages of teaching her eLearning class to ensure they were using their laptops appropriately. She used AnswerGarden for brainstorming and Scratch in designing a movie as a communication tool. She found that her students used the digital technologies to communicate with other class students outside of school in the process of learning technology and they would bring their new understandings into class to show their peers what was possible.
### Table 6.24 - Alessandra's knowledge base

<table>
<thead>
<tr>
<th>Knowledge base for teaching (KB)</th>
<th>Evidence from Alessandra’s restory #1 – Starting an eLearning Program</th>
<th>Evidence from Alessandra’s restory #2 – English in a eLearning class</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB1</td>
<td>Content knowledge.</td>
<td>English curriculum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OneNote, ClassDoJo, AnswerGarden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interactive whiteboard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Laptop/projector</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LMS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scratch</td>
</tr>
<tr>
<td>KB2</td>
<td>General pedagogical knowledge.</td>
<td>Use of MSOneNote</td>
</tr>
<tr>
<td></td>
<td>Teaching in an eLearning classroom</td>
<td>ClassDoJo for behaviour management</td>
</tr>
<tr>
<td></td>
<td>eLearning</td>
<td>ABTutor to manage screens</td>
</tr>
<tr>
<td></td>
<td>New furniture for classroom</td>
<td>AnswerGarden for brainstorming</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use of interactive whiteboard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scratch</td>
</tr>
<tr>
<td>KB3</td>
<td>Curriculum knowledge.</td>
<td>Digital literacies</td>
</tr>
<tr>
<td></td>
<td>eLearning</td>
<td>English</td>
</tr>
<tr>
<td></td>
<td></td>
<td>State curriculum</td>
</tr>
<tr>
<td>KB4</td>
<td>Pedagogical content knowledge.</td>
<td>Use of digital technologies for teaching and learning.</td>
</tr>
<tr>
<td></td>
<td>Use of digital technologies for teaching and learning.</td>
<td>Teaching MSOneNote as part of teaching not separate technology lessons</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scratch for presenting an ethical dilemma</td>
</tr>
<tr>
<td>KB5</td>
<td>Knowledge of learners and their characteristics.</td>
<td>Student motivation</td>
</tr>
<tr>
<td></td>
<td>Student motivation</td>
<td>How to use laptops</td>
</tr>
<tr>
<td></td>
<td>Laptop</td>
<td>Log on/off correctly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OneNote</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Student choice of technology tool</td>
</tr>
<tr>
<td>KB6</td>
<td>Knowledge of educational contexts.</td>
<td>ICT Committee</td>
</tr>
<tr>
<td></td>
<td>eLearning</td>
<td>eLearning class</td>
</tr>
<tr>
<td></td>
<td>Parents engagement</td>
<td>Parents engagement</td>
</tr>
<tr>
<td></td>
<td>Knowledge of school networks/infrastructure</td>
<td>Knowledge of school networks/infrastructure</td>
</tr>
<tr>
<td></td>
<td>eLearning in her classroom</td>
<td>eLearning in her classroom</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Student engagement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engaging parents in eLearning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sharing information with parents</td>
</tr>
<tr>
<td>KB7</td>
<td>Knowledge of educational ends, purposes and values.</td>
<td>Digital technologies</td>
</tr>
<tr>
<td></td>
<td>Digital technologies</td>
<td>Engaging students</td>
</tr>
<tr>
<td></td>
<td>Offering opportunities for gifted and talented students.</td>
<td>Offering opportunities for gifted and talented students.</td>
</tr>
</tbody>
</table>

Alessandra had developed her pedagogical content knowledge (KB4) over her teaching career as evidenced in her teaching reading. She had found a powerful motivation for students was their peers. By forming reading groups she was able to help her students develop their reading skills. In improving her PCK with digital technologies to achieve TPACK, she used MSOneNote to capture their progress.
through the Reading Stamina activity. She used Reading Stamina as a strategy to for
the teaching of reading. Using MSOneNote she was able to capture student self-
assessment of reading and comprehension questions. Not only were the students
reading but they were reading to understand to be able to post questions that would
challenge their peers to answer. The group meetings, at the end of the week, the
students were able to discuss their reading, ask their questions and explain their
answers.

She used AnswerGarden in the classroom as a tool to capture her
brainstorming activity. The use of digital technologies allowed all to contribute and kept
a record of all contributions. For her ethical dilemma topic she had decided the student
outcome was a movie showing the students understanding of an ethical dilemma. In
teaching her students she had used a variety of different movie technologies but
decided on using Scratch for this unit, although students could negotiate to use another
tool if they desired. Alessandra didn’t teach how to use Scratch but demonstrated its
effectiveness for producing a movie and encouraged her students to access the
tutorials if they decided to use it as their tool.

Having taught students from Prep to Year 7 (4-12 years of age), Alessandra
would have developed knowledge of learners and their characteristics (KB5). In her
digital portfolio, described how she used her knowledge of young students influenced
her to use digital technologies to capture their learning through digital photography and
video recording. Digital technologies enabled her to be able to share her student work
with their parents as a class video was shared at a class concert. Digital technologies
allowed her to keep a record of the students work for assessment purposes.
Alessandra was working with a Year 5 class and after teaching eLearning would have
developed a knowledge of learners and their characteristics especially their concerning
their abilities in using digital technologies for learning. Alessandra adopted a
demonstration teaching approach where she was able to demonstrate the use of the
laptop and software without having technology instruction lessons.

Overall, Alessandra’s work at Rome PS for over ten years and her previous
experience as an educational consultant enabled her to develop a strong knowledge of
educational contexts (KB6) and educational ends (KB7). She understood the
importance of eLearning for the students in being the first teacher in her school
motivated to implement an eLearning program in the classroom. She also understood the importance in providing an engaging learning experience that allowed for gifted and talented students.

Alessandra became an early advocate of teachers using digital technologies in the various roles she performed as educational technology consultant. Once teaching, her interest and knowledge in using digital technologies in the classroom led to her technology leadership role in the school. She was one of the first teachers in her school to complete her digital portfolio as part of the Smart Classrooms Professional Development Framework. She was given the role of accredited facilitator to mentor other teachers at her school and for teachers at other schools in her region.

Alessandra believed that her students wanted to use digital technologies in learning and she believed that they were capable of using the digital technologies. Alessandra had the confidence to use new digital technologies in her classroom. She had a strong belief that the incorporation of digital technologies was now essential to teaching and learning and her role in the school allowed her to mentor other teachers in changing their teaching practices to incorporate the use of digital technologies.

**Case summary**

This chapter introduced Alessandra as the first of two leading teachers. Through the two restories constructed from the evidence collected, Alessandra’s pedagogical reasoning with digital technologies was explored. The complexities of her pedagogical reasoning comprised her use of digital technologies and her students’ use of digital technologies. The students had access to their own digital technologies to be able to use in the classroom and continue later outside the classroom. She shared her teaching materials with the students to allow them to explore more deeply the material from the state curriculum materials in their own time. She had moved from using the state based virtual classrooms to using MSOneNote for her students, to record the work they needed to complete, their work and extra materials for them to explore if they wanted to know or complete more.

There were many influences that enable Alessandra to pedagogically reason with digital technologies. She worked in a school where the Principal supported the use of digital technologies, she was appointed as the leader of the school ICT
committee and there was an abundance of digital technologies available in school for teacher to use for teaching. Alessandra taught with Carmelina who also was interested in using digital technologies and their relationship allowed each of them to share the teaching on one class while undertaking technology responsibilities in their school. She was part of the state education systems where there was push for teachers to use digital technologies in teaching and many programs to support teaching in using digital technologies. She had the professional mindset to want to use digital technologies for teaching and a belief that students should use digital technologies in an eLearning classroom. She was able to demonstrate a wide understanding of her professional knowledge with many examples of her digital technologies knowledge.

**Case 7: Marcelia**

![Figure 6.30 - Marcelia](image)

**Background**

This section introduces Marcelia who was teaching at Venice College for just over ten years after graduating in 2003. Marcelia was qualified as an early childhood teacher and began her teaching career with primary aged students teaching in a variety of year levels. Marcelia returned to teaching young students when she prepared her digital portfolio. With her interest in using digital technologies and her willingness to mentor other teachers in the use of digital technologies, her role had changed from fulltime teacher to part-time teacher and eLearning facilitator at Venice College.

Venice College was a Prep-12 school, redeveloped from a primary school to a new college, operating as a college for a little over ten years. It is located in the
southern suburbs of a large metropolitan city. A summary of the college statistics from the *MySchool* website are shown in Table 6.25 (for further details about ICSEA and *MySchool* refer to Appendix J). The school is a large school with over 1500 student enrolments and well over 100 full-time equivalent teachers employed at the college. An explanation of how the table was compiled from the *MySchool* website is included in Appendix J.

**Table 6.25 - Venice College summary information from *MySchool* website for 2012-2013**

<table>
<thead>
<tr>
<th>School Details</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Type</td>
<td>Prep-12</td>
<td>Prep-12</td>
</tr>
<tr>
<td>Location</td>
<td>Metropolitan</td>
<td>Metropolitan</td>
</tr>
<tr>
<td>Full-time equivalent enrolments</td>
<td>&gt;1500</td>
<td>&gt;1500</td>
</tr>
<tr>
<td>Full-time equivalent teaching staff</td>
<td>&gt;100</td>
<td>&gt;100</td>
</tr>
<tr>
<td>School ICSEA value</td>
<td>1022</td>
<td>1024</td>
</tr>
<tr>
<td>ICSEA Distribution of students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom half</td>
<td>42%</td>
<td>50%</td>
</tr>
<tr>
<td>Top half</td>
<td>58%</td>
<td>50%</td>
</tr>
<tr>
<td>Educational advantage</td>
<td>58%</td>
<td>50%</td>
</tr>
</tbody>
</table>

The school has an ICSEA value of 1022 (2012) and 1024 (2013) that is above the national average of 1000. There are over 58% of its students from the top half ICSEA distribution, highlighting the educational advantage with the majority of parents in high socioeconomic status occupations and educated beyond secondary school. The top two band students are achieving below average results on their NAPLAN assessment (as shown Appendix J).

Marcelia’s data has been analysed to construct three restories included in this chapter. Her first restory describes her teaching history to middle years students; her second restory describes how she set up a virtual classroom and produced a claymation movie for teaching with a Prep/Year 1 class, and her final restory described how she presented a BYOD program at Venice college. All three restories contribute to understanding how Marcelia pedagogically reasoned with digital technologies.

**Marcelia’s restory #1: A regular history lesson**

This restory described Marcelia in her regular history lesson that she was allocated to teach when she began her part time role of eLearning facilitator. The class was Year 7 and they had just completed a unit on Ned Kelly (a famous Australian bush
The restory begins with Marcelia as she moved from the senior campus to the middle school campus in time for her lesson. Marcelia made her way back from the senior school as she was scheduled to start a lesson with her middle years’ students (aged 10-11 years) in their classroom. Their regular teacher was finishing the lesson on maths and it was time to hand over to Marcelia for history. It was the last week of term and the room was decorated with many objects from the history unit.

Marcelia has organised the students into groups of three to four students each group was allocated desks set up for group work. She asked all of the students to look at her and she explained what they would be doing for the lesson. She asked the students to look at the mobile whiteboard where she had written Café-To-Go with instructions on what they would be doing. One student at each desk was nominated the café owner or ‘recorder’ and the others were ‘guests’ where the recorder stayed at the table and the guests moved to another table when their time was up. The room was divided into two sections where the students would move within their sections for the activity. Marcelia called for volunteers to be the recorder and she selected one student from each group. The recorders were requested to obtain laptops from the trolley and set them up for use. While the students were collecting laptops she assigned each table as victim, villain or hero.

Marcelia explained that she would demonstrate what they needed to do and asked all students to watch the interactive whiteboard. While the students were logging into the school network, she moved around the room to each group to confirm the roles they had been assigned. Inside the MSWord document was a link to MeetingWords website for each team type to record all suggestions for recording Ned Kelly, as a victim, villain or hero. She projected the MSWord document onto the electronic whiteboard and moved around the room to check the recorders had opened MeetingWords. Two students were not able to log in and she requested them to use one of the desktop computers available in the classroom. The process took longer than expected to set up the students for computer use. Marcelia then introduced the students to using MeetingWords, where she explained that they needed to type the suggestions into the large space on the screen advising that they did not need to use the other boxes shown on the screen. She projected one group’s MeetingWords page onto the electronic whiteboard and found that they had already entered their first
suggestion. She read the suggestion to the whole class reminding that group that they needed to explain why they thought of Ned Kelly as a villain.

After explaining the Café-To-Go activity, she gave the students one minute to make suggestions with the recorder typing them into the MeetingWord website before they changed groups. Marcelia left the first group’s page displayed on the electronic whiteboard during the activity. Marcelia instructed the students to move to another group and the students moved and found a new seat with the next group. The suggestions began again with the recorder adding them to the MeetingWord webpage. Most students manoeuvred themselves to be able to view the recorders laptop/computer screen. They were actively engaged in the task while Marcelia moved around the room checking progress. The students moved again with more suggestions being recorded on the MeetingWord page. Marcelia surveyed the room to check that all students were participating and moved to a group to check progress.

When the students had returned to their original groups, she asked the recorder to save their work on the MeetingWord webpage while demonstrating the process on the electronic whiteboard. Marcelia explained that she was going to use a MuseumBox and navigated her computer to the MuseumBox webpage that she had opened in her Internet browser. She explained that the students were going to prepare a museum box, as she wanted to hang these up in the classroom to display along with the other artwork they had completed. They had to collect images that represented Ned Kelly as a victim, villain or hero depending on the group they were with. She showed the students an online example of a museum box where gold was the topic and it described how each item contributed to building a story about the history of gold. The museum box loaded and she clicked on one of the images in one box. The item opened displaying a flat cube view of the item. From the virtual view she rotated the cube to show the different sides and how different images and text could be used to display the item.

She had prepared her own paper version to show the students and demonstrated rotating it to show its different sides. She explained that the students would be creating a paper-based version of the cube and showed them the template. They were to make a paper version where they would source images from the Internet and print the images on a page, then cut out the images and glue them on the
template. She had organised for scissors and glue to be placed on each desk. To help the students find the images she had prepared a folder on the school network with a variety of images they could use. She asked if there were any questions and one student asked if they could print in colour. She answered advising them they could print in colour but would need to go to the library to collect the print and before they left the room they needed a note to explain why they were out of the classroom.

Before they started their task, Marcelia explained that once they had finished their museum box they would need to obtain some feedback from a peer. She handed out the templates for the students to begin. While the students worked she reviewed the image on the projected screen and decided to display another museum box example. She returned to the list of example files and selected a new museum box example and displayed the new museum box on the screen.

Many of the students completed their image collection and wanted to print their sheet on the colour printer and asked for permission to collect their sheet from the library. The students worked to complete their cubes while Marcelia moved around the room checking progress. When the first student had completed her museum cube, Marcelia decided it was time to explain the feedback process. She asked all of the students to stop what they were doing and look at her while she talked. She explained that when they had finished she wanted them to swap their museum box with another student, who had also finished, to obtain some feedback. She asked the students to look at her whiteboard and described the ‘Three stars and one wish’ feedback process she wanted them to follow. They had to review another student’s museum cube and offer three positive comments about their box and one suggestion about how they could have improved their box. On a piece of paper for each student they had to record their stars and wish as they reviewed the museum box.

The students continued working on their museum boxes. One student complained that he had tried to send his pictures eight times to the library but the pictures had not printed. Marcelia asked if he had enough printer credit and he answered that he did. She decided to check his laptop to identify the problem. She confirmed that he had printer credit and checked that he had selected the correct printer. She asked if he could return to the library to check for his printed pictures and ask for help if he was unable to locate them.
Marcelia counted down three-two-one with her hands in the air. She asked the students to stop what they were doing as the lesson was drawing to an end and she wanted to remind the students of what they needed to finish. She waited for them to stop and settle reminding them with a few ‘still waiting’ verbal comments and some direct commands to a few students. Some were completing their museum box, others preparing feedback and a few students that had finished both. She reminded them that they needed to return all materials and place all rubbish in the bin. She moved around the room to check progress before the lesson ended. Just before the bell, Marcelia used her hands to clap a rhythm that the students were familiar with, they responded and the room settled with all eyes on Marcelia. She performed another hand rhythm and the students responded. To finalise the lesson she asked the recorders to shutdown and return their laptops, all students completed their cubes - those yet to receive feedback were stored separately for the next lesson. As a close to the lesson, Marcelia asked the students if they enjoyed the different activities they completed in the lesson. The majority of students raised their hands without giving verbal feedback.

**Marcelia’s restory #2: A Claymation movie**

This restory captures Marcelia teaching a multi-aged class of Prep/Year 1 students at Venice College that she described in her digital portfolio. Marcelia had 46 students which she shared teaching with another teacher. Her teaching partner was an experienced teacher who had worked at Venice College for a number of years. They had a teacher aide who they shared in the teaching space and for this lesson they had a pre-service teacher who was in her final year of study. The teaching space contained an interactive whiteboard and ten computers for student use. There were adjustable walls that could be removed to open up the space or close to create a smaller classroom environment. Marcelia was one of the first teachers at the college to utilise the digital technologies in this classroom.

She had set up a virtual classroom project at the beginning of year for her Prep/Year 1 class to share what they were learning with parents and to access learning objects. Initially, this was a collaborative project with her teaching partner, and guided with the support of an online facilitator as a mentor. The project progressed and she was continually reviewing, she added new material to learn how to use a virtual classroom in the learning management system. To ensure her young students could
use the virtual classroom, she demonstrated how to use the materials on her interactive whiteboard, and then completed activities in the virtual classroom where students worked in small groups with adult support to access the materials using one of the ten computers available in the room. The idea around the virtual classroom was that it provided an extension to what she completed in the classroom, as most of the material was similar to what was used during teaching. Marcelia not only taught her students how to access and use the Internet but also how to navigate around learning objects. Marcelia developed the virtual classroom not only as an extension to what they were doing in the classroom but also as a way to connect with parents. When introducing the virtual classroom, she asked parents to attend an information session after hours, she described how:

Nine families were represented at the information session ... It was an informal exploration of the virtual classroom and I was able to answer general and specific questions during the session (M-5f-e).

To ensure they remained safe on the Internet she created a Cybersafety program that she shared with the students and their parents. She explained that she created the virtual classroom

To give parents another opportunity to share their child’s learning experiences (M-5g-e).

Marcelia understood the importance of engaging parents in their children’s learning and their eagerness to be involved.

In preparing for the college open day, Marcelia arranged for a planning session with her teaching partner to discuss what and how they would teach a science unit with their Prep/Year 1 class. She wanted to create a Claymation movie. She was familiar with the MSMovieMaker and decided that they could create a Claymation movie with student audio of the students telling a story. This would take the whole term of ten weeks. Marcelia first had to identify the topic they could use in science that would be useful for creating the Claymation movie. To begin, she asked the students what they wanted to learn about and the students were keen to suggest ideas that she recorded on the interactive whiteboard before asking students to vote. The voting concluded with her students wanting to learn about animals that were endangered. Marcelia cleared the interactive whiteboard and wrote five questions on the screen:

1. What do you already know?
2. What do you want to find out?
3. How will we find out?
4. Who will we share this information with?
5. How will we share this information?

She asked the students each question and recorded their responses on the interactive whiteboard. She explained how she wanted them to create a Claymation movie and showed them an example from another class. The students were very excited about making a Claymation movie about endangered animals. Marcelia allocated students to their regular reading group as wanted similar reading level students to work together. Each group was assigned an adult (teacher, teacher aide or pre-service teacher) to support them through the process and help prepare their storyboard. She asked the students, with their adult helpers, to research the animals using a variety of mediums including the Internet, books, and posters available in the classroom plus the learning objects that she shared with the class through the virtual classroom. She asked the students to decide on the main message for their story and then to construct a story around their animals. Working in their group the students described a story while the adult prepared the storyboard. In order to construct the storyboard, Marcelia had searched for a template on the Internet. The students needed to tell their story in six steps in preparation for the Claymation movie.

With the support of an adult, students selected and constructed the set and props, and due to the student age careful consideration was given to the durability of the props. The adult helped prepare the set to take the digital photographs for the Claymation movie. With adult support, some students were able to sequence the photographs in MSMovieMaker. Marcelia checked and finalised the construction of the movies using MSMovieMaker to have them ready for students to record the audio. Marcelia scheduled time in the computer lab where the students, with adult support, were able to record their voices telling their story.

During the process of constructing the Claymation movie, Marcelia interviewed the students to understand what they were learning about animals for science and what they were doing for the Claymation movie. Marcelia collected anecdotal evidence of involvement and their contribution to the Claymation movie, and, at various times she photographed the students in action. At least weekly, she interviewed the students.
to give them the opportunity to explain what they had learnt. By the end of the unit, she described how she had developed her MSMovieMaker skills and was confident in using the software. She had not added audio to a movie previously and described how she had developed new skills. In terms of the mechanics of taking the digital photographs, she developed new camera management strategies that would make the task easier for her young students. At the time of the project, the school was going through a network upgrade, which limited access to the computer lab when they needed to record the audio. To manage this she negotiated with the school’s ICT technician to minimise the impact on her project.

She acknowledged that most of her students had developed their computer skills and were able to log in and find resources without support from an adult. She had found that her students’ confidence in using the Internet depending on if they has access to computers/Internet at home. With the use of the virtual classroom and searching for learning objects, Marcelia had developed the confidence in using this the learning management system that enabled her to

participating in professional educational conversations that I may not have engaged in, except in a different context (M-5f-e).

with other digital technology using teachers.

When the unit was completed, Marcelia shared the Claymation movie with her peers where one suggested it should be shown at the next school assembly. She showed the Claymation movie on college open day and received positive feedback from parents. Finally, she included the Claymation movie on the student end of year CD as part of a collection of their work. Marcelia reflected:

I would try to be more aware of not being caught in the time trap – when we are in the midst of such a task consider the time it takes to do over, seems unfeasible. Next time I would have more experience and have developed more confidence in working with Windows movie maker and creating such an application, however, I have enjoyed this project and listening to the students explanations (M-5f-e).

Marcelia’s restory #3: The BYOD (Bring Your Own Device) program

The final restory is constructed from the analysis of her think-aloud concept map interview. This short restory describes a small snapshot of the processes that
Marcelia completed to progress the BYOD program at the college. The decision to move to BYOD came from the new college Principal who had experienced a BYOD program at their previous school. Before the college could run a BYOD program, the Parents and Citizens (P&C) Association needed to support and recommend the program in order for the program to be rolled out in the college in the following school year. At the time of the interview Marcelia had started in her new role as fulltime eLearning facilitator and she was responsible for implementing a new BYOD program at the school. The restory begins after Marcelia had completed a BYOD parent information night. Marcelia and the Principal had previously presented the BYOD approach for the school at a previous staff meeting. The school had been successfully running a 1-1 laptop program with senior students for a number of years where the school supplied the laptops after receiving funding from the National Secondary Schools Computer Fund. A number of parents had complained about the type of device selected for the 1-1 program because all students had the same device and Marcelia was surprised that parent feedback suggested that the parents wanted two options as she expected that all parents would want to decide on their own device. One option was for the college to arrange bulk purchasing of BYOD devices for those parents that wanted to not have to select and purchase a device with the second option allowing parents to opportunity to purchase their own device.

After receiving the feedback from the BYOD parent information night, Marcelia decided to convene a meeting with the college Principal to discuss the possibility of a bulk purchase program. Before she could discuss this with the Parents and Citizens Association (P&C) she needed to discuss the best approach with the college Principal. She explained that she needed to:

*unpack what we needed to do and what it looks like, then we’ll go to the P&C and say, ‘This is what it looks like. This is what you need to do’. We will support them in that and in all the decisions they have to make throughout that process (M-2g-306).*

She met with the Principal and they decided that the college would allow both options. Parents could purchase their own device that met a minimum set of specifications, or secondly, they could purchase a college recommended device. This meant that Marcelia needed to determine the minimum specifications for a device and investigate if there was a preferred supplier of computer equipment that the college could
recommend to parents. Over the next few weeks, Marcelia collected all of the required information in order to prepare a presentation for the next P&C meeting. She prepared a Prezi presentation that summarised the information to describe the issues with implementing a BYOD program at the college.

A week later, she presented her Prezi at the next P&C, the members asked a few questions but agreed to the approach that she recommended. From this meeting there were many tasks that needed to be completed in order to implement the BYOD program at the college. The BYOD program would impact many areas of the school from infrastructure, textbooks, printing, software and finally, most importantly, how teachers decided to use BYOD devices for teaching and learning within their classrooms.

These three restories have been included in this thesis to understand how Marcelia pedagogically reasoned with digital technologies and what has influenced her when she has pedagogically reasoned with digital technologies. The restories provide an insight into Marcelia’s teaching practices and her role in changing the technology approach in her school. The next section explores her pedagogical reasoning with digital technologies in answering Research Question 1.

**RQ1: How did Marcelia pedagogically reason with digital technologies?**

A summary of Marcelia’s pedagogical reasoning with digital technologies from her restories is shown in Table 6.26. The three restories provide an insight into Marcelia’s pedagogical reasoning with digital technologies. Restories 1 and 2 describe Marcelia as a teacher in the classroom while the third restory describes how Marcelia was introducing a change with a new BYOD program across the college. The college had run a 1-1 laptop program with a defined laptop and software for a number of years while BYOD program would introduce student digital technologies with multiple devices and software into all classrooms for the first time. BYOD had the potential to change how all teachers pedagogically reason with digital technologies.
### Table 6.26 – A summary of Marcelia’s pedagogical reasoning

<table>
<thead>
<tr>
<th>Pedagogical reasoning</th>
<th>Evidence from Marcelia’s restory #1 – A regular history lesson</th>
<th>Evidence from Marcelia’s restory #2 – A claymation movie</th>
<th>Evidence from Marcelia’s restory #3 – The BYOD program</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Evaluation</td>
<td>Moving around the room. Showing the Meeting Word output. Asking students questions. Completed Museum Box to hang in room.</td>
<td>Claymation movie from each group. Anecdotal evidence Digital photograph of students. Student interview.</td>
<td>Assessment with BYOD. Evaluating student work completed on BYOD.</td>
</tr>
<tr>
<td>5 Reflection</td>
<td>Technological issue with accessing Museum Box.</td>
<td>Improved skills and confidence of using MSMovieMaker. Experience of creating claymation. Network upgrade.</td>
<td>A lot of work to implement BYOD.</td>
</tr>
<tr>
<td>6 New comprehension</td>
<td>Museum Box was accessible but unreliable.</td>
<td>Students’ skills and confidence with digital technologies. Claymation with audio is a time consuming process. Confidence in using virtual classroom</td>
<td>BYOD.</td>
</tr>
</tbody>
</table>
Marcelia’s *comprehension* began with understanding the content that she needed to teach history. From the first restory, Marcelia began with the state curriculum materials that she could selectively modify for her students. Marcelia didn’t follow the state curriculum unit plan, as she had decided on an extension activity after the students had completed the curriculum unit.

*This lesson is probably an extension of a culminating activity because the kids have already completed all their formal assessment tasks and then being the last week of term... I wanted the lesson where they were still using the familiar content that they’ve been working on. However, I wanted to try and deepen it a bit (M-1g-124).*

She used two activities in her lesson and explained the first as:

*I decided to use Café-To-Go because I wanted the kids to be able to kind of like brainstorming activity. I wanted them to bring back to the front of their memory all the different ideas that we discuss about Ned Kelly (M-1g-120).*

Then moved to the Museum Box but she explains her thinking in planning the lesson:

*as technology goes I actually had some trouble getting into Museum Box and creating my own. Then I transferred that experience to implementing it in a lesson and thought that was going to be a major problem for the students. I suppose I’ve adapted a technology based activity and made it a hands on activity, but the concept is still the same (M-1g-132).*

From her experience of using the MuseumBox website she anticipated the problems that her students might experience. For this activity she did not reject the opportunity of using digital technologies because of its reliability but she was able to demonstrate what she wanted the students to achieve using the virtual tool, which was more visually interesting and there were many examples already prepared to show a diverse range. Not only did she need to know the history content, but, understand a range of digital technologies before she could begin her planning including MeetingWords, MuseumBox. She planned how the students would access them on the Internet with her MSWord file to simplify the process. She needed to know how to access the state curriculum materials and understand what was required of her. For this unit, most of preparation involved understanding the state curriculum materials before she could modify to suit her students.

For the second restory, Marcelia describes the Claymation movie she completed with her early years students. For this unit, Marcelia needed to comprehend science and endangered animals and what was suitable for teaching Prep/Year 1
students. Although they decided on the content they wanted to study, Marcelia would have guided the students in suggesting appropriate topics, which aligned with the science curriculum for early years’ learners. For this unit she also needed to understand how to use a variety of specific digital technologies including: MSMovie Maker; digital photography; and audio recording and editing. She needed to understand how to use her laptop and interactive whiteboard in her classroom and the virtual classroom with the learning objects. Finally, she needed to comprehend the importance of protecting her students when using the Internet and, for this, she implemented a Cybersafety program suitable for her young learners and their parents.

In the final restory, Marcelia describes how she is implementing a BYOD program at her college. In terms of comprehension this restory suggests how Marcelia is preparing her college for a major change in their pedagogical framework where all teachers would be challenged to incorporate the use of the students BYOD digital technologies into their teaching and student learning. The challenge for them would be that now they would need to cater for differing platforms, devices and tools where they would need to generalise their teaching materials to generic non-specific requests. They could no longer tailor all instruction for one particular vendor or device, for example, using the generic word processing rather than specific digital technologies in MSWord. For the remaining teachers who had to plan for the use of computers in the classroom (as they did not have enough desktops for each student or had to book a laptop trolley for the class) the change to BYOD would have a significantly greater impact on teaching and student learning in how they comprehended what and how they needed to teach. They could no longer rely on a paper textbook as their primary source and with the move to BYOD, Venice College was making textbooks available in a digital format. The change to BYOD has further implications for transformation, instruction and evaluation.

In terms of transformation, Marcelia used two different approaches to completing her planning. In the first restory, she reviewed and edited the state curriculum materials to suit her objectives and learners. The state curriculum materials were comprehensively compiled with recommended content that included the use of digital technologies. Her selection would have focused on checking the validity of the content and making it suitable for teaching her students. She did not need to think through the representation or selection of the material, as the teachers who prepared
the state curriculum materials had included a wide range of options to suit different contexts and students. Most of her work was in adapting and tailoring the state curriculum for her students.

For this lesson, Marcelia determined her own content, which she was able to justify as it was the end of the term and the students had completed all assessment. She still needed to prepare for the lesson by creating Meeting Word pages for the student groups to use, copy their links into a MSWord document which she then saved onto the college intranet for the students to access. For the Museum Box she explained that she perceived the students would have trouble using the online version and so resorted to a paper-based version for lesson. The advantage was that students were able to produce a physical cube that could be displayed in the classroom.

From the second example, Marcelia developed her own planning documents and completed all steps in the transformation process. She prepared material to show the students the lifecycle of the two animals to help them understand what was an endangered animal. She began with searching the Internet for suitable resources to communicate the lifecycle of the two animals the students had selected. In selecting the resources that she could use she would have checked the validity and suitability of each resource before deciding the most appropriate for her young learners. She used a familiar questioning approach that she recorded on her interactive whiteboard to determine the science topic the students wanted to learn about. She used a student voting process to decide the most popular. In preparing them for creating a Claymation movie she was able to show her students an example movie (not Claymation) prepared by another class the previous year at her college. To prepare she searched and modified a storyboard template and prepared paper copies for each group to use. She identified and prepared the virtual classroom with learning objects that supported their learning about endangered animals so that the students could access in or outside of class. In preparation for some lessons she needed to complete work in MSMovieMaker which was time consuming.

From the third example, BYOD would have implications for preparation where teachers would need to review their content for use with a student BYOD. This raised the question of where would the content be stored? Before the use of digital technologies, content was stored in books or the teacher paper-based folder but with a
move toward an electronic format this could include e-books, websites, college intranet or a virtual classroom. With the introduction of BYOD, there are many more options for representing the content and more work for the teacher to make selections of the content that is available and adapting and tailoring for learning.

Instruction for Marcelia involved the use of a range of digital technologies in her classroom: from her interactive whiteboard, laptop, desktop computer and laptops for students. She used her digital technologies to demonstrate what the students were required to complete on the MeetingWords webpage and where to access the MSWord document in order to find the correct website. She used groups in both restories with adult support for her young learners in the second restory. In the first restory, she used her voice and physicality to manage student behaviour by moving around the room. This gave her the opportunity to check what students were doing on the computers and for one group she was able to project their MeetingWords webpage onto the interactive whiteboard for the class to see. In the second restory, she used additional adults to assist in keeping the students focused on the tasks they needed to complete for the Claymation movie. To manage her young learners her instruction centred on her interactive whiteboard where she used the board to write, to show a movie and to communicate what needed to be complete. The process of instruction became more about guiding and directing the adults (teacher aide, pre-service teacher) to manage the young student groups to complete their tasks.

From the third restory, BYOD was going to impact the teachers’ pedagogical knowledge: from classroom management, communication to explain concepts and content, and to the completion and assessment of the students’ work. Across the college, all classrooms had data projectors installed - not all with interactive whiteboards. Marcelia explained that she had an interactive whiteboard but the interactive whiteboard software had not been loaded onto her laptop. The challenge with instructing in a BYOD classroom was the technological problems that teachers faced with using multiple platforms and devices. Marcelia explained that there was a plan to offer technical assistance to students to help resolve issues instead of relying on their teacher therefore removing the burden of teachers needing to know how to use multiple platforms and devices. The college had also specified a minimum requirement for the BYOD to minimise the device problems that students might face. Implementing
a BYOD program had the potential to introduce a new range of technological problems that teachers would face when using digital technologies for teaching and learning.

In the first restory, Marcelia used multiple strategies to evaluate student understanding during and after interactive teaching. She asked questions and moved around the room checking student progress. She collected anecdotal evidence while students were involved in constructing the Claymation movie. She took digital photographs of her young students while they were working and she interviewed each. She highlighted that assessment practices would change to incorporate the use of student BYOD device. This in turn could change how teachers made judgements about student work completed on a BYOD student device from how students completed work, how it was collected, how feedback was added and how the results were communicated to students and their parents.

Evidence of Marcelia’s reflection and new comprehensions were available from her digital portfolio. She shared that she had improved her skills and confidence of using software and that she had developed new understandings about her students and their use of digital technologies. She reflected that it was not a good time to use digital technologies when the school was going through a network upgrade.

**RQ3: What influenced Marcelia when she pedagogically reasoned with digital technologies?**

Marcelia highlighted many influences from her restories and they are summarised in Figure 6.31. The discussion on influences begins with the external influences of the school and the educational system leading to the internal influences of her professional knowledge and mindset.
Figure 6.31 – Marcelia’s influences

External to Marcelia

Marcelia has worked in Venice College for over ten years and there were a number of factors about Venice College that enabled her to use digital technologies. She was an early adopter of digital technologies at the college and from this time she was one of the first teachers to work in a classroom with an abundance of digital technologies. The previous Principal had initiated a 1-1 laptop program at the college and realising Marcelia’s potential, had offered her the opportunity of new part-time role of eLearning Facilitator with the latest Principal upgrading the role to fulltime to implement a BYOD program at the college.

At the same time as the technological changes discussed above, all state schools were mandated to implement a pedagogical framework (Department of Education and Training, 2011). Venice College implemented a *Symphony of Teaching and Learning* (Hodson & Sippel, 2012) pedagogical framework that supported the use
of digital technologies in line with their 1-1 laptop program. The *Symphony of Teaching and Learning* program was:

> to enable and empower whole school transformation of teaching practice in contemporary learning environments ... <to> provide pedagogical choices for teachers to differentiate in order to improve student learning outcomes (Hodson & Sippel, 2012).

Teachers were provided resources that included digital and non-digital choices that aligned to higher order thinking across all year levels. Marcelia was key in implementing the new pedagogical framework at Venice College by providing support to teachers as they used the Symphony of Teaching and Learning resources. Parent support for the use of digital technologies in teaching and learning was a major consideration in running the 1-1 and BYOD programs. From an early time, Marcelia used digital technologies to share with parents what she was doing with her students.

Marcelia worked in the state education system and so participated in the *Smart Classrooms Professional Development Framework* and completed her digital portfolio documenting her use of digital technologies. She had access to the state supplied education systems including school management system, educational website and learning management system. She accessed and used the state curriculum materials. She had access to a range of software that she used regularly. Her education system enabled and supported her in the use of digital technologies.

**Internal to Marcelia**

Throughout Marcelia’s data, and expressed in her restories, are many examples and explanations that describe her knowledge base for teaching and the construction of the restories demonstrates some of these and this is shown in Table 6.27. After her many years as an early childhood teacher and then as eLearning Facilitator, she had developed a comprehensive understanding of the curriculum (KB3) and the content (KB1) for teaching science and history in primary/early year’s settings. Marcelia was familiar with the state curriculum materials for teaching history and she was familiar with the state based curriculum documents for early learners. Although her role had changed over the ten years or more that she had worked at Venice College, she was able to adapt to each changing circumstance and identify the relevant curriculum for the students. She had moved to teaching in the middle school and explained:
I was a bit nervous about being with this age group. I’m not primary trained and I just felt a bit out of it. I suppose this year I really felt like a first year teacher quite a lot of the time. Struggling with things like a first year teacher does. You know finding resources and that type of thing. Last year I knew where all the learning support resources were. This year I need to find where all the teacher resources are for the middle school (M-1g-492).

In terms of content, Marcelia needed to understand how to use the various digital technologies she had chosen for teaching and learning. She needed to understand how MeetingWords could be used as a brainstorming tool and how the Museum Box could be reengineered to a non-technology activity. From the MeetingWords website, it is advertised to be used as a meeting tool that allows text editing; it does not say that it is a great tool for teachers. Marcelia reengineered the MuseumBox to a non-digital tool because she understood that the students would have difficulty using the website to create a MuseumBox, thus changing the activity from virtual to physical to suit her students. She needed the knowledge of these digital technologies to be able to consider them for learning. Marcelia needed to understand how a Claymation movie could be used as a learning and assessment tool. She needed to understand the components of a Claymation movie to understand how she could teach how to create one. She needed to understand how to use MSMovieMaker and to record and edit audio and how to attach the audio file to the movie file. Unlike MeetingWords and the Museum Box, the Claymation required a very complex process of planning, designing, recording and editing. Marcelia did not share all of her knowledge with her students because of their capabilities and she did not share her knowledge with her teaching peers as they were required to manage the students to complete their parts.

Marcelia used a variety of pedagogical strategies (KB2) for managing and organising her students: from student groups to sitting on the mat and the Café-To-Go activity and MeetingWords for brainstorming. She used her interactive whiteboard as a place to record and share information with her class. She had experienced problems with accessing the Museum Box webpage and decided to have students create physical Museum Boxes that could be displayed in the classroom. In deciding to use digital technologies Marcelia realised the importance of Cybersafety and implemented a program that included the parents.
Table 6.27 – Marcelia’s knowledge base

<table>
<thead>
<tr>
<th>Knowledge base for teaching (KB)</th>
<th>Evidence from Marcelia’s restory #1 – A regular history lesson</th>
<th>Evidence from Marcelia’s restory #2 – A claymation movie</th>
<th>Evidence from Marcelia’s restory #3 – The BYOD program</th>
</tr>
</thead>
<tbody>
<tr>
<td>K B 1</td>
<td>Content knowledge.</td>
<td>Science – Animal life cycles</td>
<td>Use digital resources</td>
</tr>
<tr>
<td></td>
<td>History - Ned Kelly State curriculum materials</td>
<td>Animal life cycles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meeting Words</td>
<td>Endangered animals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use digital resources</td>
<td></td>
</tr>
<tr>
<td>K B 2</td>
<td>General pedagogical knowledge.</td>
<td>Adult support for tasks</td>
<td>Teaching and learning with BYOD.</td>
</tr>
<tr>
<td></td>
<td>Student groups Laptop Café-To-Go activity using MeetingWords.</td>
<td>Learning questions to begin topic.</td>
<td>Printing.</td>
</tr>
<tr>
<td></td>
<td>Museum Box website and physical construction.</td>
<td>Student voting on topic.</td>
<td>Accessing materials.</td>
</tr>
<tr>
<td></td>
<td>Materials to cut and glue.</td>
<td>Created a claymation movie.</td>
<td>Virtual classroom.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Used a storyboard template.</td>
<td>BYOD care and management.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cybersafety</td>
<td>Cybersafety</td>
</tr>
<tr>
<td>K B 3</td>
<td>Curriculum knowledge.</td>
<td>Early Childhood curriculum</td>
<td>Digital curriculum.</td>
</tr>
<tr>
<td></td>
<td>State curriculum materials – History</td>
<td></td>
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</tr>
<tr>
<td>K B 4</td>
<td>Pedagogical content knowledge.</td>
<td>Student ownership of topic.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Café-To-Go-brainstorm.</td>
<td>Claymation movie.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Create MeetingWords</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prepared Word</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Prepared images on intranet</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Made Museum Box with images glued on the side.</td>
<td></td>
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</tr>
<tr>
<td>K B 5</td>
<td>Knowledge of learners and their characteristics.</td>
<td>Young learners.</td>
<td>Individual device management.</td>
</tr>
<tr>
<td></td>
<td>Active learning</td>
<td>Adult support required.</td>
<td>Motivation to use technology.</td>
</tr>
<tr>
<td></td>
<td>Physical Constructing</td>
<td>Ability/confidence of using digital technologies</td>
<td>Cybersafety</td>
</tr>
<tr>
<td></td>
<td>Museum Box.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>MeetingWords</td>
<td></td>
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</tr>
<tr>
<td>K B 6</td>
<td>Knowledge of educational contexts.</td>
<td>Prep/Year 1 classroom</td>
<td>P-12 College P&amp;C</td>
</tr>
<tr>
<td></td>
<td>Middle school classroom</td>
<td>P-12 college</td>
<td>Principal support and leadership.</td>
</tr>
<tr>
<td></td>
<td>P-12 college</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K B 7</td>
<td>Knowledge of educational ends, purposes and values.</td>
<td>State curriculum materials</td>
<td>Science Digital technologies.</td>
</tr>
<tr>
<td></td>
<td>State curriculum materials</td>
<td>Pedagogical framework</td>
<td></td>
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<td></td>
<td>Pedagogical framework</td>
<td>Digital technologies</td>
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<tr>
<td></td>
<td>Digital technologies</td>
<td>Engaged learners</td>
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</tr>
</tbody>
</table>

Marcelia has been able to show an extensive array of PCK and her TPACK (KB4) throughout her data and some of this is reflected in her restories. Her first
restory describes how she used Café-To-Go to brainstorm ideas about Ned Kelly as a hero, victim and villain. The objective of this activity was to prepare them for the Museum Box activity as she

wanted them to bring back to the front of their memory all the different ideas that we discussed about Ned Kelly (M-1g-120).

The Café-To-Go wasn’t a normal brainstorming activity, as she wanted the students to move from group to group and brainstorm multiple times with multiple other students while thinking of Ned Kelly from three different perspectives. MeetingWords allowed Marcelia to capture all of her students' thoughts on each group webpage and because they were captured online they were sharable and able to be stored online for future reference. She demonstrated on her interactive whiteboard how to use MeetingWords or what she wanted the students to do but did not need to explain how to create a new MeetingWords page or explain the technology. By preparing an MSWord document with links, she had eliminated the potential technology problems that could have emerged with middle school students using a new technology.

For the Museum Box activity she reengineered it from online to offline. She had foreseen the potential problems her students would have experienced if trying to access and complete their own Museum Box, as the site was unreliable. She was able to demonstrate on her interactive whiteboard the purpose of the activity by showing the students the virtual interactive Museum Box. She had prepared a box template that she had printed for all of her students. To complete the box, the students needed to find images and resize them to fit a single page and then print them out. Marcelia had created an example to show the students what the final product looked like. Much thought had gone into a simple activity to ensure all students completed the activity in the allocated timeframe. Marcelia showed her PCK in terms of allowing the students ownership over the science topic by allowing them to decide and then vote. With the use of learning objects in the virtual classroom, Marcelia was able to demonstrate the life cycle of a butterfly and koala. They collected enough material to allow the students to create a storyboard, prepare sets for photographing scenes for their movie. Marcelia had to perform all of the editing and she added the audio for the Claymation movie.

For both restories, Marcelia has shown knowledge of learners and their characteristics (KB5) from using group work, to movement and tactile tasks while
offering personal interaction in the classroom. As evidence of her knowledge of educational contexts (KB6), both of the restories described how Marcelia was familiar with all levels in the P-12 College. She had worked within the state education system for all of her career. For Marcelia’s knowledge of educational ends (KB7), the Australian curriculum had become part of her teaching through the state curriculum materials. As the college’s pedagogical framework supported the use of digital technologies, Marcelia was key in driving the cultural change of implementing the framework at the college.

Marcelia highlighted the changes that BYOD would have on teaching and learning for the college. The Principal was the driving force behind the change, but Marcelia played a key role in delivering the message across the college. She understood that with BYOD, teachers content knowledge (KB1) would need to include student use of technology and with the state curriculum materials there were resources suggested. The greatest impact would be on each teacher’s pedagogical knowledge (KB2) where the challenges of using the BYOD in learning would introduce an array of changes in the classroom and the management of the students. The new state curriculum materials were designed with technology as integral so teachers would develop their curriculum knowledge (KB3) using the state curriculum materials. In terms of knowledge of learners (KB5), an assumption of a BYOD program is that students want to use their own technology for learning. At the time of the study, BYOD was very new to Venice College and the college was one of the first across the state to implement a BYOD program and therefore setting a standard for other schools to explore.

Marcelia showed a range of beliefs, motivations and confidence in using digital technologies for teaching and learning. She had a personal motivation to use digital technologies and was one of the first teachers at Venice College to use digital technologies in teaching and learning. She was one of the first teachers to complete her digital portfolio as part of the Smart Classrooms Professional Development Program. As shown in her restories, Marcelia had confidence to use a range of digital technologies for teaching and learning and developed her skills by supporting other teacher across the college. Marcelia showed how she believed that students were capable of using digital technologies. She understood what would engage her students in digital technologies and they wanted to use digital technologies in the
classroom. Marcelia believed that young students were capable of using digital technologies. She explained her belief as:

_ I also believe that young children are very capable. They can follow multiple instructions and complete a task....ICT can support and be used to enhance learning experiences across all curriculum areas and age groups, whilst the level of scaffolding will vary according to age, individual ICT experience and ability level (M-5g-r)._

Although young learners need guidance and support from adults, she was surprised to find that some in her class were able to actively use technology independently.

**Case Summary**

This section examined the second lead teacher, Marcelia’s pedagogical reasoning. Her first story explored her teaching in the classroom where she used digital technologies to teach history to Year 7 students; and her second story described examined her teaching young students about science where they created a Claymation movie with Prep Year students. The final story was focused on implementing a BYOD program at Venice College and her role as eLearning Facilitator. Although brief, it provides an insight into Marcelia’s role in changing the teaching and learning landscape at Venice College.

Throughout the stories there was evidence of Marcelia’s pedagogical reasoning with digital technologies. There were many influences that enabled Marcelia to pedagogically reason with digital technologies. From her early evidence it is clear to see she has access to a wide range of digital technologies in her classroom, enabling her to experiment and explore how digital technologies could be used effectively for improved teaching and learning. She was able to access and use multiple resources available for teachers and students. Marcelia had the professional mindset to want to use digital technologies for teaching and learning. She was mindful of the potential technological problems that students may face in the classroom. She prepared to minimise those technological values in order to allow the activities to proceed without interruption. Finally, she had professional knowledge that not only covered the knowledge base but also an extensive knowledge of digital technologies.
Chapter summary

This chapter introduced Alessandra and Marcelia as an example of two lead teachers. Both Alessandra and Marcelia had been teaching for over ten years and both teachers have moved from teaching in the classroom to roles where they were influencing how digital technologies are used for teaching and learning. From reading their stories, there is evidence of how these teachers’ pedagogically reasoned with digital technologies. Like the previous chapters, it is clear that digital technologies have had a major influence over their pedagogical reasoning.

With the recent implementation of the Australian Curriculum and the development of state based curriculum materials, both Alessandra and Marcelia began their pedagogical reasoning with the resources that were available to them. In developing these materials, another teacher had prepared a comprehensive unit plan with lesson plans, links to all resources that had been tested in the state system and all assessment including assessment rubrics. The transformation entailed modifying the materials to suit their students. Both teachers used a variety of digital technologies for teaching and learning in terms of: presenting content; managing behaviour; demonstrating how to use software; finding; sharing; assessing; and protecting.

Both Alessandra and Marcelia work within the state education system and used many of the digital technologies afforded to them including the: learning management system; educational website; school and student management system; and the state curriculum materials. They both participated Smart Classrooms Professional Development Framework and were first to complete their digital portfolio. Their Principals encouraged and supported their use of digital technologies in the classroom and in mentoring other teachers at their school. Both teachers demonstrated many examples of their professional knowledge covering all aspects of the knowledge base. Both teachers possessed a professional mindset that supported their use of digital technologies including believed that their students wanted to and were capable of using digital technologies for their learning.

This chapter examined Alessandra and Marcelia to understand how lead teachers pedagogically reason with digital technologies and what influenced them when they pedagogically reasoned with digital technologies. From the analysis of their pedagogical reasoning, it is clear that digital technologies have a major impact on their
pedagogical reasoning, their knowledge base and their mindset about the use of digital technologies in teaching and learning. This chapter concludes the presentation of the case studies, and, for the next chapter, the results will be presented and discussed.
CHAPTER 7: RESULTS FROM CROSS CASE ANALYSIS OF THE SEVEN TEACHERS

This chapter

The teacher studies explored in Chapters 4, 5 and 6 highlight the similarities and differences of the pedagogical practices with digital technologies of the early career, experienced and lead teacher participants. The findings resulted from examining each participating teachers data independently, their explanations about their school and classroom contexts as well as their presentation of digital professional portfolios, prepared for audiences prior to their involvement in this study. As described in the literature review (Chapter 2), Shulman’s Model of Pedagogical Reasoning and Action (MPRA) is a framework that articulates the processes of pedagogical reasoning: comprehension, transformation, instruction, evaluation, reflection and new comprehension. Although the MPRA has provided a useful framework to analyse the practices of these teachers, this chapter proposes new insights to understanding how teachers’ pedagogically reason with digital technologies.

This chapter addresses the research questions to provide a new digitally enhanced view of pedagogical reasoning relevant for teacher practice. As a reminder the aim of this study was to understand how teachers’ pedagogically reason with digital technologies, where the central research questions posed were:

**RQ1:** How do teachers pedagogically reason with digital technologies?

**RQ2:** What are the differences in pedagogical reasoning with digital technologies across three career stages?

**RQ3:** What influences teachers when they pedagogically reason with digital technologies?

Cross case analysis

In this chapter, the major themes identified in the data and a summary of the assertions are reported that represent the commonalities and disparities across teachers’ pedagogical reasoning and the influences including knowledge, beliefs and contexts of the participating teachers in this study. As discussed in the methodology...
chapter, cross-case analysis can help identify whether the case attributes are unique and singular or common and shared within career stage. In this cross-case analysis, the influence of digital technologies on the pedagogical reasoning becomes increasingly evident. The analysis of each case has brought two important factors to the foreground: the deeply personal nature of pedagogical reasoning using digital technologies; and its interdependence on internal and external influences specific to context. With this in mind, unique insights into these particular teachers’ pedagogical reasoning have been provided through the analysis of the combination of the data collected in this study.

The most challenging aspect of this project was in recruiting participating teachers that were prepared to be video recorded while teaching. For all participating teachers this was their first time allowing a researcher with a camera into their classrooms. The video recording became the scaffolding mechanism for the interview and provided a visual representation of their pedagogical reasoning during their teaching. The interview dialogue, in the video-stimulated interview and the think aloud concept mapping interview, elicited details of their pedagogical reasoning with digital technologies, their beliefs, their knowledge and what influenced their decision making when using digital technologies. The teachers were able to articulate their thought processes that led to their pedagogical reasoning at a particular time and place.

Think-aloud concept mapping interview provided a visual and oral representation of their influences when they were thinking about teaching with digital technologies including the relational propositions between influences. Allowing them to prepare a concept map with simple instructions enabled the teachers to identify key influences of personal significance to their specific contexts. In their discussion, while preparing their concept maps, they revealed influences, insights to their beliefs and descriptions of their context that they wanted to personally emphasise. All discussion was recorded to allow analysis alongside the concept map. A comprehensive view of their pedagogical reasoning was furthered by their digital portfolios prepared as part of the Smart Classrooms Professional Development Framework, as they were prepared to describe the thinking and practices they used with digital technologies in up to three teaching scenarios. Using the structured framework to prepare a digital portfolio as defined in the Smart Classrooms Professional Development Framework, multiple facets of their pedagogical reasoning were captured along with multiple items of
evidence included to support their statements about their pedagogical reasoning with digital technologies.

Together, these data collection techniques gathered a wide variety of in-depth data about the participating teachers’ pedagogical reasoning with digital technologies including what influenced them. To begin the first research question will be answered to understand how these teachers’ pedagogically reasoned with digital technologies.

RQ1: How do teachers pedagogically reason with digital technologies?

Each stage of pedagogical reasoning will be presented with the results of the cross case analysis that have been gained from the data analysis. A cross-case comparison is discussed for each stage and along with a summary list of assertions is presented in a figure shown at the end of the section. The summary of assertions will be explored in the next chapter – Chapter 8 - Discussion and Conclusions.

Comprehension

Looking across the seven teacher cases there are a variety of content areas, year levels and sources as shown in Table 7.28. When looking at their comprehension, there was evidence of their shared practices in where they begin to comprehend what they needed to teach. The first was in understanding their students, as all of the teachers selected the content they needed to comprehend by first understanding their students. Donnatella, who worked in a lower socio-economic school, understood her students were choosing an elective subject. Her head of department recommended that she use Adobe Flash as a tool to engage the students, as it was available at the school and different to what they had used previously. Her students were difficult to engage and may have selected the subject because they thought they would have the opportunity to use the computers to play games. Drago, Carmelina, Alessandra and Marcelia all worked with students who had laptops and their content decisions were based on how students could incorporate the use of their laptop. Florentina, Carmelina and Marcelia were described in working with early years’ students where most could not read or write, or operate a computer. Viviana prepared an MSPowerPoint presentation that explained the mathematics content, in a very simplified form to help her Year 10 students understand it in preparation for their exam.
Overall, for these teachers, the stage of comprehension began with understanding their students.

Table 7.28 – Cross case comparison – Comprehension

<table>
<thead>
<tr>
<th>Case</th>
<th>Subject</th>
<th>Topic</th>
<th>Year level</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARLY CAREER</td>
<td></td>
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</tr>
<tr>
<td>Donnatella</td>
<td>Computer studies</td>
<td>Flash</td>
<td>10</td>
<td>Internet tutorials</td>
</tr>
<tr>
<td>Drago</td>
<td>Science</td>
<td>Environments</td>
<td>7</td>
<td>State curriculum materials</td>
</tr>
<tr>
<td>Viviana</td>
<td>Mathematics</td>
<td>Probability</td>
<td>10</td>
<td>State curriculum materials</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPERIENCED</td>
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<td></td>
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</tr>
<tr>
<td>Carmelina</td>
<td>Mathematics</td>
<td>Numbers</td>
<td>6</td>
<td>State curriculum materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Writing</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading</td>
<td>P</td>
<td>Wiki</td>
</tr>
<tr>
<td>Florentina</td>
<td>Becoming aware</td>
<td>Maps and outdoors</td>
<td>P</td>
<td>Previous teaching</td>
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<td></td>
<td>Exploring</td>
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<td></td>
<td>environments</td>
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<tr>
<td>LEAD</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Alessandra</td>
<td>English</td>
<td>Ethical dilemma</td>
<td>5</td>
<td>State curriculum materials</td>
</tr>
<tr>
<td>Marcelia</td>
<td>Science</td>
<td>Lifecycles</td>
<td>7</td>
<td>Idea</td>
</tr>
<tr>
<td></td>
<td>History</td>
<td>Ned Kelly</td>
<td></td>
<td>State curriculum materials</td>
</tr>
</tbody>
</table>

All of the participating teachers worked in the state education system. With the implementation of the Australian Curriculum, the Queensland state education system developed teaching materials for a range of subject areas, topic and across year levels. These had been developed by teams of seconded teachers who had identified the content that needed to be taught, determined the best way to teach it and mapped it against the national curriculum requirements. They prepared standard packages for each year level that could be taught in every classroom across the state. For the state school system, it meant that a common curriculum was being implemented across all state schools.

This meant that the same materials and resources were commonly available to the participating teachers in the study for use in teaching or learning. Thus a strong influence on their pedagogical reasoning was the use of state curriculum materials as a starting point in comprehension. The materials included a unit plan, lesson plans, resources and assessment to understand what they needed to teach, how to teach it
and how to assess student learning. Many of the participating teachers selected from these materials to develop planning to suit what they wanted to achieve for the unit.

Teachers needed to comprehend how they accessed the curriculum through a common secure website on the Internet. For many teachers in schools, the content was downloaded and stored on the school network facilitating ease of access. Updates to the state curriculum materials would be immediately available to all teachers across the state when published online. At the time of this study, the state curriculum materials had been through a number of revisions. Digital technologies have allowed for easier storage and use of the curriculum as they can be searched, copied and edited using tools available on the teachers’ laptops. They can be shared with teachers with a common layout across all subject areas and are easily handed over to the next teacher where they can interpret what they need to teach the topic at that school and modified to suit the needs of the next group of students. If they choose, teachers no longer have to interpret the curriculum and implement it in their own way, as now there starting point is the state curriculum materials. What is significant is that comprehension for planning and implementing now has a significant expectation that they understand how to use the digital technologies in order to access, change and manage the curriculum materials.

There were four participating teachers, where the state curriculum materials were not pertinent to the data: Donnatella teaching Year 10 Computer Studies; Florentina and Carmelina teaching early years curriculum with students aged 4-5 years old; and Carmelina with her learning contract in her eLearning class. Donnatella’s Head of Department recommended her curriculum topic for computer studies, as this was a subject that was offered at her school to encourage students to study digital technologies in the senior years. She began with searching the Internet to determine the best way to teach her students the topic using a new software program. She had not used the software previously so she researched a variety of online tutorials and completed them in order to understand how to use the software and to decide what she could teach her students. Her comprehension began with researching and then learning what she had to teach. Florentina and Carmelina were described in a prep classroom where Florentina was teaching science through an online wiki project she had established. Carmelina taught the pre-schoolers specifically how to read with digital technologies. This extended what the students were learning with their regular
classroom teacher. In order to comprehend what was suitable for reading, Carmelina investigated eBooks to determine their suitability for her young students. In Carmelina’s second example with Year 5 students, she used a learning contract to let students negotiate their learning and she needed to understand and teach her students how to use MSOneNote. Both teachers needed to understand how to use the digital technologies for teaching and learning in order to decide what to teach their students and how to use or enable access to the digital technologies.

An important consideration in comprehension is in understanding the school culture and its influence on the approach for the implementation of digital technologies. In the schools of the participating teachers, there were various approaches to the use of digital technologies. Rome PS, although a long user of digital technologies, had many teachers that relied on Carmelina’s role to teach digital technologies with their students, as separate from subject learning. Viviana worked in a school where digital technologies were limited to computer labs and access to the Internet was slow and unreliable. The teachers in the maths department were not frequent users of digital technologies but were interested to understand how she was using it for teaching. Donnatella taught computer studies as a separate subject with the goal of engaging students in learning. Marcella worked in Venice College where they had operated a student laptop program in the senior school and were moving to a BYOD across the whole college. Many of this study’s teachers were pioneering the implementation of digital technologies within their schools and were influential in changing the culture to allow for a growing use of digital technologies. The assertions from comprehension are summarised in Figure 7.32.
Figure 7.32 - Summary of assertions - Comprehension

**Transformation**

A summary of the transformation processes for the participating teachers is shown in Table 7.29. For many, transformation began with preparation where the majority of teachers modified the state curriculum materials to make it suitable for teaching for their class except where the state curriculum materials were not available. For Drago, Viviana, Carmelina, Alessandra and Marcelia, they needed to select from the state curriculum materials the topics they wanted to teach and produce a modified version of the state curriculum materials that was stored as their planning documents. They did not need to check the content or find new content, as the state curriculum team had already done that for them.

In order to transform their content for teaching, their first step in the transformation process was thinking what would suit their students and what was possible in their classrooms – that is their adaptation and tailoring. Drago, Carmelina and Alessandra modified their state curriculum materials to suit a specifically designated eLearning class that they were each responsible for. In many cases, this meant adding to the state curriculum materials to include more student oriented and accessible digital technologies. Their transformation was in making the content suitable for their students, such as Viviana reviewing her content to identify what to teach to her low achievement students to prepare them for an exam. Her transformation also began with thinking about her students to select the most suitable material that she could teach in the timeframe. Marcelia began her transformation where she selected two interesting activities (Café-To-Go and MuseumBox) for her students to complete to
Table 7.29 – Cross case comparison – Transformation

<table>
<thead>
<tr>
<th>Case</th>
<th>Preparation</th>
<th>Representation</th>
<th>Selection</th>
<th>A&amp;T</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EARLY CAREER</strong></td>
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<tr>
<td>Drago</td>
<td>Modified state curriculum materials - unit and lesson plans (for 2 classes).</td>
<td>LMS. Email communication.</td>
<td>Cooperative learning. Quizzes with immediate feedback. Daily email communication.</td>
<td>Y7 eLearning and standard class at Rome SC.</td>
</tr>
<tr>
<td>Viviana</td>
<td>Modified state curriculum materials. HOD supplied.</td>
<td>Question/answer.</td>
<td>MSPowerPoint presentation. Write questions and answers in book.</td>
<td>Y10 mathematics students at Genoa SHS.</td>
</tr>
<tr>
<td><strong>EXPERIENCED</strong></td>
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<td><strong>LEAD</strong></td>
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</table>
extend or deepen their learning in history. She, like Drago, Carmelina, Alessandra and Viviana, started with the state curriculum materials and adapted and tailored it for the students.

Drago described how he needed to teach two separate Year 7 classes the same science topic. He began his transformation with the state curriculum materials and designed learning activities utilising the use of student laptops. This enabled him to plan for a variety of digital technologies including the learning management system, email and presentations. He was able to select from a variety of instructional strategies that enhanced his approach. For Viviana, her head of department had already modified the state curriculum materials for all Year 10 teachers in the school mathematics department. Then specific to her teaching role, she was to interpret the materials to identify the most suitable ways to teach her lower mathematically skilled students. She did not need to select or check the validity of the content; her major task was to determine the best way of representing the content and selecting the most appropriate teaching strategies to engage her students and manage their behaviour.

As Donnatella did not have state curriculum materials to use for teaching how to use Adobe Flash, she prepared her content including checking its validity and making it suitable for teaching. She searched the Internet to find suitable tutorials that her Year 10 students could access to supplement their learning. From the tutorials she was able to prepare a student workbook with a number of tasks that the students could complete over the duration of the unit. She selected a follow-along demonstration as her main teaching strategy. She did not have curriculum documents to identify the goals she needed to achieve and the previous teacher left little documentation of their planning for her to understand what Year 10 computer studies had completed previously. Her transformation provided a rich view of her preparation, representation and selection.

Carmelina’s role required her to work with all prep students to support their classroom learning with their regular teacher. To do this she had decided to deliver content that focused on improving the reading skills of the prep students through the use of digital technologies. She had selected the best eBooks that she could download for access in the computer lab and prepared an MSPowerPoint presentation with hyperlinks to enable easy access to each eBooks. In making it suitable for learning, she simplified the access in order for her young students to be able to navigate to the
eBooks in order to read them. She did not need to teach how to use MSPowerPoint but used a demonstration strategy to show her young students how to access the eBooks. She encouraged the students to help each other solve any technical issues that arose, before asking her.

Florentina established an environmental study project where she enabled her class to join other classes from around the state regardless of student year level. They explored their class and the other class's environment through the use to digital photographs taken by the students complemented with a text description that explained the reasoning for the inclusion of the photograph. She took steps to ensure the content would be suitable, she set up the project, and then advertised for participants. She upgraded the platform moving to a secure wiki environment that all schools could access easily from the Internet. During the videoconference session with another class, students were able to ask questions to each other to encourage a deeper understanding of environments. Florentina’s transformation did not focus on the content but with building a structure to capture content that she could use.

In the same way, Alessandra used her ‘Reading Stamina’ activity to encourage students to read more books and used digital technologies to capture content in a predefined template that could be explored further to deepen student understanding. By allowing students to self manage their reading experience and by capturing their learning in MSOneNote, she allowed her students to develop a better understanding of the books they were reading and a chance to discuss that understanding with their peers with little teacher intervention.

Marcelia used the Internet to find content on animal lifecycles as a stimulus to share with her young students to provide them the inspiration to develop a Claymation movie. She allowed her students to explore their resources, digital and non-digital, to find the lifecycle that they could then describe in a story that was used as the basis for their Claymation. Marcelia did not focus on the content, but on the students to enable them to develop their own content (with adult support) that could be shared through the Claymation. Digital technologies allowed for the collection of content, the development of the template that was used to prepare their storyboard and then capture their understanding through audio recoding and photography for creating the Claymation movie. The assertions from transformation are summarised in Figure 7.33.
A summary of the participating teachers instruction is shown in Table 7.30. All teachers retrospectively described their teaching through the video-stimulated recall interview or their digital portfolios. The video captured for the interview recorded the teachers during active teaching to understand: how they organised and managed their classrooms; the classroom communication they used; how they assigned work and checked on progress; and how they interacted with the students. It is important to remember that instruction includes elements of evaluation that actively occur inside the classroom and transformation when the participating teacher was required move from their planned approach.

All classrooms included digital technologies for teachers to use but not all were resourced to facilitate students’ use of digital technologies for learning. All teachers had school supplied laptops and worked in environments where there was cabled and Wi-Fi networks. Florentina, Carmelina, Alessandra and Marcelia used interactive whiteboards in their classrooms with Marcelia sharing that she did not know how to use the software to operate the interactive functionality of the interactive whiteboard. All teachers used their laptops to perform their administrative duties during active teaching for example marking the roll or accessing student information. Also, the laptop was used to prepare and present the content; or to access MSOneNote files, the learning management system, the Internet or videoconference websites. They used the central projection screen to show students what work they needed to complete and how to complete it.
Chapter 7: Results from the cross case analysis of the seven teachers

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<tr>
<th>Case</th>
<th>Organisation and classroom management</th>
<th>Classroom communication</th>
<th>Assigning and checking work</th>
<th>Interacting with students</th>
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All teachers used digital technologies to help manage their students’ behaviour by showing them on the projected screen their content and their tasks. Donnatella
showed the work for students to follow along with the tutorials recorded in her workbook. Drago used the projected screen to show what students needed to do to ensure they knew the requirements of the task. Viviana used the projected screen to enable her to face her students. She only wrote when she needed to explain her working or add another problem for the students to solve. Carmelina used MSPowerPoint as the access tool to the eBooks for her young students to limit the technological knowledge they needed. Marcelia assigned groups when the students walked in the door to ensure students were working where she wanted them to work. Alessandra used ABTutor to manage what was on her students’ screens where she could privately message them if they were off task where her students understood she used it as a tool to ensure they were doing the right thing.

Donnatella, Drago, Carmelina, Alessandra and Marcelia included activities where students used their computers to access content or produce materials for learning. Marcelia used the computers that were available in her room but Drago, Carmelina and Marcelia worked with students who were participating in the eLearning program. Carmelina and Alessandra used MSOneNote, while Drago used the learning management system for teaching, assigning work and checking progress. Drago’s restory of teaching in two different classrooms, highlighted how digital technologies advantaged his students. Donnatella was assigned an art classroom that had a range of old computers that were set up around the perimeter of the room. Not all worked and she was in a continuous process of problem solving to make them ready for student use. Marcelia had a bank of laptops and a number of desktop computers and had to move a group of students from the laptop to a desktop in order for them to participate in the Café-To-Go activity, as the laptop wouldn’t allow the students to logon. Instead of helping resolve the issue she moved them to another form of digital technologies to be able to participate. Viviana’s school had received laptops for student learning but they had not, after six months, been set up for classroom use but she questioned how she would be able to use them for learning with her challenging students. Florentina had a variety of digital technologies in her classroom, some she had personally purchased and others supplied by the school. Her personal equipment included an iPod that she allowed students to use for taking digital photographs.

To check on progress, all teachers moved around the room to work with individual students or groups. By presenting the task requirements on the electronic
whiteboard, teachers were available to facilitate their students as they completed work. They did not need to spend all of the time at the front of the room writing content or instructions on a whiteboard. All had prepared their content ahead of time: Donnatella’s with her workbook, Drago with his science presentation, Viviana with the mathematics presentation, Carmelina with her eBooks and MSOneNote, Florentina with the wiki, Alessandra with MSOneNote and Marcelia with the MSWord document on the school intranet and setting up MeetingWords.

Their use of these technologies freed them to move around the room interacting with their students to ask and answer questions, remind them of behaviour management routines, check responses and provide feedback to individuals, groups or the whole class. Alessandra was the only teacher to use digital technologies to award or deduct points on her ClassDoJo. She projected the screen onto the interactive whiteboard, where all students’ avatars were shown and their tally of points. As she moved around the room she awarded students by giving them points when they were doing as she requested. As she shared the ClassDoJo with their parents, Alessandra was able to give immediate feedback on their performance in the class. Drago used digital technologies to share what one student had found and thought it worthy to show the whole class. He called this emergent and incidental learning. He asked the students to operate his laptop, connected to the interactive whiteboard, and show the whole class thus providing him with the opportunity to engage the class in a discussion. In the discussion, Drago posed questions to the students and challenged them to find the answers with many actively participating in the discussion and using their laptops to search for answers.

The digital technologies did not work as planned for all teachers. During each participating teacher’s observed lesson and explored further in the interviews that followed, each articulated his/her thinking when the digital technologies did not go as planned. Donnatella first explained how she wanted to use Internet tutorials for the students to access during the class but she had not tested the access with a student logon. A student quickly highlighted that they could not open the website she selected and Donnatella had to think quickly to decide what else could she do. She had a student computer that would not log on and she checked the computer to discover the blue cable had been disconnected, a strategy some students used at her school by removing the blue cable to stop the computer from being able to logon to the network.
to avoid doing work. She had to identify possible solutions to ensure that she had an adequate number of computers for all of the students to be able to complete their work.

Viviana embedded YouTube videos in her MSPowerPoint presentation but in the classroom the videos failed to fully load in time and kept playing segments of audio while continually trying to download more content. In the end she had to abandon the video as the technology failed and she continued with the lesson ignoring that aspect. Viviana’s school Wi-Fi and Internet was notoriously slow and unreliable to use in the classroom. Marcelia experienced the same problem where the MuseumBox failed to load at the time she was showing the students what they needed to do. Marcelia attempted to problem solve the issue but quickly moved on to showing her physical example that she had prepared earlier. Finally, Florentina wanted to run a videoconference to join another class but the school was temporarily unavailable because of a fire evacuation drill. The technology did not fail in this case but it forced Florentina to change her plans instead of making the class wait with nothing to do. She quickly determined three activities that could work on while she contacted the other class to find out why they were unable to attend. In all of these situations the teacher needed to quickly transform their planned learning to a new approach that could work at the time to not allow the technological failure to interrupt learning. The assertions from instruction are summarised in Figure 7.34.
**Figure 7.34 - Summary of assertions - Instruction**

**Evaluation**

A summary of the participating teachers evaluation is shown in Table 7.31. During instruction, all teachers moved around the room to check on student progress. They asked individual students direct questions, questions to groups and questions to the whole class. For Donnatella, Drago, Carmelina and Alessandra those questions were focused on the student use of digital technologies as they completed their tasks. Though, Drago and Alessandra used questioning to further explore student thinking. Alessandra used AnswerGarden to encourage all students to participate in answering what they thought about an ethical dilemma. Through this digital tool she was able to get all students to participate even the quiet students. Through this process she quickly gained an understanding of what the class understood about the topic. It was captured electronically and stored for future reference.

**Assertion In1**: Organisation and classroom management become different when using digital technologies for teaching and learning.

**Assertion In2**: Teachers will use a variety of digital technologies for assigning and checking student work.

**Assertion In4**: Evaluation during instruction will include class, group and individual verbal questioning, physically checking computer screens for work and using digital tools for sharing progress.

**Assertion In5**: Transformation during instruction occurs when digital technologies do not go as planned where teachers temporarily change learning activities to either: wait for the digital technology to catch up, ignore the digital technology component and adapt the plan with a completely new approach.
Drago used a class discussion to gauge student understanding but noted the difference in participation by his eLearning students as opposed to the other class. His eLearning students were able to use their laptops to search for more information
independently that they could add to the discussion therefore extending the discussion. The digital technologies allowed him to project what he was doing on the screen while explaining his thinking out loud and the students used their laptops to complete their own searches and contribute what they found to the class discussion. During the lesson Drago was able to ask his eLearning students to email their work for him to review but for the other class he needed to collect their workbooks to be able to check their progress. Drago also used an online quiz to check for student understanding that was offered through the learning management system.

During instruction, Alessandra used her students to evaluate each other as part of the reading stamina group. Each day the students would post questions in their group OneNote that would be discussed in class on the Friday. Alessandra facilitated the process where students complete their own evaluation of the books they were reading with notes of what they were doing captured in MSOneNote where Alessandra could review after instruction to check on progress, provide feedback and use for grading. Viviana prepared a maths warm up for the start of each lesson where she reviewed the work completed in the last lesson through a series of questions that the students answered. She made it a game, where the students worked through the questions to be the first to find her deliberate mistake.

All teachers completed some form of evaluation after teaching through checking student work online, assignments, an examination, digital photography or making notes about student work. Feedback was given in class to students individually, in groups or to the whole class or through email as annotations to shared student work. Teachers described how they used their students’ work to make judgements for reporting.

In evaluating their own performance, the seven teachers explained where they had to deviate from the plan: Donnatella where the students were unable to access the online tutorials; Viviana where the YouTube video was too slow in loading; Florentina when the other school was unable to join the videoconference; and Marcelia when the museum box was taking too long to load on the screen. Drago shared a reflection important for evaluation, in that it highlighted how digital technologies gave his eLearning students an unfair advantage because they were able to produce better quality work and it was unfair to compare their work to the other students when awarding grades. Marcelia reflected that for the creation of her Claymation movie
there was a heavy reliance on her to complete all of the MSMovieMaker tasks. The assertions from evaluation are summarised in Figure 7.35.

**Assertion E1:** Evaluation-during-instruction involves verbally checking for student understanding/misunderstanding and managing behaviour in the classroom.  
**Assertion E2:** Evaluation-after-instruction includes a variety of approaches where most teachers organised for their students to use digital technologies to prepare and submit assessment.  
**Assertion E3:** Teachers use digital technologies to access a history of work for making fair assessment decisions.  
**Assertion E4:** Teachers use digital technologies for marking, reporting and providing feedback to students during and after teaching.  
**Assertion E5:** Teachers use digital technologies to provide more individualised feedback more often.

**Figure 7.35 - Summary of assertions - Evaluation**

**Reflection**

A summary of the participating teachers reflection is shown in Table 7.32. Aspects of their reflections about using digital technologies were captured throughout their video-stimulated recall interview. A second source was from the teachers that had previously prepared a digital portfolio for their studies or their employers, where they reflected on how they used digital technologies for teaching and learning. For the digital portfolio, teachers documented the skills they developed, why the task they included was worth doing and further reflection for each item of evidence mapping them against their professional knowledge, practice, values and relationships. One example taken from Marcelia’s digital portfolio highlighted the importance of her developing professional values through her investment in learning to use the systems and software and then she had moved to sharing that knowledge to influence other teachers in the use of digital technologies at Venice College. The final source of data emerged in the concept map think-aloud interview where teachers reflected on the challenges they face in using digital technologies in their classrooms.
Donnatella and Florentina reflected how they needed to identify ways to work around digital technology problems they experienced in their classroom; Donnatella in terms of the online tutorials she selected; and Florentina in using the videoconference to join other classes. Donnatella, Viviana, Florentina and Marcella all reflected on new knowledge and skills in using digital technologies they had developed in order to teach students how to use the digital technologies in the classroom. Marcella reflected how she combined physical and digital based activities to deepen students learning of
history. Carmelina shared how she observed how her young students were able to help each other solve digital technology problems of when accessing the eBooks through MSPowerPoint. Carmelina reflected that the development of the learning contract for differentiated learning was successful and reusable but next time she would select a smaller focus. Drago’s reflection focused on teaching the same content to two different classes with one being his regular eLearning class. He shared that he believed his eLearning students were advantaged because the quantity and quality was greater than the students that had to complete the same task in the workbooks. A difference that he felt was going to be seriously examined by the school community. Alessandra reflected that digital technologies allowed her to capture a history of evidence of student learning to be able to judge her teaching effectiveness.

In relation to the learning, all teachers reflected on how students were engaged in the learning tasks. Donatella was able to engage her students with the ‘follow along’ demonstration and her workbook and she reflected that from that engagement she was able to collect assessment from the students. Drago found that with the regular use of laptops, his eLearning class was able to produce better quality work, which made marking assessment unfair for students that did not. Viviana used her digital technologies in the classroom to help in managing behaviour and she reflected that it was an effective strategy that allowed her to incorporate the use of the warm up activities with a deliberate error that the students enjoyed finding and bringing it to the attention of the class. Carmelina reflected that she was frustrated that students could not access YouTube videos and so had to advise her students to access the material at home. She also reflected that the students enjoyed working through the learning contract with some students completing their required formal tasks at home in order to be able to complete the extension or more entertaining activities with their peers in the classroom. Florentina reflected that her students enjoyed participating in the wiki project and they were capable of using a range of digital technologies. Alessandra reflected that her ‘Reading Stamina’ activity was very successful in getting students to read at a deeper level in order to challenge other students to do the same. She discussed how eager they were for their weekly meetings and how little effort it was to facilitate them through the process. Marcella reflected how impressed she was with the skill level of her young students when they engaged in the Claymation movie.
process. This reflection will inform her future practice to identify some students that could take more of a director's role leaving less free to spend time with other students.

For these teachers, there was no regular formal reflection process during their regular to capture and share their reflections. Some completed a digital portfolio where they shared their practices and reflections to describe how they used digital technologies in the classroom. They carefully selected items of evidence that was used to map against the professional values, knowledge, relationships and practice. Another teacher, who assessed the quality of the content and read all responses, to ensure that all professional values, knowledge, relationships and skills were adequately described moderated all of the digital portfolios. In this process of moderation the teachers would discuss their reflections on teaching the item and in preparing the DPL. Viviana and Donnatella's teacher education digital portfolios included some reflections of their teaching in mapping their responses to the professional teaching standards. The assertions from reflection are summarised in Figure 7.36.

**Figure 7.36 - Summary of assertions - Reflection**

**New Comprehensions**

A summary of the participating teachers new comprehensions is shown in Table 7.33. As with reflection, evidence of the participating teachers new comprehensions were shared through the video-stimulated recall interview and their digital portfolio. The participating teachers' new comprehensions were described in terms of purpose, subject, students and pedagogy.
### Table 7.33 – Cross case comparison – New comprehensions (NC)

<table>
<thead>
<tr>
<th>Case</th>
<th>NC – Purpose</th>
<th>NC – Subject</th>
<th>NC – Students</th>
<th>NC - Pedagogy</th>
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<td><strong>EARLY CAREER</strong></td>
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All of the participating teachers described how they had new understandings of the purpose of using digital technologies in their classrooms. For all, except Viviana, their new comprehensions were based around students developing digital literacies.
Donnatella described how her students engaged in learning about Adobe Flash while Drago, Carmelina and Alessandra described new comprehensions about student engagement in an eLearning classroom where all students were using laptops. Carmelina described how she had developed new comprehensions of managing differentiated learning through the use of the learning contract. Florentina and Marcelia describe how they had developed new comprehensions about the benefits of class collaboration and sharing of student work. Florentina joined other classes involved in the wiki based online project and Marcelia in preparing the Claymation that she was able to share with the school community through the presentation to staff, at the college assembly and on the open day. Lastly, Viviana’s new comprehensions focused on how she taught mathematics to challenging students.

All of these teachers developed new comprehensions about the content they taught. Donnatella did not need to be an expert in Adobe Flash to teach her Year 10 Computer Studies’ students. Viviana used digital technologies for teaching mathematics and managing student engagement. Drago encouraged his students to use their laptops to independently explore more answers and questions as part of his approach for incidental learning. Carmelina taught reading through eBooks and differentiated learning in mathematics and English through the learning contract. Florentina used her online wiki project to teach about environments and her robotic BeeBots to explore maps. Marcelia taught science through the development of a Claymation movie and history through a museum box. All teachers developed new comprehensions about using digital technologies for teaching their content. The exception was Alessandra who described how she moved to an eLearning classroom that allowed her to capture more student work, to provide timely feedback to students and provide a solid foundation for her grading decisions. The electronic storage of this work allowed her to be able to review student work to understand what engaged her students.

All teachers, except Viviana, developed new comprehensions about their students and their ability and confidence of using digital technologies for learning. Donnatella saw the confidence of her students grow in learning how to use Adobe Flash, her new comprehensions was about the examples she asked them to create and giving them choice next time. Drago, Carmelina and Alessandra shared how they had developed new comprehensions about eLearning and how their role changed from teacher to facilitator as students had increased confidence in using their digital
technologies to complete their work individually or in a group. Carmelina shared how she had developed new comprehensions in how her young students were able to manage their reading when working with eBooks. Florentina allowed her students to explore the use of BeeBots after they had built an elaborate map of wooden block on the floor; she was discovered how it engaged the students and how they were able to manipulate the BeeBots without formal instruction. Marcelia shared how her new comprehensions of her students: how some were more capable with the digital technologies and could take on a role of director next time. Viviana described how she developed a better understanding of how to manage and engage her bad behaviour students in learning mathematics.

Many of the teachers developed new comprehensions after experiencing dilemmas in the classroom. Donnatella did not want to rely on using online tutorials for teaching software. Donnatella learnt that she needed to link her workbook to assessment in order to be able to use student work when deciding grades as some students were unreliable in submitting assessment. Drago developed new comprehensions about teaching two different classes: how the regular use of digital technologies advantaged his eLearning students as they produced more and better quality work when typing it into MSWord instead of hand writing in a workbook. Viviana developed a new comprehension about using YouTube in the classroom, as it was unreliable in downloading the file during teaching. Marcelia learnt that the online museum box library was unreliable in showing students different examples. She already anticipated that her students could not use the website to create their own online museum box before changing to a physical version she could hang in the classroom.

Many teachers developed new comprehensions of their pedagogy after successfully using digital technologies. Viviana believed that a mathematical based warm up activity that she was able to project on the screen was the best way to prepare her challenging students for learning. Marcelia believed that the virtual classroom that she set up through a slow process of understanding in how to use the tool would change how she used virtual classrooms in the future as she saw the benefits for her young students and their parents in exploring the learning objects outside the classroom. Florentina saw the benefits of setting up an online wiki project
that allowed her class to explore other classrooms across the state. The assertions from new comprehensions are summarised in Figure 7.37.

**Assertion NC1:** Teachers new comprehensions emerge from the focus on the use of digital technologies for teaching and learning  
**Assertion NC2:** New comprehensions cover three knowledge base areas: content, learners and general pedagogy  
**Assertion NC3:** New comprehensions emerge because of dilemmas experienced in using digital technologies for teaching and/or learning.

**Figure 7.37 - Summary of assertions – New comprehensions**

**RQ2: What are the differences in pedagogical reasoning with digital technologies across three career stages?**

Each stage of pedagogical reasoning will be examined to understand differences in career stage identified in the teacher case studies. The cross-case comparison is presented organised by career stage along with a summary list of assertions gained from the data analysis. The assertions will be explored in the next chapter – Chapter 8 - Discussion and Conclusions. The seven participating teachers were selected based on their career stage and whether they were early career, experienced or lead.

**Comprehension**

All of the teachers described how they comprehended their materials including how they used a variety of digital technologies for teaching and learning. For some, a major aspect of their comprehension was in identifying and gaining an understanding in the digital technologies they were going to use for teaching and learning. For example, Carmelina, an experienced teacher, described how she needed to learn how to use MSOneNote in her eLearning class while Donnatella, an early career teacher, learnt to use Adobe Flash. In order for them to effectively use the tools, they needed to comprehend how they worked and how they could be used for teaching and learning. All required that they developed new understandings of the digital technologies in order to use them for teaching and, for some, learning.
For the early career teachers their comprehension included getting to know their schools, their students, their classrooms, the resources available and the culture towards the use of digital technologies, as well as the education system that they joined. Alessandra and Carmelina, being in the same school as Drago, were mentoring Drago. Donnatella and Viviana were some of the first teachers in their school in using digital technologies that were available to them. Both Donnatella and Viviana were aware of the online state managed tools but only Drago was able to use for them for teaching and learning.

All participating teachers worked in the state education system and accessed the state curriculum materials through the same technological infrastructure available to them. In the case study of Donnatella however, the subject she was teaching did not have state curriculum materials to help her. One noticeable difference between the three early career participating teachers and the four experienced and lead participating teachers was that the former were learning to teach their topics for the first time. All three had not taught their units previously to the same year level of students. For example, Donnatella shared how she had to learn how to use Adobe Flash before teaching it. For Drago and Viviana, the state curriculum materials enabled them to develop new PCK and TPACK.

A discernable difference between the two experienced and two lead teachers was the particular responsibilities that the lead teachers had in their schools. Alessandra was leading the implementation of eLearning classes and Marcelia was helping the college move to a BYOD program. These teachers were instrumental in setting up these programs to influence how their respective schools' teachers would in the future use digital technologies for teaching and learning. This change in their local digital education landscape would have ramifications for the comprehension practices of all teachers by extending the curriculum to accommodate for eLearning and BYOD. The assertions are summarised in Figure 7.38.
Most of the participating teachers were able to begin transformation with the state curriculum materials where, in preparation, they modified the materials to suit how they were going to teach the topic to their students. In preparation they all used their digital technologies to access the curriculum except for Viviana as it was given to her. For those teachers that used the state curriculum materials, they did not need to check the validity or content, they just needed to make it suitable for teaching. The teachers showed a range of digital technologies they decided as their representation. They all used digital technologies for teaching and learning except for Viviana as her students did not have access to student laptops. For selection, the more experienced teachers showed a more sophisticated use of the digital technologies, for example, Carmelina using MSpowerPoint as a tool linking eBooks for easy access for young learners. Carmelina and Alessandra used MSOneNote as a central tool for teaching and learning, though Alessandra first implemented the idea. The assertions are summarised in Figure 7.39.

**Assertion CS-C1**: Teachers, regardless of career stage, need to understand how to use digital technologies for teaching and learning.

**Assertion CS-C2**: Early career teachers need time to comprehend their context in order to use digital technologies successfully.

**Assertion CS-C3**: Teachers who meet the experienced and lead career stages should effectively mentor early career teachers helping them where needed to continue to develop their understanding of digital technologies for teaching and learning.

**Assertion CS-C4**: Teachers who meet the lead career stage will lead change related to digital technologies for teaching and learning in their school.

**Figure 7.38 - Summary of assertions – Career stages – Comprehension**

**Transformation**

Most of the participating teachers were able to begin transformation with the state curriculum materials where, in preparation, they modified the materials to suit how they were going to teach the topic to their students. In preparation they all used their digital technologies to access the curriculum except for Viviana as it was given to her. For those teachers that used the state curriculum materials, they did not need to check the validity or content, they just needed to make it suitable for teaching. The teachers showed a range of digital technologies they decided as their representation. They all used digital technologies for teaching and learning except for Viviana as her students did not have access to student laptops. For selection, the more experienced teachers showed a more sophisticated use of the digital technologies, for example, Carmelina using MSpowerPoint as a tool linking eBooks for easy access for young learners. Carmelina and Alessandra used MSOneNote as a central tool for teaching and learning, though Alessandra first implemented the idea. The assertions are summarised in Figure 7.39.
Instruction

The first noticeable difference in this study was in relation to the digital technologies available in their classrooms. For the three early career teachers, Donnatella and Viviana, were allocated classrooms where there was no interactive whiteboard: Donnatella in a converted art room; Drago a demountable building; and Viviana an older mathematics classroom. Both Alessandra and Marcella, the experienced teachers, were involved in making digital technology investment recommendations at their schools, which allowed them access to more Internet digital technologies that they could use in teaching. Alessandra explained how she was able to arrange for the purchase of an interactive whiteboard and new furniture for her classroom. The teaching strategies used by the teachers were similar although the more experienced teachers were more sophisticated in assigning and checking work.

The assertions are summarised in Figure 7.40.

**Assertion CS-I1:** More experienced teachers tend to have access to better classrooms with more reliable digital technologies.

**Assertion CS-I2:** More experienced teachers used digital technologies for teaching and assigning and checking student work.

Evaluation

For the evaluation that occurred during the lesson (or evaluation-during-instruction), all teachers exhibited a similar approach, with the exception where the lead teachers selected digital technologies to evaluate student work during the lesson. For example, Alessandra used AnswerGarden to encourage all students to participate and Marcella used MeetingWords to capture student thinking. In both cases, the teacher or the students could revisit it, as they created a permanent record of the
interaction. Drago used an online quiz to check for student understanding with feedback available to the student. All teachers shared how they used a variety of different approaches to evaluate students after instruction had been completed, all evaluation included students using digital technologies, except for Viviana in mathematics, as there was a paper-based exam for all classes. The assertions are summarised in Figure 7.41.

**Assertion CS-E1:** Lead teachers use digital technologies for evaluation-during-instruction.

**Figure 7.41 - Summary of assertions – Career stages – Evaluation**

**Reflection and New comprehensions**

All participating teachers shared reflections on their teaching and learning, but the early career teachers reflections focused on managing student behaviour in the classroom with a less emphasis on checking for student understanding. Both experienced and lead teachers were responsible for mentoring teachers. This was evidenced in their digital portfolios, plus they shared how they had responsibility for running professional development with other staff at their schools on using digital technologies. The difference between early career and the more experienced teachers new comprehensions reflected the transition from developing confidence in teaching to refocus on student learning. The experienced and lead teachers new comprehensions reflected their increased knowledge and confidence of using new digital technologies. The assertions are summarised in Figure 7.42.
RQ3: What influences teachers when they pedagogically reason with digital technologies?

Influences across the case studies were classified as either internal or external to the teacher. Internal influences focused on their professional knowledge and mindset while external influences focused on their school and the education system. A cross-case comparison for the internal and external influences is discussed along with a summary list of assertions gained from the data analysis. The assertions will be explored in the next chapter – Chapter 8 - Discussion and Conclusions.

External to the teachers

In analysing the data collected for this project, there were a variety of external influences described by the participating teachers. These influences have been included in the restories provided for each teacher and are important to understanding the context in which they worked. External influences are divided into two groups based on contextual view. First, is the school in which the teacher works, where specific factors either helped or prevented them in using digital technologies for teaching and/or learning. Second, is the state education system, where all participating teachers were employed, and so across the cases the teachers shared how they used the range of the state supplied digital tools for teaching and/or learning.

A summary of the participating teachers external influences from their schools is shown in Table 7.34 where positive influences are recorded as enablers (E) and negative influences recorded as barriers (B). All of the participating teachers described how their schools had invested in digital technologies and how they were using digital

Victoria L Smart, Doctor of Philosophy
Griffith University, 2016
technologies for teaching and learning. For Drago, Carmelina and Alessandra who worked at Rome PS, they had access to reliable digital technologies for teaching and learning in some classrooms. Alessandra’s role was Lead teacher; she had a major influence over how the technology budget was spent at her school. Donnatella and Viviana, were the only two to highlight how they had limited reliable digital technologies and they discussed how the digital technologies in their schools prevented them from exploring new digital technologies beyond what they had found worked in their classrooms. Viviana’s school had purchased laptops for student use however at the time of the study, she was still considering how she would use these in the future with her challenging students. Donnatella described how she used the digital technologies to teach her subject Computer Studies. The irony for this specific teaching focus was that these digital resources proved to be unreliable and insufficient if all of her students turned up for class. She described how there were no plans to move to a student laptop program in the future.

Table 7.34 - Influences from school

<table>
<thead>
<tr>
<th>CASE</th>
<th>School technology investment</th>
<th>Classroom digital technologies</th>
<th>School support for digital technologies</th>
<th>Other teachers</th>
<th>Students</th>
<th>Parents</th>
<th>Principal</th>
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<tbody>
<tr>
<td>EARLY CAREER</td>
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Many of the participating teachers discussed how they had used the technical support provided at the school with some teachers increasing their knowledge of digital technologies to be able to lead the technical support personnel or provide other teachers technical support. Donnatella remarked how other teachers had used her classroom for the computers, and were not diligent to ensure the students did not damage the equipment. She had complained so many times to the school administration and they installed a video camera in the room to deter students from damaging the equipment.

At Rome PS, Drago, Carmelina and Alessandra were supporting each other in using digital technologies. All teachers, except Donnatella and Viviana, had described how their principals had encouraged and supported their use of digital technologies for teaching and learning. Marcelia described how her principal had asked her to display the Claymation movie for the students, staff and parents to view on the open day. Where the school was using or planning to use student laptops, eLearning or BYOD, the teachers described how parents were keen for their children to participate in the program. Carmelina and Alessandra described how there was an over application by parents for their children to participate in the eLearning program when it was first offered. Drago, Carmelina and Alessandra all described how the use of digital technologies had changed how they interacted with the parents, as parents became more aware in a timely manner, of what was being taught, how their children were learning and how they might help their children.

From this, a number of assertions are proposed that summarise the external school influences in using digital technologies. From a school perspective, there are six assertions shown in Figure 7.43.
Figure 7.43 - Summary of assertions – External influences - School

A summary of the external influences from the education system is shown in Table 7.35. Donnatella and Viviana were the only two teachers to mention barriers in terms of using the Internet for accessing online tutorials that were restricted to students and downloading YouTube videos for teaching mathematics as the Wi-Fi in that building was unreliable and the bandwidth for the school too low. For Viviana the Wi-Fi could not cater for the demand of teachers at the school and the bandwidth was an ongoing problem that the school was discussing with the provider. For the other teachers, the state based education systems that they could access for teaching and learning enabled them to use student systems, the learning management and access the state curriculum materials without problems. Donnatella was not able to use the state curriculum materials, as it was not available for her computer studies subject. Most of the teachers had participated in the state run Smart Classrooms Professional Development Framework (SCPDF) professional development program, where many of the experienced teachers were recruited as accredited facilitators that mentored other teachers in achieving an accreditation. Viviana mentioned the positive influence of being exposed to digital technologies through her supervising teacher and lunchtime training offered at her practicum school.
From this, a number of assertions are proposed that summarises what the teachers shared about external education systems’ factors that enabled or limited them in using digital technologies. From the school perspective, there are four assertions shown in Figure 7.44.

Table 7.35 - Influences from education system

<table>
<thead>
<tr>
<th>CASE</th>
<th>Access to digital technologies</th>
<th>Access to Internet websites</th>
<th>Access to student management</th>
<th>LMS</th>
<th>State curriculum materials</th>
<th>SCPDF</th>
<th>Practicum experience</th>
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<td>EARLY CAREER</td>
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Internal to the teachers

Internal influences are divided into two groups based on the research. Firstly, the teachers' professional mindsets were clear when they shared details of their beliefs, motivations, previous experience and confidence of using digital technologies for teaching and learning. Secondly, the range and depth of professional knowledge of these participating teachers were evident as they explained their thinking when planning and using digital technologies for teaching and learning.

A summary of the participating teachers professional mindset is shown in Table 7.36. The participating teachers described how they had developed their confidence in using digital technologies for teaching and learning. All expressed a personal motivation and confidence of using digital technologies for teaching and all except Viviana shared their motivation for using digital technologies for learning. Viviana expressed a reservation of allowing her bad behaviour students to use digital technologies for learning – but this was linked to an external factor as the school had purchased a set of student laptops but they were yet to be set up.

All early career teachers and Alessandra, one of the lead teachers, had previous experience of using digital technologies in their previous careers that helped in their transition into teaching. All seven participating teachers shared how they believed that students wanted to use digital technologies and that they were capable of using digital technologies. Donnatella shared how she believed they wanted to use digital technologies but they were not capable of using the digital technologies without instruction. Viviana believed that her challenging students wanted to use digital technologies but not for learning purposes and she believed from experience in her school that they weren’t capable of using digital technologies for learning mathematics.

**Figure 7.44 - Summary of assertions – External influences – Education system**

<table>
<thead>
<tr>
<th>Assertion E-ES1</th>
<th>Teachers and students need access to a wide range of digital technologies available over the Internet.</th>
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<tr>
<td>Assertion E-ES2</td>
<td>The current state curriculum materials support the use of digital technologies.</td>
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<td>Assertion E-ES3</td>
<td>Teachers who prepare digital portfolios to describe the use of digital technologies are able to elaborate on their pedagogical reasoning.</td>
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<td>Assertion E-ES4</td>
<td>Pre-service teachers exposed to teachers who use digital technologies, will tend to use digital technologies for teaching.</td>
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</table>
Drago, Viviana and Carmelina shared how they believed that learning with digital technologies needed to be relevant. Carmelina aligned her technology specialist lessons with what the students were doing with their class teacher. The experienced and lead teachers were willing to mentor other teachers in using digital technologies.

**Table 7.36 - Influence from teachers professional mindset**

<table>
<thead>
<tr>
<th>CASE</th>
<th>Personal motivation to use DT for teaching</th>
<th>Personal motivation to use DT for learning</th>
<th>Confidence in using DT for teaching</th>
<th>Confidence in using DT for learning</th>
<th>Previous experience</th>
<th>Students want to use DT</th>
<th>Student capable of learning needs to be relevant</th>
<th>Willingness to mentor</th>
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</table>

From this, a number of assertions are proposed that summarise what the teachers shared about their professional mindset in using digital technologies with six assertions shown in Figure 7.45.
Figure 7.45 - Summary of assertions – Internal influences – Professional mindset

A summary of the participating teachers knowledge of digital technologies is shared in their data shown in Table 7.37. When looking at teachers professional knowledge there are two views: specific knowledge of digital technologies and the knowledge base for teaching that was developed from the research led by Shulman (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987). This first summary reports the differing types of knowledge of digital technologies the teachers used and then moves to the second summary discuss the knowledge base for teaching.

All of the participating teachers described how they used digital technologies for communication with other teachers, students, parents and the school administration. All teachers described how they used a range of digital technologies for teaching from the use of their laptop, an interactive whiteboard, accessing the Internet to find teaching resources, the curriculum, the learning management system and the state curriculum materials. All teachers had a working knowledge of using the Internet for teaching but not all demonstrated how they used the Internet for learning. Viviana and Florentina did not share in their data or digital portfolio how they engaged students in using the Internet for learning while Donnatella planned to use the Internet to access online tutorials but because she had not tested if the students could access the online tutorials she had to change her approach for teaching Adobe Flash. Drago, Carmelina and Alessandra used an extensive list of Internet based resources that they used for teaching and learning. Drago explained how he used the Internet for emergent and incidental learning where he talked students through his thinking how he used the
Teachers shared how they used a range of digital technologies for preparing materials, and presenting materials for teaching. All showed how they had repurposed their digital technologies for teaching, for example, Carmelina used MSPowerPoint as a tool for young learners to access eBooks. The hyperlinking functionality was designed for including links to documents or websites for presenting not necessarily for linking eBooks for young students. While Drago and Viviana used MSPowerPoint as a presentation tool to teach their content. Carmelina and Alessandra used MSOneNote as a tool for sharing content and capturing student work. MSOneNote is marketed, as a tool for people to use to organise notes, there is no mention of using it as a teaching and learning tool in the classroom. Carmelina and Alessandra would have an advanced knowledge of these digital technologies in order use it in way that it was not
designed to be used. The mix of digital technologies used by the teachers, suggests that some digital technologies were purposefully designed for education use (e.g. Spelling City, Matheletics, AnswerGarden, ClassDoJo) while other digital technologies were repurposed by teachers for educational use (e.g. MSOneNote for teaching and learning, MeetingWords for brainstorming, MSPowerPoint for eBooks, videoconferencing for connecting classrooms, MSMovieMaker for making Claymation, YouTube for online tutorials).

All teachers described their knowledge base for teaching with examples of their content, curriculum, knowledge of contexts and educational purposes. All worked in the state education system and were informed and prepared for implementing the current curriculum through the state developed curriculum materials. They described how they worked with various aged learners to develop their knowledge of learners and their motivations and confidence of using digital technologies. Donnatella worked with students who were interested in studying digital technologies and Viviana worked with challenging students where she used digital technologies to help manage to be able to manage their behaviour. Teachers used a variety of pedagogical approaches that used digital technologies for teaching and learning. Finally, teachers were able to describe many instances that highlighted their development of their PCK and TPACK from teaching and learning. An example from each teacher is presented and discussed in the following discussion.

Donnatella needed to teach a topic that would engage her students in the subject Computer Studies. She knew it would be a challenging class because it was a choice offered to non-high achieving students. Many did not regularly attend her class because of other commitments or they were absent from school. She did not decide the topic but her Head of Department recommended that she use the software available at the school and that the students should be interested in creating animated files in Adobe Flash. Donnatella needed first to learn how to use the software before she could teach her students. She accessed the Internet as there are a large number of free and easy to access online tutorials that people have created to share with anyone. In planning her unit, she used digital technologies to access suitable content, prepare her workbook that explained how she had planned to teach the unit. In the classroom, the students followed Donnatella through her demonstration as she completed the exercises in the workbook, as they could not access the online tutorials.
that she had recommended for them to use. The use of digital technologies meant that Donnatella was using her TPACK to determine the best way available to her to teach this unit.

Drago prepared his science unit where he intended to use digital technologies in many aspects of teaching and learning. It was not until he experienced the difficulties of teaching in the non-eLearning classroom that he had to revert to an approach where he did not use digital technologies for learning. As he had a laptop and there was a projector in the classroom, he was able to continue using digital technologies for teaching but because of his students’ lack of experience and confidence in using digital technologies he needed to change to allow them to write their work instead of using the laptop. The enactment of PCK and TPACK is complicated as it comes into play in teaching and learning depending on the use of digital technologies. As Drago was responsible for planning the unit, he did not simply add digital technologies to how they had taught it previously at the school, he was able to take a new approach that incorporated the use of digital technologies for teaching and learning. Drago initially planned his unit using his TPACK but after one lesson with the non-eLearning class he needed to think without thing if digital technologies modifying his approach to enable the non-eLearning students to cover the same content and not become overcome with the use of digital technologies. He displayed his ability to use his TPACK when thinking with digital technologies and his PCK when he needed to change his approach.

Drago demonstrated his unplanned but routine approach of TPACK-in-action or where digital technologies enhanced teachable moments. He explained how he used emergent and incidental learning to explore more while in the act of teaching. He described how a student had found some content worthy of sharing with the class. He asked the student to use his laptop to display the content on the projected screen. He used the opportunity to discuss the content with the students to emphasis what they needed to do for their assessment. During the discussion the students used their laptops to search for answers while he and the students posed and discussed questions relevant for learning. This small moment in this busy classroom provided the opportunity for students to explore his and their understandings of the content where digital technologies helped in sharing answers to questions that may not have been asked in order to develop a deeper personal understanding of the content. This
episode of pedagogical practice is significant in demonstrating the value to learning of the proficient use of digital technologies that was not available to the non-eLearning class.

Viviana used MSPowerPoint to teach mathematics to low achieving behaviourally challenging students. She explained how she used MSPowerPoint because it allowed her to include YouTube videos and it freed her from writing all content on the whiteboard so she did not have her back to the students. Using MSPowerPoint and YouTube was a new approach for teaching mathematics at her school. Considering her students, the classroom and the content she needed to cover, this is an example of how she planned with her TPACK in teaching mathematics. To engage her students she used a warm up activity as the first slide on her MSPowerPoint, where she had purposely included an error to test if they could find it. As this was the first activity they regularly completed when the class started, she was able to move around the classroom focusing on getting the more challenging students settled and doing work. Even the challenging students were engaged to find the error to be the first to advise the class. In preparing her MSPowerPoint presentation her enactment of her TPACK was pedagogically powerful in teaching mathematics to these challenging students. She was very good in managing their behaviour throughout the lesson but with the use of digital technologies she was able to move around the classroom to provide a more targeted and focused approach.

Carmelina had two very good examples of her enactment of her TPACK in teaching her specialist lesson and the eLearning class. For her young learners she used MSPowerPoint as a tool with hyperlinks in order for the students to easily access a number of eBooks. The students did not need to know how to use MSPowerPoint as a presentation tool, they didn’t need instruction on how to use a laptop as Carmelina had already set up the laptops for their use and demonstrated that use on the interactive whiteboard. Knowing her young students, their literacy needs, the books that would interest them and their abilities was an enactment of her TPACK in planning for using digital technologies for learning. Her second example describes how she used the learning contract to help eLearning students negotiate their learning to cater for different learning levels and the school approach for differentiated learning. Carmelina was able to embed all teaching and learning in MSOneNote with her planning she creating the MSOneNote template and embedded how to use
MSOneNote as part of the process. Her role in the classroom changed from teacher to facilitator where she worked with individual students to check learning and manage progress. Within the MSOneNote were activities that students could email as tasks or assessment to allow Carmelina to provide feedback and it also incorporated the links to websites that managed spelling and mathematics tasks where all was used to help her in assessing student performance. Both examples highlight her TPACK in planning tasks that incorporated the use of digital technologies for teaching and more importantly student learning.

Florentina developed an online wiki project on differing environments that she shared with teachers all across the state, regardless of year level or subject as the teacher could determine how it was used in their classroom. Florentina used it to help her young students understand different environments where, through videoconferencing other classrooms, the students could ask questions about the environment. When the class was unable to join the videoconferencing session as described in her restory, Florentina organised the students to work on three different activities. The students drew maps on paper, traced maps on the interactive whiteboard and built maps on the floor where the map on the floor was used as a racetrack where the students programmed the BeeBot to race around the track. Florentina planned with her TPACK but used her PCK-in-action when she needed to give the students new activities while she could investigate why the other class was unable to attend the videoconference.

Alessandra used MSOneNote in the same manner as Carmelina’s learning contract. One specific use highlighted how she combined her PCK and TPACK for teaching reading. In using MSOneNote she was able to capture electronically the students engagement in reading stamina. She gave them a central place where all students could access, to ask and answer questions about the book they were reading. Not only did this task engage the students in reading but developed a passion for reading as they had a captive audience who were just as passionate about reading the same book that they discussed at the weekly meeting. Her second example included her planning for a movie based on an ethical dilemma. In her unit she used AnswerGarden for brainstorming and had planned to use Scratch to create the movie. For this unit, considering her students, the content and her pedagogical approach she
had planned a number of activities that used digital technologies for teaching and learning highlighting her combined PCK and TPACK.

Marcelia described two units where she used a variety of digital technologies for teaching and learning. In teaching history, Marcelia used her Café-to-go activity combined with MeetingWords for her students to brainstorm ideas to be used when creating their museum box. Instead of using the museum box webpage to create a virtual museum box, she asked her students to create a physical version using the virtual version to explain what they needed to do. She anticipated the problems and frustrations that she and they would experience with the virtual version that had been originally designed for student use. With her understanding of her students, the resources available in their classroom and the content that she decided it was better to make a physical version. For her second example she described how she created a Claymation movie with her young students. Using a variety of digital technologies she was able to prepare, shoot and edit adding audio to the MSMovieMaker movie to create a Claymation movie with student audio. Both examples show how Marcelia was artful in combining her PCK and TPACK to create sharable examples of student learning.

From this, a number of assertions are proposed that summarise what the teachers shared about their professional knowledge required to pedagogically reason with digital technologies. There are five assertions shown in Figure 7.46.

**Assertion I-K1**: Teachers need knowledge of purposeful digital technologies and other repurposed digital technologies for teaching and learning.

**Assertion I-K3**: Digital technologies influence all aspects of a teachers’ knowledge base.

**Assertion I-K4**: Teachers plan to enact their PCK/TPACK in teaching or learning when they plan for a whole unit, for a lesson or for an activity.

**Assertion I-K5**: Teachers are able to use their PCK and/or TPACK during teaching to change the teaching or learning based on student feedback.

**Figure 7.46 - Summary of assertions – Internal influences – Professional knowledge**

**Chapter summary**

From the analysis of the participating teachers’ practices, a new view and understanding of the stages of pedagogical reasoning emerges. There was evidence
that teachers moved through each stage of pedagogical reasoning using digital technologies for important pedagogical and administrative purposes. For nearly all of the teacher cases, the state curriculum materials supplied by the state education system informed their comprehension and transformation. In the state curriculum materials, all planning and assessment was supplied that incorporated the use of digital technologies for both teaching and learning. All that these teachers needed to do was select the best approach and adapt and tailor the material for their students. Instruction occurred in classrooms where there were a wide variety of digital technologies for teaching and for most classrooms digital technologies for learning. Nearly all teachers described how they used digital technologies for evaluation in terms of assessment while four described how they used digital technologies for assessment during instruction. All teachers described how they transformed learning during instruction when their digital technologies did not go as planned. Teachers shared their reflections and new comprehensions when watching the video of their teaching or through their digital portfolio with many focused on the use of digital technologies.

An exploration of the internal and external influences to pedagogical reasoning highlighted the importance of the contextual factors within the school and education system and their personal factors of their professional mindset and knowledge. All worked in schools as part of the state education system and had access to a common range of digital technologies for teaching and learning. In schools, where there was a supportive culture to using digital technologies, teachers demonstrated a wide range of purposeful and repurposed digital technologies they used for teaching and learning. All teachers showed a range of beliefs, motivations and confidence in using digital technologies from either their previous career before teaching or their interest in using digital technologies. All teachers showed elements of their professional knowledge base and highlighted the impact of digital technologies in how they accessed and enacted pedagogical reasoning. The most interesting aspect was looking at their PCK and TPACK, as many teachers moved between PCK and TPACK; depending on how digital technologies were used by the teacher or the students.

In Chapter 8 of this thesis, the next chapter, the assertions will be discussed in relation to the literature to further understand the research questions. The answers are strongly built on the foundation of Shulman’s MPRA (Shulman, 1987b; Shulman &
Sykes, 1986; Wilson, Shulman, & Richert, 1987) to understand how teachers pedagogically reason with digital technologies. From this, the implications that have emerged in answering the research questions will be discussed, together with directions for future practice and research.
CHAPTER 8: DISCUSSION AND CONCLUSION

This chapter

This chapter is the final chapter in this thesis and presents the key achievements of the study. The chapter is divided into two sections. The first section presents a discussion and explanation of the major findings of this study in terms of the research questions, the conceptual framework and links to the discussion to the relevant literature. The second section concludes this thesis with a discussion of the implications for the potential for future research, the limitations of this study and the suggestions for future research.

Discussion of major findings

RQ1: How do teachers pedagogically reason with digital technologies?

This study was undertaken to understand how teachers' pedagogically reason with digital technologies in response to a growing concern over the influence of digital technologies on teaching and learning. The literature suggested that Shulman's Model of Pedagogical Reasoning and Action (MPRA) offered a suitable framework that could be used to understand how teachers' pedagogically reason with digital technologies (Finger & Finger, 2013; Starkey, 2010c; Webb, 2002; Wilson, Shulman, & Richert, 1987). The study included an examination of the pedagogical reasoning of teachers at differing career points to understand how they pedagogically reasoned with digital technologies and what influenced them. This section presents a discussion of the findings for Research Question 1. From the findings presented in Chapter 7, there are a number of assertions for each stage of Shulman’s MPRA, that will discussed in relation to the pedagogical reasoning literature presented in Chapter 2.

Comprehension

Shulman and his students (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) proposed that the first process of pedagogical reasoning was comprehension – “To teach is to first understand” (Shulman, 1987b, p. 14). In understanding, he shared that teachers must understand their content in several ways within and outside the content area, as well as understand the purposes for teaching it.
Teachers can not simply understand the content as a content specialist, but, understand how they can transform the content “into forms that are pedagogically powerful and yet adaptive to the variations in ability and background” (Shulman, 1987b, p. 15) of their students. To reach a level of understanding in order to transform the content, Wilson, Shulman, and Richert (1987) suggested that teachers must critically understand the content in terms of its substantive and syntactic structure. Shulman implied that teachers develop this understanding in teaching the same content many times therefore developing their pedagogical content knowledge. With the availability of digital technologies used by the participating teachers in the findings, this study highlights the new challenges that teacher’s experience that add to what Shulman suggested. The assertions identified in the findings of Chapter 7 are reproduced in Figure 8.47. They will be discussed to understand the contribution of the findings can make to the existing body of knowledge on pedagogical reasoning to be able to understand how comprehension is impacted when teachers use digital technologies for teaching and/or learning.

**Assertion C1**: Comprehension begins with understanding the students – the subject, year level, their experience of using digital technologies to determine what will engage them.

**Assertion C2**: Comprehension includes developing an understanding of the digital technologies available in the classroom and how they can be used for teaching and/or learning.

**Assertion C3**: Comprehension will benefit when national curriculum materials prepared for teaching include identified suitable digital technologies

**Assertion C4**: In finding and understanding the content teachers must now use digital technologies.

**Assertion C5**: Comprehension to use digital technologies begins with understanding the culture of the school.

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**Figure 8.47 - Summary of assertions from Chapter 7 – Comprehension**

Prior to the implementation of the Australian Curriculum, a common theme from the participating teachers in this study, was that they began their pedagogical reasoning with understanding their students. In various papers, Shulman and his students (Shulman, 1986; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) defined comprehension in terms of understanding the content as well as understanding the educational purposes. At the time of his writing, content would have been confined to texts whether textbooks, newspapers or books, very tangible and uncomplicated.
types of resources. Now, there are still valuable texts that are used by teachers but with wide range of content available for teaching accessed through the Internet, the search for content takes on a whole new meaning. Before the Internet, searching for content would have been a reasonably simple linear task. Now searching for content can be never-ending. In using digital technologies new content can be explored before, during and after teaching, where students can share new content they found in their assessment.

To overcome the challenges of finding the right content, the participating teachers in this study began their comprehension with understanding what would engage their students to determine what they could teach in line with their curriculum guidelines. Once they understood the year level and the subject, they could then identify how they could use digital technologies to engage the students in learning. Shulman (1987b) did not ignore the importance of students in comprehension because in a footnote he suggested that under some conditions, teaching may begin with group of students where the teacher “may focus on comprehension of a particular set of values, of the characteristics, needs, interests or propensities of a particular individual or group of learners” (p. 14). Evidence in this study, emphasised that the participating teachers began their comprehension with first understanding their students in terms of what would engaged them and if they were going to use digital technologies, what prior experience the students had with using digital technologies. If the students had limited experience, then, teaching would need to demonstrate how to use the digital technologies.

After the implementation of the Australian Curriculum, all except two participating teachers (because there was no state curriculum materials for their subject or year level), began their comprehension with the state curriculum materials where: the educational purpose was described and linked to the Australian Curriculum; the content was determined to suit the students (year level and subject); and suitable digital technologies were incorporated. The teacher needed to comprehend the state curriculum materials before moving to transformation. In her study, Gudmundsdóttir (1988) also saw teachers who used an ‘intended curriculum’, where the curriculum guidelines that varied across school districts in the United States. She described how that the intended curriculum could cover the goals, content and materials depending on the teacher’s location. Webb (2002) agreed, after studying ICT teachers in the UK,
that the ICT teachers she studied began their comprehensions with the national curriculum or syllabus.

Many of the participating teachers in this study used the Internet to find content that was suitable for their students. They used a variety of Internet based resources that they could share with their students. The participating teachers with many years of teaching experience did not use a text but developed their own content based on the resources they could access through the Internet and their knowledge of previously teaching the same content. In her study, Starkey (2010c) described Barry, a participant in her thesis, who had substantial knowledge of the content, and how he used the Internet to find a website that was suitable for his students.

Keast, Loughran, Mitchell, and Panizzon (2014) and Keast, Mitchell, Panizzon, Loughran, and Tham (in press) suggest that comprehension in science begins with ‘Big ideas’. They suggest that big ideas are the starting primary ideas that comprehension is focused on and the starting point and that teachers ‘pinball’ reasoned around four focal points: big ideas; contextual constraints; student engagement; and quality learning and quality learners. For big ideas, they suggested that primary and secondary teachers are different in they way they think about big ideas. The findings from this study suggest that most of the teachers, including primary and secondary, began their comprehension with the state curriculum materials where prior to their planning the big ideas for the content had been determined, as had the use of digital technologies. The findings confirm that the participating teachers in this study were also concerned with their contextual constraints in terms of the digital technologies available to them and how they were going to engage their students with and without the use of digital technologies.

Some participating teachers believed that they did not need to become experts in the content and for some participating teachers their students would direct their own learning, and the teacher's role was as guide or facilitator. This offers a different perspective of teaching where the teacher is not the master of the content that they shape and share with their learners. When Shulman described Nancy (Shulman, 1987b) as a portrait of pedagogical excellence, in the way she managed the ideas within her classroom, her mastery of the content in teaching English was key to her pedagogical reasoning. She was “like a symphony conductor, posing questions,
probing for alternative views, drawing out the shy while tempering the boisterous” (Shulman, 1987b, p. 2) with the focus on her sharing her understanding of the texts to engage her students in English literature. Her teaching relied on a well-developed knowledge of teaching the material, to the students, over a number of years or her advanced pedagogical content knowledge. What would happen if she were to teach another topic that she did not know? Shulman described Colleen, another expert teacher presented in his article, when she was observed teaching grammar, a topic she had no training in,

"Colleen looked like a different teacher during that lesson. Her interactive style evaporated. In its place was a highly didactic, teacher-directed, swiftly paced combination of lecture and tightly controlled recitation...she was uncertain about the content and adapted her instructional style to allay her anxiety" (Shulman, 1987b, p. 18).

Shulman found the expert teachers in his study were uncomfortable when they were not familiar with the content.

As a contrast, multiple participating teachers in this study at various times used their digital technologies to explore new content or unplanned content during their lessons. One participating teacher described his ‘emergent and incidental learning’ that he used to explore and share, something he had not prearranged or tested previously, which added to the content shared during the lesson. The content was unknown until it was discovered during the lesson and his use of digital technologies enabled him to find the content when he needed to answer student questions. His students did not expect him to be the expert in the content but with digital technologies he was able to find new relevant content to share during teaching that he demonstrated to his students. Not only teaching them how to find content but how to access the content and check its validity. Starkey (2010c) agreed that digital technologies “alter the position of the teachers from the source or conduit of knowledge to a role of a learning expert” (p. 241).

Another important aspect of comprehension that was suggested by the participating teachers was the importance of understanding what digital technologies were available for teaching and learning. In determining what was available to them, they could gain an understanding of the culture of using digital technologies in their schools. If the participating teacher wanted to use Internet for learning they described
how they would need to check if they could access the website from the classroom, reliable Internet access in the classroom, a data projector and a computer they could easily operate while teaching. If they required the Internet for student learning, then it would be a different scenario beginning with a series of questions starting with - how were the students were going to use the digital technologies? Were laptops available in the classroom or is the laptop trolley needed? Does it need to be booked? Is the lab computer lab available? With a final check, if the students have access to the website? For some participating teachers their comprehension included understanding how a virtual classroom could be used for teaching, learning and parent access. If they worked in a culture that did not support the use of digital technologies then gaining an understanding of the digital technologies was focused on what they could manage to use in their classroom. Two early career participating teachers shared how the culture of their school limited the digital technologies available to them and made using the digital technologies they had unreliable where the other participating teachers all worked in schools where they were well supported by other teachers and their Principal.

For other participating teachers, they needed to understand how to use software that was not designed for teaching or learning and their knowledge of digital technologies helped them repurpose the digital technologies for teaching or learning. Koehler and Mishra (Koehler & Mishra, 2008; Mishra & Koehler, 2006, 2007) have suggested on multiple occasions that in developing technological pedagogical knowledge required the “teacher to engage with the affordances and constraints of particular technologies in order to creatively repurpose these technologies to meet specific pedagogical goals of specific content areas” (Mishra & Koehler, 2006, p. 1032). The comprehension of the digital technologies that can be used for teaching and learning is not a simple undertaking and had contextual implications as shown in the variety and accessibilities described in the restories.

**Transformation**

Shulman and his students (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) claimed that transformation was a series of four processes that results in a plan or set of strategies for teaching. The objective is to transform “to think one’s way from the subject matter as understood by the teacher into the minds...
and motivations of learners” (Shulman, 1987b, p. 16). From this study there are a number of assertions identified in the findings from Chapter 7 and are reproduced in Table 8.48. They will be discussed to understand the contribution of the findings to the existing body of knowledge on pedagogical reasoning to understand the process of transformation.

**Assertion T1**: Preparation involves preparing planning materials using digital technologies.
**Assertion T2**: Without state curriculum materials, teachers move between preparation, representation and selection while thinking about their students and what digital technologies were available for teaching and learning.
**Assertion T3**: Preparation, representation and selection were predetermined in the state curriculum materials but needed to be reviewed based on availability of digital technologies in the classroom.
**Assertion T4**: Adaptation and tailoring are the most important step in transformation with or without the state curriculum materials.
**Assertion T5**: Transformation involves integrating and actioning digital technologies for teaching and learning.

**Figure 8.48 - Summary of assertions from Chapter 7 – Transformation**

As mentioned under comprehension, most of the participating teachers were able to begin transformation with the state curriculum materials that included the unit plan, lesson plans, resources and assessment. All of these materials were available online through a secure website and could easily be modified by the participating teacher. The process involved using their digital technologies to access and download from the state curriculum materials website and modify before uploading their version to the school management system. For the participating teachers, their transformation focused on adapting and tailoring the state curriculum materials to suit their students and what digital technologies were available to them in their classroom for teaching and learning. This confirms what Shulman described for adaptation and tailoring (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987). As another team of teachers had prepared the state curriculum materials, that team had already checked the validity, determined the best representation of the content and selected the instructional strategies that incorporated the use of digital technologies. The participating teachers were focused on adapting and tailoring the unit plan, lesson plans (if they used them) and the assessment for their students within their classroom based on the availability of digital technologies for teaching and/or learning.
The participating teachers without the state curriculum materials began their transformation thinking about their students. In preparation they did not need to check the validity of the content because they had already done that in their comprehension by only selecting the content they wanted to teach. This is different to Shulman’s understanding of the processes of comprehension and transformation (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) as he clearly explained how the content was transformed with a separation between the two. Starkey (2010c) suggested that one of her beginning teachers blurred the line between comprehension and transformation when he selected an Internet based resources for teaching. The findings of this study challenge this notion of separation between comprehension and transformation when using digital technologies.

In representation, Shulman suggested teachers used analogies, metaphors and Gudmundsdóttir (1988) proposed stories, that they have developed over many years of teaching the content that incorporated their students understandings and misunderstandings. Gudmundsdóttir (1988) suggested their stories “capture the totality of a series of texts that make up a course of study. The story is the idea that holds the texts together, giving them purpose, direction and drama” (p. 33). The participating teachers in this study did not share how they used stories, analogies or metaphors. Most shared how they had not taught the content previously, and as a result, the focus was on identifying the value of digital technologies to transform the content.

For this study, the participating teachers needed to perform their planning by identifying the best way to represent the content (this may have already been done when selecting the content) and then selecting the best instructional strategies for teaching and/or learning. For representation and selection, many participating teachers incorporated the use of a range of digital technologies for teaching and/or learning. In many cases they explained how their thinking was in moving back and forward between all three processes of preparation, representation and selection while thinking of their students. They would not move through the processes of preparation, representation and selection as separate processes before adaptation and tailoring, all three would be done as part of adaptation and tailoring. This supports the idea of pinball reasoning suggested by Keast, Mitchell, Panizzon, Loughran, and Tham (in press). With or without the state curriculum materials, all participating teachers
produced planning materials including a unit plan, resources and assessment that were loaded into the school management system. They used their digital technologies to access, update and upload their version in line with the approach used in their school.

Shulman and his students (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) and the authors who purposely looked at pedagogical reasoning with digital technologies (Webb (2002); (Webb, 2008, 2011a, 2014) and (Starkey, 2010b, 2010c)) there was no mention of the processes that teacher undertook in transformation except for preparing planning materials. For all participating teachers in this study, transformation involved preparing for the use of the digital technologies for teaching and/or learning. Whether that was: MSOneNote or MSPowerPoint; setting up Internet based resources; creating a virtual classroom in the learning management system; or a paper-based workbook; there was some element of preparation for teaching and/or learning.

**Instruction**

Shulman and his students (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) described instruction as the actual act of teaching or the “observable performance of the variety of teaching acts” (Shulman, 1987b, p. 17). This includes: organising and managing the classroom; classroom communication; assigning and checking work; and interacting with students. Not all of the classrooms in this study had an abundance of digital technologies to enable teachers to use them reliably for teaching. However, for most of the participating teachers, they used digital technologies to support student learning. To understand the implications of the findings for this study, the assertions from Chapter 7 are reproduced in Figure 8.49. They will be discussed to understand the contribution of the findings to the existing body of knowledge on pedagogical reasoning to understand the process of instruction.

When Shulman first proposed pedagogical reasoning the impact of digital technologies was not an issue. Webb (2002) was one of the first researchers to propose a new model that incorporated digital technologies but her view was from ICT teachers in the United Kingdom who were teaching the secondary digital technologies curriculum. Starkey (2010b, 2010c) completed her study looking at beginning teachers who used digital technologies in New Zealand. Both did not describe in detail how their teachers instructed in their classroom to understand the impact of digital technologies.
on their instruction in the level of detail proposed by Shulman. For this study, participating teachers were video recorded in the classroom to enable them to share through the video-stimulated recall interviews what and how they used digital technologies. From the findings, the elements of instruction that Shulman recommended can be discussed to understand the impact of digital technologies on their teaching and learning during instruction.

**Assertion In1**: Organisation and classroom management become different when using digital technologies for teaching and learning.

**Assertion In2**: Teachers will use a variety of digital technologies for assigning and checking student work.

**Assertion In4**: Evaluation during instruction will include class, group and individual verbal questioning, physically checking computer screens for work and using digital tools for sharing progress.

**Assertion In5**: Transformation during instruction occurs when digital technologies do not go as planned where teachers temporarily change learning activities to either: wait for the digital technology to catch up, ignore the digital technology component and adapt the plan with a completely new approach.

**Figure 8.49 - Summary of assertions from Chapter 7 - Instruction**

For this study the classrooms of the participating teachers had an abundance of digital technologies for teaching. All participating teachers had school-supplied laptops and taught in classrooms where there was a data projector, some had interactive whiteboards, some students used desktop computers in all except one participating teachers’ classrooms and for others, their students had their own laptops. All participating teachers used their digital technologies for teaching but not all could use digital technologies for learning. The organisation and classroom management was similar in all participating teachers’ classrooms. The classroom communication approach was the same for all participating teachers except where the participating teacher was leading the class from the front of the room communicating requirements to students. All participating teachers assigned work from the front of the room with work displayed projected on to their whiteboard, which freed them to move around the room checking student work and interacting with students. Interaction with students was mainly verbal. Many digital technologies were used in all four aspects of instruction.
In the discussion to support MPRA, Shulman described two features of pedagogical reasoning that were not represented in the model that could be identified as future research opportunities. These are the cross over of processes between transformation and evaluation that can occur during instruction and Shulman and his students (Shulman, 1987b; Wilson, Shulman, & Richert, 1987) described how this crossover occurs during active teaching in the classroom. Sockett (1987) suggested that Shulman had ignored reason-in-action when he challenged the validity of the knowledge base and the MPRA but what Socket missed was how Shulman had included some discussion of reason-in-action in both evaluation and transformation. In evaluation he shared “this process includes the on-line checking for understanding and misunderstanding that a teacher must employ while teaching interactively…checking for understanding requires all forms of a teacher comprehension and transformation” (Shulman, 1987b, pp. 18-19). This implies that in the process of teaching, a teacher will check for understanding during active teaching and in finding misunderstanding they can transform-during-teaching to a new approach/format. The teacher will then check for understanding again, where they may need to transform-during-teaching the content again for the students.

Similar to the work suggested by Shavelson (1983); Shavelson and Stern (1981) and Clark and Peterson (Clark & Peterson, 1984, 1986) they investigated teachers’ interactive thoughts and decisions during teaching. The early work of Shulman and Elstein (1975) asserted how teaching has interactive components as shown in the general conceptual model for clinical information processing in teaching and learning but this was not acknowledged in the MPRA. This transformation-during-teaching and evaluation-during-teaching are important components of pedagogical reasoning especially when working with digital technologies. If the digital technologies fails, as in availability or in helping students understand, during the lesson the teacher has to very quickly transform what they were going to teach into a new form to be able to continue the lesson. Sockett (1987) used the in-action wording but the findings in this study will use more representative worked to not draw parallels with Schön (1983) in-action and on-action use of the terminology.

There were many examples of where the participating teachers preformed evaluation-during-teaching in terms of asking students questions to check for understanding during the lesson. Digital technologies changed the dynamics of the
classroom where participating teachers were able to focus on checking for student understanding individually instead of directing from the front of the room. As content was projected on the whiteboard teachers were free from writing on the whiteboard to be able to move around the room to check student progress by interacting with students or checking their computer screens. One participating teacher shared how she used a warm up quiz to prepare students for studying mathematics; she was able to gauge their understanding of the previous lesson in this small activity. One participating teacher used scheduled interviews with individual students during class time to check on progress in their learning contract. Multiple participating teachers shared how they use online quizzes in the learning management system that students completed at the end of the lesson. With the quiz automatically marked and feedback returned to the student, the teacher could monitor students understanding by reviewing the results after the lesson that could impact how the following lesson was delivered. Evaluation-during-instruction was an active part of the participating teachers’ lessons highlighting the importance of evaluation-during-instruction in pedagogical reasoning.

In terms of transformation-during-teaching, a few teachers shared how the use of their digital technologies did not go as planned and they were required to change what they were doing. One participating teacher was unable to use a videoconference she had set up and resorted to used physical activities in the classroom to discuss environments. When she realised that the other class was not able to attend she easily transformed learning. Another discussed how she had planned to use Internet tutorials to teach how to use software tool but had to resort to teaching from the workbook she had prepared. A third described how she had planned to use YouTube videos in her mathematics lesson but had to ignore them because they were slow to load in time. Her transformation-during-teaching was a simple process of ignoring the failure and so she skipped the pages on her MSPowerPoint. A fourth participating teacher described how he used his digital technologies for what he termed emergent and incidental learning. He was able to move beyond his planned approach to explore answers to questions to help develop a deeper understanding for his students to prepare them for their assessment. Overall, transformation-during-teaching occurred when the participating teachers needed to deviate from the plan in reaction to what was happening in the classroom and should be considered an important aspect of pedagogical reasoning using digital technologies.
Evaluation

Shulman and his students (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) described evaluation as the actual act of teaching or the “online checking for understanding and misunderstanding that a teacher must employ while teaching interactively, as well as more formal testing and evaluation that teachers for to provide feedback and grades” (Shulman, 1987b, p. 17). Evaluation-during-instruction has been discussed under the previous topic of instruction therefore this section will focus on the features of evaluation after instruction. To understand the implications of the findings for this study, the assertions from Chapter 7 are reproduced in Figure 8.50. They will be discussed to understand the contribution of the findings to the existing body of knowledge on pedagogical reasoning to understand the process of evaluation.

Assertion E1: Evaluation-during-instruction involves verbally checking for student understanding/misunderstanding and managing behaviour in the classroom.

Assertion E2: Evaluation-after-instruction includes a variety of approaches where most teachers organised for their students to use digital technologies to prepare and submit assessment.

Assertion E3: Teachers use digital technologies to access a history of work for making fair assessment decisions.

Assertion E4: Teachers use digital technologies for marking, reporting and providing feedback to students during and after teaching.

Assertion E5: Teachers use digital technologies to provide more individualised feedback more often.

Figure 8.50 - Summary of assertions from Chapter 7 - Evaluation

Shulman (1987b) suggested that evaluation involved understanding what the student understands and to do this a teacher needs a “deep grasp of both the material to be taught and the processes of learning” (p. 19). Although Webb (2002, 2011a, 2014) and Starkey (2010b, 2010c) studied pedagogical reasoning with digital technologies, they accepted that evaluation was a process but provided limited discussion of their studies and implications that digital technologies may have on evaluation.

Checking for understanding develops a teacher’s pedagogical content knowledge for that content. One participating teacher shared how she learnt how to teach Year 10 students how to use software through a demonstration approach where
she was able to use her workbook in order for students to build their skills and knowledge of the software in order to produce a similar product as their assessment. Another participating teacher shared how she used MSPowerPoint to teach mathematics where her presentation used similar content to their examination to give them the best opportunity to pass the examination. Both of their teaching focused on preparing students for their formal assessment. Informal feedback was provided in response to her movement around the room checking student work with formal feedback provided in the results of their formal assessment. A small group of participating teachers reported how they used MSOneNote as a tool for sharing and collecting work from their students where their students emailed their work at the end of the lesson and the participating teacher was able to add feedback before returning the work via email. As all work was captured through the use of digital technologies, these participating teachers reported how they attempted to return work before the following lesson as their digital technologies allowed them to review student work anywhere on any device. Digital technologies have changed how these participating teachers informally checked for student understanding and misunderstanding.

The participating teachers in this study used a variety of digital technologies to prepare, capture and report on formal evaluation of student learning. Many shared how students used digital technologies for assessment from completing work with new software, word processing assignments, MSOneNote files, Claymation and digital photography. One participating teacher shared how he taught two different classes, one with student digital technologies and the other with limited access to student digital technologies. He found there was a noticeable difference in the quantity and quality of the work produced by both classes. He reflected how he thought the students with digital technologies had an unfair advantage over their peers. Though one participating teacher shared that when using digital technologies it was important to ensure the authenticity of student work as allowing students to complete assessment online outside of school did not guarantee that it was their work. To overcome this, the set up a process where the students completed all assessable work in the classroom to ensure it was their work. Using digital technologies allowed them to keep a digital history of student work and assessment that could be used in making grading decisions. In using digital technologies, evaluation-during-instruction is made more possible to see student work and to give feedback.
Last element of evaluation that Shulman (1987) shared was in the teachers own evaluation of their performance of instruction and the materials used in that instruction. He shared that this was separate to the next process of reflection but offered little discussion of why. For this study many participating teachers shared the experience of teaching as reflections shared in their self reported data captured in their digital portfolio or interviews. This study is significant in its contribution to understanding how teachers’ reflection occur in reality.

**Reflection**

Shulman and his students (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) suggest that reflection is the process of looking back to “reconstruct, re-enact and/or recaptures the events, the emotions and the accomplishment” (Shulman, 1987b, p. 19) as “the process of learning from experience” (Wilson, Shulman, & Richert, 1987, p. 120). Many of the participating teachers shared their reflections in their digital portfolio and their interviews to provide an insight into their meaning of reflection. To understand the implications of the findings for this study, the assertions from Chapter 7 are reproduced in Figure 8.51. They will be discussed to understand the contribution of the findings to the existing body of knowledge on pedagogical reasoning to understand the process of reflection.

**Assertion R1:** Teachers often had no regular formal process for recording reflections.

**Assertion R2:** The digital portfolio as a tool can be used to capture teachers’ reflections on the use of digital technologies.

**Assertion R3:** Reflective practice of teachers is facilitated when teachers are able to reflect with peers on their teaching.

**Assertion R4:** Teachers reflections look back at student work to comprehend student learning.

**Assertion R5:** Reflections can elucidate all aspects of pedagogical reasoning.

**Figure 8.51 - Summary of assertions from Chapter 7 - Reflection**

Shulman emphasised that the process of reflection looks at both teaching and learning but when thinking about teaching the link between the processes of instruction, evaluation and reflection the boundaries blur. When thinking about evaluation a teacher would question the success of their teaching. Did the students show evidence of learning in the manner the teacher planned? When thinking about reflection, it is more about the experience of teaching or as Shulman suggested, when
the teacher learns from teaching in developing their “wisdom of practice” (Shulman, 1987b). Shulman shared that reflection can be done “alone or in concert with the help of recording devices or solely from memory” (Shulman, 1987b, p. 19) where reflection allows the teacher to “reteach…to examine the extent to which the teacher can learn from his analysis of past experience” (Shulman & Sykes, 1986, p. 19). Reflection is considered important, as it is a process by which teachers through effective reflection can improve on their practice. However, understanding teacher reflection “requires intensive knowledge of what, how and for what purposes teachers learn…where there is a wealth of evidence that testifies to the importance and breadth of scope of teacher reflective thought” (Marcos & Tillema, 2006, p. 112).

The participating teachers in this study shared their reflections in their digital portfolio and their interviews. For most, the reflection focused on looking back at teaching that was triggered when recollecting how a planned approach had to change because of a problem with their planned use of digital technologies. One participating teacher failed to check student access to an online tutorial website, another did not anticipate the digital technologies knowledge of a second class he taught. Another reflected how she could not reliably access embedded YouTube videos for teaching mathematics. All of these examples highlight that reflection was based on a dilemma experienced in the classroom that meant they had to deviate and the challenge of changing their teaching from what they had planned in terms of the activities completed in the classroom and in collecting students work as part of assessment.

The evidence from the participating teachers highlighted that reflection comes after teaching; it is not until the teacher has comprehended, and then transformed their content with their planning enacted in the classroom, with the students, that meaningful reflection can take place. None of the participating teachers’ reflections concerned their comprehension or transformation about content they did not teach. They began the process of reflection where they questioned how successful they were and did their lesson go as planned? If it didn’t go as planned, then they shared how they had to rethink what happened to understand what piece in the complex puzzle of teaching they could have changed to improve the teaching or learning outcomes. Reflection was revealed in overall satisfaction of teaching with many participating teachers sharing in their interviews how they thought the lesson went well but rich reflection focuses on specific aspects of teaching and/or learning where many of the participating
teachers shared how they would make better choices to improve the quality of their teaching and learning outcomes with many reflecting how they learnt how to better use their digital technologies next time.

For many of the participating teachers who were experienced teachers, their reflection focused on successes they experienced in learning how to use new digital technologies or using new digital technologies in the classroom for the first time. These types of reflections were a dominant feature of the discussion in their digital portfolios. One participating teacher reflected that the use of MSOneNote to create a learning contract to help in managing differentiated learning was a success for the unit but she reflected that next time she would select a much smaller focus. Another participating teacher shared how digital technologies enabled her to access a history of her teaching to be able to gauge her effectiveness. One participating teacher shared how she was able to change what the students were learning when she was not able to run her planned videoconference. The reflections of these teachers reflected their successes in teaching that may have come about because of the dilemmas they experienced.

Reflection for these teachers was not regularly captured as a history of reflection that could be revisited at a later date. Though many of the participating teachers had completed a digital portfolio (DPL) in response to a state professional development program. Where teachers completed a digital portfolio with evidence where they described why and how they were using digital technologies for teaching and learning. The digital portfolio was prepared to encourage and recognise teacher use of digital technologies. The use of the video-stimulated recall interview allowed the participating teachers to review their teaching after viewing the video of them teaching and then discuss how they used digital technologies. In viewing the video, many of the participating teachers shared reflection of the challenges they faced when using digital technologies.

In terms of student learning, many participating teachers reflected how they had observed the students engage in learning when using digital technologies. One participating teacher reflected how he learned that digital technologies offered his eLearning class more opportunities to excel compared to the second class that had limited experience and skills in using digital technologies for learning. Another
participating teacher reflected how using MSPowerPoint to show her warm-up activity enabled her to engage challenging students in engaging in learning mathematics as they attempted to be the first in the class to find her deliberate error. Another participating teacher reflected that the use of MSOneNote and her reading stamina activity engaged and challenged her students in reading their texts at a deeper level then she anticipated. A final participating teacher reflected that she was surprised to find that some of her young prep students were capable of taking on more responsibility in the production of the Claymation movie.

The introduction of digital technologies can change the status quo, as the teacher needs to be prepared for when their digital technologies don’t go as planned. One participating teacher shared how her plan to use online tutorials failed when the students could not access the website. She reflected how she had to change her approach to a follow along demonstration with the workbook. Another participating teacher’s reflection highlighted how the students and classrooms can have a significant effect on student outcomes. He had two classes, one with students who regularly used their own digital technologies for learning and the others who didn’t, his reflection highlighted that with the same content in two different classrooms, the student outcomes can be completely different. A third participating teacher shared how the embedded videos she wanted to use in teaching mathematics failed to load on the screen. She reflected that she would need to find a better way to use YouTube video in her classroom.

Many of the participating teachers’ reflections showed their development of pedagogical content knowledge (PCK). In taking the transformed content into the classroom, the participating teachers were able to share what they had learnt through the experience of teaching. Through, teaching that content to that particular group of students in that classroom, they learnt what teaching strategies were effective with those students to engage them in learning. Shulman suggested that pedagogical content knowledge “represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organised, represented and adapted to the diverse interests and abilities of the learners” (Shulman, 1987b, p. 8). Others support Shulman’s view that through the experience of teaching, teachers develop PCK but the participating teachers in this study shared through their reflections
that they had developed a wider view of PCK that can be applied with differing contexts, students and content.

A participating teacher in this study shared how she would use a learning contract again but with differing content. Her PCK was not merely that a learning contract worked with Year 5 eLearning students teaching English and Mathematics but that she could use it again to teach a smaller unit of mathematics. Her reflection suggested that she learnt how to use a learning contract that was not restricted to the particular content she used but a general belief that she could use it to teach other similar content. It wasn’t just the pedagogical aspect in isolation, as it was the combination of the students in an eLearning classroom where she learnt how a learning contract worked. Her PCK did not focus on teaching the same content again to the same type of students in the same classroom; it was enriched or enhanced where she could apply her PCK in new classrooms, with new students or with different mathematics content, as it was an effective way to teach mathematics. Her PCK was very personal to her, supporting what the PCK researchers at the PCK Summit (Berry, Friedrichsen, & Loughran, 2015; Gess-Newsome & Carlson, 2013a, 2013b) agreed in their consensus model of PCK.

Many of the participating teachers’ reflections shared their development of their technological pedagogical content knowledge (TPACK) as they worked with different digital technologies for teaching and/or learning. Their reflections highlighted the difference in using digital technologies for teaching and using digital technologies for learning. All participating teachers used digital technologies for teaching, where many participating teachers shared their TPACK in discussing how they used their digital technologies successfully. One participating teacher shared the success of her Claymation movie while another used videoconferencing for teaching early years science and others shared their success in using MSOneNOte in teaching English and mathematics. Many of the participating teachers did not add digital technologies but redefined the content and method of teaching to suit their students and they were able to do this easily in using the state curriculum materials. The participating teachers reflections highlighted how they were able to move from TPACK to PCK when their digital technologies did not go as planned. One participating teacher reflected how successfully she was able to redirect her students into three different activities when
waiting for her videoconference and then redirected the students into programming BeeBots in reaction to the work of one group.

**New comprehensions**

Shulman and his students (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) suggest teachers gain new comprehension of both the content and the purpose as a singular. Many of the participating teachers shared their new comprehensions (plural) in their digital portfolio and their interviews. Many shared new comprehensions concerning new knowledge of the content, their students and pedagogy but predominantly new comprehensions focused on using new digital technologies. To understand the implications of the findings for this study, the assertions from Chapter 7 are reproduced in Figure 8.52.

**Assertion NC1:** Teachers new comprehensions emerge from the focus on the use of digital technologies for teaching and learning

**Assertion NC2:** New comprehensions cover three knowledge base areas: content, learners and general pedagogy

**Assertion NC3:** New comprehensions emerge because of dilemmas experienced in using digital technologies for teaching and/or learning.

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**Figure 8.52 - Summary of assertions from Chapter 7 – New comprehensions**

**Suggested revisions to Shulman’s MPRA**

Wilson, Shulman, and Richert (1987) assert that pedagogical reasoning begins where comprehension is the first and last step in pedagogical reasoning where new understandings have been gained through the processes of pedagogical reasoning. Many of the activities in MPRA are defined as processes, as they have an action and a result. For example, transformation, which involves a series of actions with a result that include teacher plans, resources and assessment. When thinking of new comprehension: What are the actions of new comprehension and what is the result? It is suggested that new comprehensions are not a process but a change in knowledge where “it is a new understanding that has been enhanced with increased awareness of the purpose of instruction, the subject matter of instruction, and the participating teachers – teachers and student … this enriched understanding may grow slowly by
accretion … or a single experience may promote a quantum leap” (Wilson, Shulman, & Richert, 1987, p. 120).

Nilsson (2009) was the first to look into Shulman’s MPRA and she proposed a revised version of the model. She highlighted how her model followed the same process flow proposed by Shulman, except for the flow from new comprehension into comprehension. She represented the relationship as an influence where new comprehension was influenced by transformation, instruction and evaluation but new comprehension influenced comprehension. She termed these relationships ‘teaching concerns’ where she suggested that pre-service teachers developed more sophisticated understanding of each when faced with critical incidents during teaching. Webb (2002) in her revised version of MPRA, and without explanation, suggested that new comprehension did not symbolize a process and also represented it as a data flow from reflection to comprehension. Starkey (2010c) included new comprehension in her model but did not go beyond Shulman’s definition. From the research on pedagogical reasoning there have been few studies that attempted to provide an understanding of new comprehension and suggest that new comprehension may not represent a logical process of pedagogical reasoning but a relationship between reflection and the other processes.

Many of the participating teachers shared through their reflections how they developed, not one but multiple, new comprehensions of teaching and learning, as a consequence of using digital technologies. They shared how they used MSOneNote and described their new understanding in terms of how it improved their classroom communication. For one participating teacher, using MSOneNote with the learning contract allowed her to implement a learning program where students negotiated what, when and where they would complete their work. She shared how it was an effective tool to manage differentiated learning. Another shared how she used MSOneNote for her reading program and that she was able to leave the students to independently managing their reading progress with their peers. Her new comprehensions was two part: one part focused on her being able to allow the students to operate independently where they shared their progress through MSOneNote; and the second was in using MSOneNote to capture progress that she could access anytime to check on progress.
Many studies described in this literature review (Feng & Hew, 2005; Gudmundsdóttir, 1988; Nilsson, 2009; Starkey, 2010c; Webb, 2002, 2010) have acknowledged that the flow of pedagogical reasoning as not circular as Shulman and his students suggested. Wilson, Shulman, and Richert (1987) proposed that new comprehensions lead into the process of comprehension to begin the process of pedagogical reasoning again. They did not provide an explanation as to why it begins again with the only suggestion with the arrow in their model and Shulman suggesting that enriched new understandings feedback into comprehension when a teacher has to teach the content again. As discussed above, it is suggested that new comprehensions be removed from MPRA as it does not represent a process, now the suggestion is to remove the arrow with the suggestion that the model is not cyclical as it was first proposed. A teacher may move through the process of pedagogical reasoning and never return to teaching the content again. Removing the arrow shows that the process is a sequential flow that has a beginning, an end and is not recursive.

Many studies described in this literature review (Feng & Hew, 2005; Gudmundsdóttir, 1988; Nilsson, 2009; Starkey, 2010c; Webb, 2002, 2010) have acknowledged that the flow of pedagogical reasoning as not circular. Shulman’s MPRA does not show the cross over of processes between transformation, instruction and evaluation that was included in their descriptions of the processes (Shulman, 1987b; Shulman & Sykes, 1986; Wilson, Shulman, & Richert, 1987) acknowledging the complex interplay between the three that occurs in the classroom during active teaching. Sockett (1987) described this, as ‘reason-in-action’, when he claimed that Shulman had ignored the place of reason in teaching action. Shulman (1987b) was not clear in describing the transformation and evaluation processes, except to hint that both occur during instruction, when he attempted to describe the ‘in-action’ processes Sockett suggested. Under the heading of evaluation, he explained “this process includes the on-line checking for understanding and misunderstanding that a teacher must employ while teaching interactively … checking for understanding requires all forms of teacher comprehension and transformation” (Shulman, 1987b, pp. 18-19). This suggests that in the process of teaching, a teacher will check for understanding, then, if the students are having trouble comprehending the content, the teacher can transform the content into another suitable format to help the students with their understanding. The teacher will then check for understanding or
they perform an evaluation during their teaching, or in other words, ‘evaluation-during-instruction’ to determine if the students need them to further transformation the content in order for students to understand.

This is similar to the work suggested by Shavelson (1983); Shavelson and Stern (1981) and Clark and Peterson (1984, 1986) with their views on teachers’ interactive thoughts and decisions. Shulman identified that teaching does have interactive components as shown in the general conceptual model for clinical information processing in teaching and learning but this was not included in later version presents in MPRA. This transformation-in-action/transformation-during-instruction and evaluation-in-action/evaluation-during-instruction are important components of pedagogical reasoning. Instead of drawing parallels with Schön (1983) use of the “in-action” and “on-action” terminology, the in-action wording will not be used. The findings from this study support the idea that teachers do both: transformation-during-instruction and evaluation-during-instruction.

In teaching with digital technologies, there are times when the digital technologies fail, and the teacher needs to rethink or perform transformation-during-teaching in order to continue teaching. The teacher has to change approach to be able to continue the lesson with a new approach. The findings from this study support the idea that teachers transform-during-teaching when their digital technologies don’t go as planned. The findings shared how the teachers shared experiences where they were required to change their approach. One participating teacher shared two different situations where he transformed-during-teaching to cater for his students. First, he shared his experience of teaching in two different classrooms and how he needed to change his teaching and learning approach because the second group of students were not able to use digital technologies as proficiently as his regular students. Second, he shared how he used his digital technologies for what he termed “emergent and incidental learning” where he could move from what he had planned and respond to the questions that the students asked in the classroom. In demonstrating his work through his digital technologies, he was able to explore answers to his students’ questions, in the classroom, at the time they asked. The findings describe many scenarios how teachers transformed-during-teaching.
Shulman was clear in explaining how teachers check for understanding during teaching or how they evaluate during instruction. The findings suggest how many teachers did check for understanding during their teaching using many of the standard classroom approaches. Some highlighted how they used digital technologies to check for understanding during their teaching, either in terms of collecting students thoughts through a tool like AnswerGarden or students were able to email their work during the lesson and this allowed the teacher to check during or after the lesson. When students were using digital technologies available over the Internet, the teachers were able to access their work and check progress and provide immediate feedback to students. The digital technologies used by the participating teachers offer new approach for teachers to be able to check for understanding during teaching that don’t involve verbal communication. For one teacher, she emphasised the importance of using digital technologies to allow all students the opportunity to input to the classroom conversation without having to physically speak or raise their hand.

It was first suggested in Smart, Sim, and Finger (2015), that Shulman created some confusion in the process of evaluation where he suggested that evaluation should include a teacher’s own evaluation of their performance as separate to the process of reflection. Reflection involves looking back at the teaching and reflecting on what went well and what didn’t, which is a more meaningful way for teachers to review their performance. This requires a redefinition of the process of evaluation to focus on student evaluation or checking for student understanding either evaluating during instruction or evaluating after instruction. Evaluation should focus on students, to understand what worked well and what didn’t to understand what concepts the students did or did not grasp. Therefore, leaving reflection for the teacher, as a separate process.

The next consideration focuses is where reflection actually occurs in the process of pedagogical reasoning. Shulman suggested reflection occurs after evaluation but this study has highlighted that reflection can occur anytime after instruction and not necessarily as a formal process. The participating teachers shared details of their reflection, which included new understandings of the content, how they could better transform the content, how they could more effectively teach the content and how that could enable them to better evaluate the students. Essentially, they shared their reflection, which highlighted how they had developed new
comprehensions of how to teach the content. Their reflection and new comprehensions was linked in terms of the change in their knowledge about teaching. This suggests that reflection is not a discrete process, as suggested by Shulman, but a trigger that generates a change in the teacher’s knowledge base, which then feeds back into how they comprehend, plan, teach and evaluate students.

The findings highlight there is an important relationship between pedagogical reasoning and knowledge. This suggests a new model, which highlights the importance of digital technologies. This new model uses the ideas first proposed by Gudmundsdóttir (1988) and extends them to show a fuller picture of pedagogical reasoning incorporated with the knowledge base. This study confirms all of the components of Shulman’s Knowledge Base for Teaching (Shulman, 1987b; Wilson, Shulman, & Richert, 1987) and adds the work dominated by Mishra and Koehler (Koehler & Mishra, 2008; Koehler, Mishra, & Cain, 2013; Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Mishra & Koehler, 2006, 2007) to include TPACK as a digital technologies enhanced version of PCK. As this model represents a new view of pedagogical reasoning, it is titled the Model of Technological Pedagogical Reasoning to reflect how teachers pedagogically reason with digital technologies. This new model is shown in Figure 8.53.

This section addressed how teachers’ pedagogically reasoned with digital technologies reviewing the findings from Chapter 7 in light of the literature from Chapter 2, in order to answer Research Question 1. The next section looks at what the findings and the literature to answer Research Question 2.
RQ2: What are the differences in pedagogical reasoning with digital technologies across three career stages?

The case studies in this thesis were selected and represented three career stages to understand how teachers pedagogically reason within each career stage. The findings confirm that there was difference based on career stage of the participating teachers. Early career teachers were continuing to develop as a teacher focussing on their growth, experienced teachers were sharing and supporting other teachers in using digital technologies while continuing to accept challenges and lead teachers were leading their schools through change in teaching and learning with
digital technologies. The career stages were in line with three of the career stages presented in the Australian Professional Standards for Teachers (AITSL, 2011). Graduate teachers represent new teachers who have just begun their teaching careers after graduation or early career. The early career teachers in this study were new to teaching after recently graduating from their teacher preparation program, most were still working towards proficient. The key for Highly accomplished teachers was that they are recognised as “highly effective, skilled classroom practitioners and routinely work independently and collaboratively to improve their own practice and the practice of colleagues” (AITSL, 2011, p. 6). The findings support the idea that the experienced teachers who participated in this study were highly accomplished teachers. Finally, the standards suggest that Lead teachers are recognised and respected by colleagues, parent/carers and the community as exemplary teachers (AITSL, 2011, p. 6). In addition, the teachers in this study were described as lead because they were leading their schools in change.

**Pedagogical reasoning across career stages**

It is evident from the literature presented in Chapter 2 that there have been many studies of pre-service and in-service teachers to understand their pedagogical reasoning though there is a definitely lack of research investigating pedagogical reasoning with digital technologies to understand the differences across the career stages. The aim of this study was to examine the pedagogical reasoning of teachers at various career stages to understand how they pedagogically reasoned with digital technologies and what influenced them to changing nature of pedagogical reasoning. This section presents a discussion of the findings for Research Question 2. Each stage of Shulman’s MPRA will be discussed to explain the differences in career stage identified in the data analysis and presented in the findings in Chapter 7. The assertions from Chapter 7 are summarised and shown in Figure 8.54.
Figure 8.54 - Summary of assertions from Chapter 7 – Career stages and pedagogical reasoning

The literature looking at pedagogical reasoning of in-service teachers working with digital technologies is limited and there was only three researchers whose work was included in the literature review. Webb (2002) studied in-service ICT teachers in the UK and who did not provide any details of the teachers she studied, Feng and Hew (2005) studied primary and secondary in-service teachers across a wide range of
experience in the USA and Starkey (2010c) studied beginning teachers in New Zealand. For both studies, Feng and Hew (2005) and Starkey (2010b) recruited digital technologies using teachers to participate in their studies. These studies provide a limited insight into the career development of pedagogical reasoning with digital technologies. This is clearly an area in need of further research and will be discussed in the second section of this chapter.

The findings from this study suggest that teachers need to understand how to use digital technologies before they can use them in teaching or learning. During the comprehension process, many of the participating teachers in this study decided that they would use digital technologies when thinking about what they were going to teach. For some, it was a necessary part of their teaching, as they could not use the digital technologies without understanding how they were going to use them in the classroom. For other participating teachers, they also needed to understand how they were going to use the digital technologies for learning. In many cases the comprehension was not just in learning how to use the digital technologies but how to repurpose them for teaching and or learning.

Many of the early career participating teachers shared how they were learning about their context and what facilitated them in using digital technologies for teaching and/or learning. They needed to understand what was available in their classrooms and the impact of digital technologies across the school. Two early career participating teachers worked in schools where there was limited technical and professional support within the school and they described how they independently experimented in using digital technologies for teaching and/or learning. Both had previously used digital technologies before beginning their teaching careers. In terms of context, the experienced and lead teachers had access to classrooms with better and more reliable digital technologies that enabled them to plan for more sophisticated digital technologies and use a wider range of digital technologies for teaching and learning. Lead teachers were instrumental in managing the set up digital technologies in classrooms and were influencing other teachers in using digital technologies.

The findings suggest that early career teacher reflected on their performance and their new comprehensions focused on how digital technologies were used. More experienced teachers shared their experiences of using digital technologies with other
teachers and their new comprehensions focused on how they were using digital technologies for student learning. Key to this was how the early career teachers were all strong in the use of digital technologies for teaching and/or learning while the more experienced teachers focused on sharing their experiences in using digital technologies.

This section addressed how teachers pedagogically reasoned with digital technologies reviewing the findings from Chapter 7 in light of the literature from Chapter 2, in order to answer Research Question 2. The next section looks at what the findings and the literature to answer Research Question 3.

**RQ3: What influences teachers when they pedagogically reason with digital technologies?**

The findings suggest that the influences across the case studies were classified as either internal or external factors that the participating teachers shared when discussing their pedagogical reasoning with digital technologies. There have been many researchers who have discussed the barriers or factors that inhibit or enable teachers in using digital technologies in the classroom (Balanskat, Blamire, & Kefala, 2008; Bingimlas, 2009; British Educational Communications and Technology Agency (BECTA), 2004; Ertmer, 1999; Lowther, Inan, Strahl, & Ross, 2008; Somekh, 2008). Ertmer (1999) used the terms first order and second order barriers, where first order focused on the external factors and second order was the more personal factors. Using Ertmer classification scheme for this study, internal refers to the professional knowledge and mindset, while, external refers to the school and the education system. This section discusses the assertions from Chapter 7 with regard to the literature presented in Chapter 2.

**External influences**

This section discusses the external influences from the school and the education system. The assertions from Chapter 7 are reproduced in Figure 8.55 where they are discussed in relation to the literature presented in Chapter 2. Ertmer in 1999 explained that first order barriers are “extrinsic to teachers and include lack of access to computers and software, insufficient time to plan instruction and inadequate technical and administrative support” (p. 48). More recently, Ertmer, Ottenbreit-
Leftwich, Sadik, Sendurur, and Sendurur (2012) suggests that many of the first order barriers have been removed as teachers have a greater abundance of digital technologies. In this study, most of the participating teachers did have access to a wide range of digital technologies for use in the classroom. They had access to the state education systems available over the Internet, the learning management system, videoconferencing, state curriculum materials and an educational website with many digital resources. Each participating teacher had school supplied and supported laptop that was loaded with a wide variety of software and enabled them to bring the content available on the Internet into the classroom.

**Figure 8.55 - Summary of assertions from Chapter 7 – External influences**

For most, the classrooms had data projectors or interactive whiteboards and computers for student use as laptops and desktop computers. The participating teachers had access to computers and software with the availability of digital technologies in the school allowing them to use digital technologies in teaching and/or learning. They had access to the state curriculum materials where all the content was already prepared and their role was to customise for their students freeing them of the time constraints of planning, especially when most of the materials incorporated the use of a range of digital technologies. Most of the participating teachers had participated in the *Smart Classrooms Professional Development Framework* where
they had prepared a digital portfolio. The digital portfolios were prepared with support within schools and provided the opportunity for teachers to explore the use of digital technologies.

Prensky (2005) claimed that teachers need to use digital technologies in order to engage students but Bennett, Maton, and Kervin (2008) challenge Prensky’s ideas saying that ‘digital natives’ are not as savvy in using digital technologies in the classroom has he implied and as a consequence education does not need to significantly change to accommodate the use of digital technologies. Most research criticising Prensky’s ‘digital native’ claims has focused on university students in response to ‘digital natives’ entering universities (Bennett, Maton, & Kervin, 2008). The participating teachers in this study shared many examples of how they have been using digital technologies to engage students or ‘digital natives’ in learning and that learning with digital technologies is very different to learning without. One participating teacher shared how he discovered the differences when having to teach the same topic to two very different classes. The students in eLearning classes had become knowledgeable in using digital technologies for learning. Some participating teachers shared how these students would go beyond what they had taught them using the digital technologies to connect with each other outside the classroom.

As highlighted in the assertions, Ertmer (1999) and Bingimlas (2009) agreed that teachers need technical support in order to use digital technologies. Although the participating teachers in this study used many digital technologies they shared how they considered it was important to have school based technical support. Ertmer and Ottenbreit-Leftwich (2013) advocated that technical, administrative and peer support is required to ensure the successfullness of digital technologies programs implemented in schools. All, except two participating teachers, shared how they were encouraged and supported by their Principal in using digital technologies and how they were supported or supported other teachers in the use of digital technologies. The experienced and lead participating teachers were most active in supporting other teachers in their schools with using digital technologies.

There is limited research on parent encouragement of using digital technologies and how parents have influence over a teacher’s use of digital technologies for learning. Barron, Martin, Takeuchi, and Fithian (2009) suggest parents play a number
of roles to assist their children in using digital technologies, including resource provider. Their description suggested that parents were described as resources providers in terms of books, video equipment, software and online accounts. There was no mention of providing a device for student use in the classroom. For a number of participating teachers, the parents were prepared to pay a levy for their children to participate in the eLearning program and there were fewer places than applicants. The same was in the implementation of BYOD with parents having to pay for a device that their child would use in the classroom. In both cases the parents agreed to pay a substantial cost for their children to have their own digital technologies that would be used for learning.

There is limited research looking at how pre-service teachers are exposed to digital technologies while on practicum. Meagher, Ozgun-Koca, and Edwards (2011) shared how pre-service teachers develop a positive attitude to using digital technologies and the quality of their planning with digital technologies when they are exposed to digital technologies on their practicum. One of the study's early career teachers described how she was exposed to digital technologies while on her practicum and that experience opened her eyes to possibilities of using digital technologies in the classroom. She was placed at a school where her supervising teacher used digital technologies and the school offered lunchtime professional development for pre-service teachers. Exposure enabled the participating teacher to build her confidence and skills in using digital technologies to the digital technologies she could access in a school and the mathematics department where most teachers did not use digital technologies for teaching.

**Internal influences**

This section discusses the internal more personal influences that focus on the knowledge and mindset of the teacher. The assertions from Chapter 7 are reproduced in Figure 8.56 and are discussed in relation to the literature presented in Chapter 2. In contrast to first order barriers, Ertmer (1999) suggested second order barriers “are intrinsic to teachers and include beliefs about teaching, beliefs about computers (and) established classroom practices” (p. 48). As highlighted in the assertions, studies investigating second order barriers can contribute a more personal perspective of the barriers that inhibit teachers from using digital technologies in the classroom.
The literature from the Knowledge Growth in Teaching project emphasises there was a complex relationship between knowledge, the mindset of the teacher when they pedagogically reason (Gudmundsdóttir, 1988; McGraw, 1987; Ringstaff, 1987; Ringstaff & Haymore, 1987). Many studies discussed in the literature review have mentioned the beliefs and knowledge that teachers shared when discussing their pedagogical reasoning (Cunningham, 2007; Endacott & Sturtz, 2015; Meredith, 1995; Peterson & Treagust, 1992, 1995, 1998). Studies looking at the use of digital technologies (Feng & Hew, 2005; Finger & Finger, 2013; Keast, Loughran, Mitchell, & Panizzon, 2014; Starkey, 2010c; Webb, 2010, 2011a) have implicated knowledge and beliefs when discussing pedagogical reasoning. Webb (2010, 2011) included ideas, values and beliefs in her model as an input for transformation, instruction and evaluation processes arguing that teacher beliefs, ideas and values about using digital technologies influence how they use digital technologies in the classroom. Along with looking at teachers' internal mindsets, Webb included the knowledge base as an input for many processes and she recently updated her model to reflect how TPACK influenced pedagogical reasoning. Many of these studies suggest that if teachers have the knowledge of digital technologies and believe that digital technologies help in
teaching or learning, they may decide to use digital technologies in the classroom. Instead of using second order or addressing each type of mindset, for this study the term professional mindset is used, as it encompasses beliefs, values, motivation, ideas and experience. This section attempts to identify the professional mindset and knowledge base of the participating teachers that enabled them to use digital technologies.

Ertmer and others (Ertmer, 1999, 2005, 2006; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ertmer, Ottenbreit-Leftwich, & Tondeur, 2014) have claimed beliefs as one of the strongest personal factors for teachers in deciding to use digital technologies in the classroom. The findings suggest that the teachers in this study held beliefs about their abilities to use digital technologies, and they believed that digital technologies were important for teaching and/or learning and engaging their students.

Many of the participating teachers had experienced using digital technologies prior to teaching - the early career teachers for example had all used digital technologies in their previous careers. All of the teachers used digital technologies in their lives outside of school and could see the benefit if using digital technologies for teaching and learning, where some even emphasised the importance of making learning relevant with digital technologies. All of the participating teachers had the personal motivation and the confidence to use the digital technologies that were available to them and were also not afraid to not be an expert in the digital technologies before using them in the classroom. One participating teacher shared how he used the digital technologies in the classroom during teaching to help answer student questions and demonstrating how he used the Internet to find relevant answers.

Identified in the assertions and in line with Shulman’s research, this study could not ignore the relationship between knowledge and pedagogical reasoning. Throughout the discussion of the findings there have been many mentions of the knowledge required for pedagogical reasoning with digital technologies. Gudmundsdóttir (1988) included a subset of Shulman’s knowledge base but explained that her focus was on the before and during aspects of pedagogical reasoning not the after processes. The elements she included were: content knowledge; pedagogical content knowledge;
general pedagogical knowledge; and knowledge of learner. She proposed the model but did not discuss her findings in relation to the model to confirm it validity. Webb (2002) included all elements of Shulman’s knowledge base as data flows into the various processes of pedagogical reasoning and the detailed view of transformation. The Model of pedagogical reasoning was incomplete as there were some unnamed data flows. In a subsequent version (Webb, 2010) she updated some of the data flows to incorporate TPACK (as TPCK). In following versions of her model she changed the presentation and only incorporated some elements of the knowledge base. In all of her publications (Webb, 2002, 2010, 2011a, 2014; Webb & Cox, 2004) where she mentioned pedagogical reasoning and the knowledge base, she suggested the relationship but did not provide research to validate her claims.

Mishra and Koehler (2006) remind us that some digital technologies have been specifically designed for educational use, while others, they suggested are 'repurposed' for educational use. The findings support this idea in that many of the teachers repurposed digital technologies for use in the classroom. Therefore, they needed to know how to use and to be confident that they could repurpose digital technologies for use in the classroom. A prime example was the use of MSOneNote in the eLearning classroom. MSOneNote is a tool to help students keep notes about various topics similar to a folder with many sections. The marketing material for MSOneNote clearly advertises how students can use it for digital note taking. Two of the participating teachers in this study used MSOneNote as a communication and student work tool. Teachers prepared OneNote files on a unit of work and then shared that with their students. Another example is using MSPowerPoint as a tool for accessing eBooks. The findings suggest that teachers need to know how to use a range of ‘purposeful’ digital technologies.

Another finding suggests that digital technologies impact all aspects of the knowledge base, as teachers use the Internet to access content, curriculum and information about different pedagogical approaches especially when using digital technologies. The participating teachers in this study used the Internet to share content with other teachers in order to share how they used digital technologies to teach content, essentially sharing their PCK and TPACK with each other.
As obvious from the literature review, the research has tended to focus on TPACK or PCK leaving the remaining knowledge base components under researched. The findings suggest that the participating teachers planned to enact their PCK or TPACK when they planned their unit and many selected from the state curriculum materials, which included many examples of where purposeful digital technologies could be used for teaching and learning. The participating teachers shared how they were able to enact their PCK or TPACK during teaching after checking for student understanding and finding that they needed to select new approaches. In one case, Drago was able to switch from TPACK to PCK when he needed to move away from an approach that used digital technologies. As these teachers had developed their PCK and TPACK, they were able to interchange between the two when they needed to use or not use digital technologies. The findings suggest that is a complex relationship between PCK and TPACK and how teachers can move from one to the other depending on how digital technologies are used by the teacher or the students.

**Limitations of the study**

Many limitations of this study have already been discussed, and this section will review them. First, the sample size of seven teachers prevents the findings to be generalised across a larger population, however the case study method did allow for the interpretation of commonalities across cases. Second, this study relied on the self-reported reflections through interview and their digital portfolios of the teachers describing their experiences of pedagogically reasoning with digital technologies. The case study method was useful in this regard as it was the intent of the study to explore the experiences of teachers and them communicating of their experiences allowed the researcher to build rich case studies that described their pedagogical reasoning with digital technologies. Third, the relationship of the researcher with some of the participating teachers may have influenced their participation by them feeling obliged to answers to research questions they felt the researcher was seeking. While this is possible, the nature of the relationship also enabled the researcher into their schools to recruit them other teachers. The researcher’s knowledge of the teachers and their history of their relationship served to enhance the interpretation of the experiences they shared enabling the researcher to not misrepresent the teachers in their cases.
Implications of the research findings

The implications for this study, firstly, confirm that Shulman’s work in the definition of the processes of pedagogical reasoning is still relevant for teachers when they have to incorporate digital technologies. This has the potential to promote a uniform approach that benefits teacher education, teacher practice, teacher evaluation and educational research. Further research to investigate the impact of pedagogical reasoning on these four areas would also be prudent. This section will provide implications for each of these areas.

The primary focus of this thesis was to investigate how teachers pedagogically reason with digital technologies. The outcomes from the seven case studies show that pedagogical reasoning of teachers continues to be an important aspect of teaching and now, with the affordances of digital technologies, understanding how teachers pedagogically reason with digital technologies for teaching and learning can provide some important insights into teacher thinking. This study has confirmed that Shulman’s MPRA provides a useful framework for exploring teachers’ pedagogical reasoning to understand the impact of digital technologies. The seven case studies presented in this thesis described their pedagogical reasoning in a variety of different teaching scenarios with the findings showing an alignment to Shulman’s work.

The findings arising from this research have practical implications that are relevant to pre-service teacher education and in-service teacher development. There are important lessons to be learned about pedagogical reasoning and then pedagogical reasoning with digital technologies. This work has provided a richer and deeper review of Shulman’s original work to understand how teachers’ pedagogically reason with digital technologies and this can be used to help pre-service teachers understand the complex nature of teaching and the interplay of the wide range of knowledge and give in-service teachers the framework for discussion. This work has explored this foundation, and added, by acknowledging and discussing the influence of digital technologies. It is recommended that teacher education curriculum include not only the importance of pedagogical reasoning but pedagogical reasoning with digital technologies.

The findings presented in Chapter 4, 5 and 6, discuss the experiences of seven teachers as they use digital technologies in the classroom. Their stories provide...
insights into the work they do as new teachers. The discussion of their pedagogical reasoning and their knowledge base give an indication of the complex interplay of the knowledge needed to teach. Teacher education needs to prepare teachers so that understand the knowledge required and the processes of pedagogical reasoning. While in-service teacher development can use this framework to explain how they pedagogically reason with digital technologies.

One early career participating teacher highlighted the importance of her practicum experience where her supervising teacher demonstrated how she used a range of digital technologies and she participated in a lunchtime programme that focused on teaching teachers about the digital technologies available at the school. Even though she had experience in using digital technologies prior to commencing her teacher education this highlights that pre-service teachers with experience in using digital technologies still need exposure to mentor teachers who use digital technologies and when they do have exposure they quickly develop the confidence to use digital technologies in the classroom for teaching and/or learning. They, then, become influencers/mentors in their schools by sharing with other teachers how they use the digital technologies for teaching in their subject areas. The more experienced teachers included in this thesis described how they were sharing their professional experiences with digital technologies in order to influence other teachers in their school in using digital technologies that were available to them. This highlights the importance of teacher professional development, run in schools by teachers based in that school, provide an important part in the process of teacher development.

All of the teachers in this study completed a teacher education digital portfolio. For most teacher education programs, portfolios that are prepared are usually developed as a solo exercise in evidence gathering to show competence against the professional standards. Digital portfolios can be used as places for reflection and they have the “potential to make unique linkages, connections and reflections among multiple experiences and artefacts” (Parkes, Dredger, & Hicks, 2013, p. 101). Reflection is a valuable tool, as it enables rich learning weaving together theory, context and practice (Parkes, Dredger, & Hicks, 2013). This authentic learning enables students to bring together the theory of education studies to their practices as a pre-service teacher. When moving to in-service many pre-service teachers do not maintain their digital portfolio past job recruitment or graduation. Shepherd and Skrabut (2011)
explain that “research on e-portfolio retention suggests that teachers quickly abandon practices following career milestones” (p.32).

All, except two as their schools did not participate in the Smart Classrooms Professional Development Program, completed a digital portfolio that contained up to three items of evidence with a justification of how they pedagogically reasoned with digital technologies. These digital portfolios contained rich evidence of their reflection on teaching with digital technologies and provided a valuable look at their pedagogical reasoning with digital technologies. Shepherd and Skrabut (2006) acknowledge that electronic portfolios “can increase reflection, develop content and pedagogy skills and facilitate communication between teachers and administrators” (p.31). Karsenti, Dumouchel, and Collin (2014) suggest that this is a reflective triangulation where “thoughtful consideration of the required professional competencies, awareness of the degree to which these competencies have been developed and selecting the materials that would most aptly and appropriately represent these”(p. 3488). This thinking is translated into written word as “it helps them extrapolate from their experience, take a step back, and adopt a critical stance” (Karsenti, Dumouchel, & Collin, 2014, p. 3488). Reflection can lead to improvement and a move towards a model of a quality teacher as defined in the standards.

Finally, pre-service teachers would benefit from examining detailed case studies of in-service teachers or if not full case studies, at least restories of teaching practice. In-service teachers need to help in developing these case studies or restories that reflect the realities of teaching in the classroom. It is important that the case studies highlight the processes of pedagogical reasoning and the interplay of knowledge. In constructing case studies or restories, in-service teachers participate in powerful professional conversations between author and teacher that help articulate their pedagogical reasoning that can be shared with pre-service teachers to help them develop their pedagogical reasoning. When these case studies or restories include teaching and learning with digital technologies it can better prepare pre-service teachers to be able to teach with digital technologies when they undertake practicum or when they enter the classroom as in-service teachers.

The Australian Professional Standards for Teachers clearly articulate the professional standards of teachers at various career stages. To provide insights into
how these standards are evidenced in practice, the Model of Technological Pedagogical Reasoning provides a framework to view the work of teachers to understand how the knowledge of teachers is essential to pedagogical reasoning with or without digital technologies. The standards indicate how pedagogical reasoning provides the framework by using the terminology of – plan, instruct, evaluate and reflect, but there has been no framework that shows how they all relate together. The Model of Technological Pedagogical Reasoning shows how knowledge and pedagogical reasoning are linked together.

Suggestions for future research

This study aimed to understand how do teachers’ pedagogically reason with digital technologies. In attempting to understand pedagogical reasoning raised further questions that could form the basis for further research.

Joining PCK and TPACK research

The TPACK research draws upon the PCK research to justify its existence but the two fields have remained separate with little work from each research community looking at the work of the other. In particular, the current PCK researchers have completed and reported on multiple projects over the last 25 years investigating the development of science teachers PCK. There is a need for new research with the aim of bringing these constructs together in order to better understand the complexities of PCK when working with digital technologies and the links to pedagogical reasoning.

The focus of this research has been on the developing an understanding of PCK where PCK is developed through reflection in and on action. Except for the inclusion of reflection on practice, stories of experience of teaching a particle topic captured in Pap-eRs or the planning questions in CoRes, there has been little research looking at the relationship between pedagogical reasoning and PCK. More recently a new generation of researchers at Monash University have begun looking at pedagogical reasoning and its role in the development of PCK. Research questions worthy of further research are: How does teachers’ pedagogical reasoning impact topic-specific professional knowledge of study areas, amplifiers and filters and classroom practices of teachers? And further, their pedagogical reasoning with digital technologies?
Research to understand Technological Pedagogical Reasoning

This study has provided restories of teaching practice of early career, experienced and lead teachers that describe their pedagogical reasoning with digital technologies. These restories begin to bridge the space between pedagogical reasoning as a philosophical construct and pedagogical reasoning as a construct with meaning to teaching practice. While the restories provide a view of pedagogical reasoning in practice, more research of pedagogical reasoning with digital technologies is needed. The small number of participating teachers limits the findings of this study, however, this study could be replicated with a larger number of teachers to yield more restories, as rich examples of pedagogical reasoning in practice. A research question worthy of further research is: How do teachers technologically pedagogically reason with digital technologies?

Considering that this study was completed in Queensland, Australia, research from different contexts in Australia and internationally would enrich the understanding of pedagogical reasoning with digital technologies. The participating teachers for this study were predominantly from a primary school setting, therefore more research from secondary schools and extending to other teaching contexts including university contexts might yield a better understanding of how pedagogical reasoning operates at different levels of education. Research questions worthy of further research are: How do teachers' pedagogically reason with digital technologies in secondary education? Or, a higher education setting? Or, an early childhood setting? Or, in pre-service education?

More research on pedagogical reasoning with digital technologies across career stages is needed as this study has included a small number of teachers in three different career stages. The findings highlight that there are differences in each career stage and that could be further explored to learn more about teachers pedagogical reasoning. To help prepare better beginning teachers, help understand the teaching practices of experienced teachers and how they share their knowledge in mentoring beginning teachers, and finally, in understanding how teachers are leading schools in changing their approach to digital technologies. Research questions worthy of further research are: How do beginning teachers pedagogically reason with digital technologies? How do experienced teachers pedagogically reason with digital technologies?
technologies? How do pre-service teachers pedagogically reason with digital technologies? How do lead teachers pedagogically reason with digital technologies?

Restorying as a methodology

Restorying is a technique where the researcher retells:

*the story in their own words. They do this to provide order and sequence to a story that might have been told out of sequence ... the researcher provides a chronological sequence and causal link among ideas* (Creswell, 2015, p. 511).

In this thesis restories have been selected based on the criteria relevant for to the purpose of the researcher, for example relevant to this study, critical events, actions or decisions in relations to pedagogical reasoning with digital technologies. Most of the restories came the participating teacher retelling of an experience of using digital technologies they thought relevant for the study. These stories were drawn from interview data and personal reflections from their digital portfolios. These stories were then restory-ed by the researcher to be included in this thesis. The idea was not new, as Shulman in his original article published in the Harvard Education Review (Shulman, 1987b), used an extended vignette or story from Sigrún Gudmundsdóttir (1988) thesis that described Nancy. In analysing the data and a call for papers for the new *Handbook of Technological Pedagogical Content Knowledge for Educator*, the story about Nancy resonated, in how important it was in discussing pedagogical reasoning for incorporating a teachers voice through a story. For this reason a new version of Nancy was constructed based on the work of Carmelina and restory-ed into a chapter that investigates the importance of pedagogical reasoning with digital technologies (Smart, Finger, & Sim, 2016).

By beginning each case study in this way, it provides a realistic, valid thick description that explicates situated meanings (Geertz, 1973) and concrete detail (Bochner, 2000). The restory is given suitable detail to capture the essence of their teaching and retelling their story in enough detail for the reader to be able to come to their own “conclusions about the scene” (Tracy, 2010, p. 843). Bazeley (2013) suggested it is “often easier for a participant to tell the story of an experience then to respond to questions, provide explanation or proffer opinions” (p. 201). As this study has shown, restorying offers a unique opportunity to capture the realities of teaching and should be recognised a valid methodology.
Conclusion

This thesis focuses on understanding how teachers’ pedagogically reason with digital technologies. The conceptual model presented in Chapter 3, guided the data gathering process and was used to summarise the key findings for each aspect of the research. This next section presents the final conclusions from this thesis.

The first research question was: How do teachers pedagogically reason with digital technologies? The seven participating teachers in this study used a range of digital technologies for teaching and learning. By describing their processes of pedagogically reasoning, elements of their pedagogically reasoning with digital technologies emerged from their data. For understanding their pedagogical reasoning, stories were constructed from their data that were used to explain how they pedagogically reasoned with digital technologies. This is reflected in the Model of Technological Pedagogical Reasoning.

The second research question explored how teachers pedagogically reasoned with digital technologies across career stages. The participating teachers were grouped based on their experience. New teachers were grouped as ‘early career’, teachers who had been teaching for a number of years were grouped as ‘experienced’ and teachers who were leading their school through change were grouped as ‘lead’. Grouping the teachers this way highlighted the differences in the roles they played. Early career teachers were developing as teachers but the three early career teachers in this study, had career changed into teaching and had previous experience in using digital technologies. This put them at a distinct advantage of having the confidence and skill of using digital technologies in the classroom. The two experienced teachers had been using digital technologies for a number of years and were influential in their schools. They described how their role in the school involved mentoring and helping other teachers in using digital technologies. The final two lead teachers were influential in their schools as they shares stories of how they were leading their schools in changing teaching practices.

The third research question explored the influences that impeded or enabled the participating teachers in using digital technologies for teaching and/or learning. Many factors were contextual where they were either viewed from the education system or school. All participating teachers worked in the state education system that
offered many affordances with the state educational technologies that were available over the Internet for them to use in teaching and learning. Five of the participating teachers took advantage of the affordances, while for the remaining two, their school context did not communicate the affordance and it was not suitable for their students. External factors varied between contexts and were influenced by school policies, availability, support and culture. There were many personal factors that were present that enabled them to use digital technologies in teaching and/or learning. All of the teachers held a personal motivation and confidence to use digital technologies for teaching and learning. Many had previous experience of using digital technologies prior to teaching. All believed that students engaged in learning when they used digital technologies for teaching. Participating teachers held a wide knowledge of digital technologies to be able to use them for teaching and learning. Some were purposely designed for education while others were repurposed. All of the participating teachers described elements of their technological pedagogical content knowledge (TPACK) that enabled them to teach with digital technologies.

The excellent use of digital technologies of Donnatella, Drago, Viviana, Carmelina, Florentina, Alessandra and Marcelia, raises questions about the how digital technologies can be effectively used in the classroom. For most, their pedagogical reasoning was triggered in the moment of a dilemma or when their plans needed to change. When in the moment of a dilemma, is when a teacher’s pedagogical reasoning is most visible. In the classrooms of these teachers, there were many dilemmas or challenges that the teachers faced when working with digital technologies for teaching and/or learning. These teachers were extremely effective in using digital technologies, and what distinguishes them from other teachers, is how they efficiently and effectively managed the use of digital technologies for both teaching and learning. They demonstrated that digital technologies, as part of the teaching and learning landscape, has pushed the dilemmas and challenges to a whole new dimensions, suggesting, that, it is a really important time to be researching pedagogical reasoning and more importantly, pedagogical reasoning with digital technologies or Technological Pedagogical Reasoning.
REFERENCES


TECHNOLOGICAL PEDAGOGICAL REASONING - THE DEVELOPMENT OF TEACHERS' PEDAGOGICAL REASONING WITH TECHNOLOGY OVER MULTIPLE CAREER STAGES

References and Appendices


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doi:10.1007/bf02299597


doi:10.1007/bf02504683


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References and Appendices


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doi:10.1007/s10639-012-9216-x

doi:10.1080/14759390400200183


APPENDIX A – RESEARCH PROJECT APPROVAL

Dear Vicky,

I am pleased to advise that the Dean (Research) has executive approved the recommendation from the Academic Element the School of Education and Professional Studies that your Doctor of Education revised confirmation of candidature research paper be confirmed. Please find enclosed a copy of the assessors’ comments to guide you in your research.

Congratulations on this achievement and best wishes for the remainder of your candidature.

Yours sincerely,

[Signature]

Sonya Grieve
Candidature Coordinator
Higher Degree Research Student Centre

cc A/Pro Cheryl Sim School of Education and Professional Studies, Prof Glenn Ferguson School of Education and Professional Studies, A/Prof Rod Gardner School of Education and Professional Studies, Dr Leonie Rowan School of Education and Professional Studies

Gold Coast Logan Mackay Nathan South Bank
TECHNOLOGICAL PEDAGOGICAL REASONING - THE DEVELOPMENT OF TEACHERS' PEDAGOGICAL REASONING WITH TECHNOLOGY OVER MULTIPLE CAREER STAGES

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APPENDIX B – GRIFFITH UNIVERSITY HUMAN RESEARCH ETHICS APPROVAL

Griffith University

HUMAN RESEARCH ETHICS COMMITTEE

ETHICAL CLEARANCE CERTIFICATE

This certificate was generated on 12-10-2011.

This certificate confirms that protocol 'Technological Pedagogical Reasoning (TPR): The development of teachers' pedagogical reasoning with technology at multiple career points.' (GU Protocol Number EDN/89/11/HREC) has ethical clearance from the Griffith University Human Research Ethics Committee (HREC) and has been issued with authorisation to be commenced.

The ethical clearance for this protocol runs from 03-10-2011 to 01-03-2013.

The named members of the research team for this protocol are:
- Mrs Vicky Smart
- APro Cheryl Sim
- APro Glenn Finger

The research team has been sent correspondence that lists the standard conditions of ethical clearance that apply to Griffith University protocols.

The HREC is established in accordance with the National Statement on Ethical Conduct on Research Involving Humans. The operation of this Committee is outlined in the HREC Standard Operating Procedure, which is available from www.gu.edu.au/or/ethics.

Please do not hesitate to contact me if you have any further queries about this matter.

Gary Allen
Manager, Research Ethics
Office for Research
G39 room 3.55 Gold Coast Campus
Griffith University
Phone: 3735 5585
Faximile: 5552 9058
Email: g.allen@griffith.edu.au
APPENDIX C – DEPARTMENT OF EDUCATION AND TRAINING ETHICS APPROVAL

Queensland Government

Department of Education and Training

22 November 2011

Vicky Smart
12 Shuttleworth St
LURAGY QLD 4112

Dear Mrs Smart

Thank you for your application seeking approval to conduct research titled “Technological Pedagogical Reasoning (TPR): The development of teachers’ pedagogical reasoning with technology at multiple career points” in Queensland State schools. I wish to advise that your application has been approved.

You may approach principals of the schools nominated in your application and invite them to participate in your research project. As detailed in the Department’s research guidelines the following applies to the study:

- You need to obtain consent from the relevant principals before your research project can commence.
- Principals have the right to decline participation if they consider that the research will cause undue disruption to educational programs in their schools.
- Principals have the right to monitor any research activities conducted in their facilities and can withdraw their support at any time.

This approval has been granted on the basis of the information you have provided in your research proposal and is subject to the conditions detailed below:

- Personnel of and adherence to the Department’s standard “Tenets and Conditions of Approval to Undertake Research” in Departmental sites is required as outlined in the document at http://education.qld.gov.au/corporate/researchforms_conditions.pdf
- Any changes required by your institution’s ethics committee must be submitted to the Department of Education and Training for consideration before you proceed.
- Any violations to the research proposal as originally submitted, including changes to data collection, additional research undertaken with the data, or publication based on the data beyond what is normally associated with academic studies, should be submitted to the research office via email. Significant violations will require the submission of a new application.
- Papers and articles intended for publication that are based on data collected from Queensland State schools and/or Departmental sites should be provided to the Department for comment before release.
- Under no circumstances should any publications disclose the names of individuals or schools.
- You are required to contact the Department if you are contacted by the media about research activities conducted on Departmental sites or if you intend to use a media release about the study.

Victoria L Smart, Doctor of Philosophy
Griffith University, 2016
APPENDIX D – CONSENT PACK – PRINCIPAL

[Consent Pack Text]

Victoria L Smart, Doctor of Philosophy
Griffith University, 2016
What you will be asked to do
You need to complete the attached consent form and return it to the researcher.

The basis by which participants will be selected
Teachers will be purposefully sampled based on them being known to the researcher and have indicated to the researcher that they are willing to participate.

In each career stage it is expected that two teachers will be identified from the state and private sectors and these teachers will represent early childhood, primary and secondary. It is hoped that up to 18 teachers will be identified to participate in this project.

The expected benefits of the research
It is expected that evidence will be found of the decisions to incorporate ICT into instructional planning and that this evidence may be termed Technological Pedagogical Reasoning. It is anticipated that the results from this study will be able to improve the understanding of the ICT skills that teachers use in curriculum planning.

Risks to you or your school
As responses will remain anonymous, it is unexpected that there will be any risk to you or your school. You are free to withdraw from the study at any time if you feel exposed to the risks listed above.

Your confidentiality
• No identifiable data will be collected and therefore participants will not be identifiable in any publication or reporting.
• All responses will remain confidential.
• Interviews will be recorded, will be transcribed and then be used for entry into a suitable qualitative package for analysis. Recordings and transcripts will be stored in a lockable file for the duration of the project and will only be used by the project team.
• The class lesson will be video recorded. This video will be used in a video stimulated recall interview with the teacher where the complete contents of the video will be viewed. The video will then be edited to:
  o remove any referrals to identify;
  o hide any faces of the children;
  o delete inappropriate comments; and
  o any other material deemed inappropriate by the teacher.
Once finalised a copy of the video will be reviewed by the teacher before authorising access for university use by the researcher.
• Once the project has been completed all audio recordings and transcripts will be stored for the required time in accordance with university policy and then they will be destroyed in line with this policy.
Your participation is voluntary
Your participation is voluntary. Your participation will in no way impact upon your relationship with Griffith University. You are free to withdraw from the study at any time.

Questions / further information
If you have any questions about the research or your participation in it, please contact Vicky Smart by email (v.smart@griffith.edu.au).

The ethical conduct of this research
Griffith University conducts research in accordance with the National Statement on Ethical Conduct in Human Research. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3735 5585 or research-ethics@griffith.edu.au.

Privacy Statement
In accordance with Queensland Information Standard 42 (which applies where the data will be collected or generated in an identified form and applies to human research conducted under the auspices of the University), the information sheet must include a legal privacy statement.

The conduct of this research involves the collection, access and / or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University's Privacy Plan at http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan or telephone (07) 3735 5585.

Feedback to you
As your responses will be anonymous individual reporting will not be possible.

If you are interested in the results of the project please contact Vicky Smart by email (v.smart@griffith.edu.au).
Technological Pedagogical Reasoning (TPR): The development of teachers' pedagogical reasoning with technology from multiple career points.

CONSENT FORM – School Principal

Who is conducting the research

A/Prof Cheryl Sim
School of Education and Professional Studies
3735 5926
c.sim@griffith.edu.au

A/Prof Glenn Finger
School of Education and Professional Studies
555REMOVETHISTEXT
REMOVETHISTEXT28618
p.finger@griffith.edu.au

Vicky Smart
School of Education and Professional Studies
0403 303 187
v.smart@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include signing a consent form;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 5686 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to participate in the project.

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APPENDIX E – CONSENT PACK – STUDENTS

Griffith UNIVERSITY
School of Education and Professional Studies

Technological Pedagogical Reasoning (TPR): The development of teachers’ pedagogical reasoning with technology from multiple career points.

LETTER TO CLASS STUDENTS

<SCHOOL NAME>

31 August 2012

Dear parent/caregiver

This letter is to provide you with information regarding research I am undertaking on Technological Pedagogical Reasoning (TPR). The development of teachers’ pedagogical reasoning with technology from multiple career points in which your child’s teacher <teacher name> has agreed to participate.

Your child is a member of a class which will be video recorded.

The video recording will be of only one lesson and will take place during the <lesson time>. The focus is on the teacher’s use of Information Communication Technology (ICT) in their teaching as your teacher has been identified as a leader in the use of ICT in their classroom.

You are being asked for permission for your child to be included in the video recorded lesson. If you do not wish for your child to be video recorded they will still be able to attend the lesson but will sit out of range of the cameras view.

Thank you in anticipation of your cooperation of this research project. Please complete the attached form and return to your teacher OR reply by email to your teacher indicating your consent.

I greatly appreciate the willingness of <teacher name> to participate in this research.

Thank you very much for your assistance

Yours sincerely

Vicky Smart
Doctor of Education - Student
School of Education and Professional Studies
Griffith University
TECHNOLOGICAL PEDAGOGICAL REASONING - THE DEVELOPMENT OF TEACHERS' PEDAGOGICAL REASONING WITH TECHNOLOGY OVER MULTIPLE CAREER STAGES

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**Technological Pedagogical Reasoning (TPR): The development of teachers’ pedagogical reasoning with technology from multiple career points.**

**INFORMATION SHEET – Classroom Student**

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<th>A/Prof Cheryl Sim</th>
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<td></td>
<td>Prof Glenn Finger</td>
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<tr>
<td>This research project is being conducted as part of the research higher degrees requirements of study by Vicky Smart for the award of Doctor of Education at Griffith University. In order to complete the doctoral studies a research project must be completed, a thesis compiled and that thesis submitted for evaluation. A/Prof Cheryl Sim and Prof Glenn Finger are the research supervisors of Vicky Smart and the A/Prof Cheryl Sim is the nominated Chief Investigator for the research project.</td>
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As there is pressure for all teachers to develop their Information Communication and Technology (ICT) skills to meet the needs of their students, this research is to obtain an understanding of how teacher across career stages plan with technology. The goal is to see how teachers incorporate ICT into their lesson planning and whether they can develop Technological Pedagogical Reasoning.

The aim is to compare the results of each activity to determine the Technological Pedagogical Reasoning of teachers at various career points.

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<th>What you will be asked to do</th>
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<td>The research process will include the following four steps with the nominated teacher and Activity 3 includes the involvement of your child:</td>
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<td>1. Initially the researcher will meet with the teacher participant to obtain background information for the project for example: biographical data, discuss ICT use in the classroom plus ICT planning. (Approximately 60 mins)</td>
</tr>
<tr>
<td>2. At a further meeting the teacher will plan a lesson for a class to show the use of ICT in the classroom. (Approximately 60 mins)</td>
</tr>
<tr>
<td>3. This lesson will be recorded on video where the focus will be on the teacher, not on the students in the class or classroom management. (Approximately 60 mins)</td>
</tr>
</tbody>
</table>
The lesson will be followed with a stimulated recall interview in which the video recording is replayed and the teacher explains aspects of the lesson to the researcher. (Approximately 60 mins)

Task 3 will only impact students. Where they will be video recorded from the rear of the classroom. The students will be recorded for only one lesson and the duration of the lesson will be as per normal timetabled class. The video recorder will be placed at the back of the room and the focus will be on the teacher presenting the lesson.

Students will participate in the class as per normal, the video will be reviewed to ensure students are not identifiable and the video will be edited to hide student faces if shown.

The basis by which participants will be selected
Teachers will be purposefully sampled based on them being known to the researcher and have indicated to the researcher that they are willing to participate.

In each career stage it is expected that two teachers will be identified from the state and private sectors and these teachers will represent early childhood, primary and secondary. It is hoped that up to 18 teachers will participate in this project.

The expected benefits of the research
It is expected that evidence will be found of the decisions to incorporate ICT into instructional planning and that this evidence may be termed Technological Pedagogical Reasoning. It is anticipated that the results from this study will be able to improve the understanding of the ICT skills that teachers use in curriculum planning.

Risks to you
As responses will remain anonymous, it is unexpected that there will be any risk to you or your child. You are free to withdraw from the study at any time if you feel exposed to the risks listed above.

Your confidentiality
- No identifiable data will be collected and therefore participants will not be identifiable in any publication or reporting.
- All responses will remain confidential.
- Interviews will be recorded, will be transcribed and then be used for entry into a suitable qualitative package for analysis. Recordings and transcripts will be stored in a locked file for the duration of the project and will only be used by the project team.
- The class lesson will be video recorded. This video will be used in a video stimulated recall interview with the teacher where the complete contents of the video will be viewed. The video will then be edited to:
  - remove any referrals to identify;
  - hide any faces of the children;
  - delete any inappropriate comments; and
  - any other material deemed inappropriate by the teacher.
- Once finalised a copy of the video will be reviewed by the teacher before authorising access for university use by the researcher.

Your participation is voluntary
You and your child’s participation is voluntary. You and your child’s participation will in no way impact upon your relationship with Griffith University. You or your child is free to withdraw from the study at any time.
Questions / further information
If you have any questions about the class lesson or your child’s participation in it, please contact Vicky Smart by email (v.smart@griffith.edu.au).

The ethical conduct of this research
Griffith University conducts research in accordance with the National Statement on Ethical Conduct in Human Research. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3735 5585 or research-ethics@griffith.edu.au.

Privacy Statement
In accordance with Queensland Information Standard 42 (which applies where the data will be collected or generated in an identified form and applies to human research conducted under the auspices of the University), the information sheet must include a legal privacy statement.

The conduct of this research involves the collection, access and/or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University’s Privacy Plan at http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan or telephone (07) 3735 5585.

Feedback to you
If you are interested in the results of the project please contact Vicky Smart by email (v.smart@griffith.edu.au).
PLEASE RETURN THIS SHEET SIGNED

Technological Pedagogical Reasoning (TPR): The development of teachers’ pedagogical reasoning with technology from multiple career points.

CONSENT FORM – Classroom Student

Who is conducting the research

AVProf Cheryl Sim  
School of Education and Professional Studies  
3735 5926  
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Prof Glenn Finger  
School of Education and Professional Studies  
555REMOVETHISTEXT  
REMOVETHISTEXT28618  
g.finger@griffith.edu.au

Vicky Smart  
School of Education and Professional Studies  
0403 303 187  
v.smart@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my child’s involvement in this research will include participation in a video recorded lesson;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me or my child from my child’s participation in this research;
- I understand that my child’s participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I or my child are free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and

* I agree to allow my child to participate in the project.

<table>
<thead>
<tr>
<th>Student Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent/Caregivers Name</td>
</tr>
<tr>
<td>School</td>
</tr>
<tr>
<td>Signature</td>
</tr>
<tr>
<td>Date</td>
</tr>
</tbody>
</table>
APPENDIX F – CONSENT PACK – TEACHER

Technological Pedagogical Reasoning (TPR): The development of teachers’ pedagogical reasoning with technology from multiple career points.

INFORMATION SHEET – Teacher

Who is conducting the research
A/Prof Cheryl Sim
School of Education and Professional Studies
3735 5926
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Prof Glenn Finger
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5552 8618
g.finger@griffith.edu.au

Vicky Smart
School of Education and Professional Studies
0403 303 187
v.smart@griffith.edu.au

Why is the research being conducted?
This research project is being conducted as part of the research higher degrees requirements of study by Vicky Smart for the award of Doctor of Education at Griffith University. In order to complete the doctoral studies a research project must be completed, a thesis compiled and that thesis submitted for evaluation. A/Prof Cheryl Sim and Prof Glenn Finger are the research supervisors of Vicky Smart and the A/Prof Cheryl Sim is the nominated Chief Investigator for the research project.

As there is pressure for all teachers to develop their Information Communication and Technology (ICT) skills to meet the needs of their students, this research is to obtain an understanding of the ICT skills that post-graduate pre-service teachers bring to the teaching profession. The goal is to see how post-graduate pre-service teachers incorporate ICT into their instructional planning and whether they can develop Technological Pedagogical Reasoning.

The aim is to compare the results of each activity to determine the Technological Pedagogical Reasoning of teachers at various career points.

In the interviews and class video, neither the participants name nor the name of the school will be used at any time and information will remain confidential to the teacher participant and the researcher.

The teacher participant will receive feedback at the end of the data gathering process and data analysis phases and they will be given the opportunity to check that the data accurately represents their point of view.

What you will be asked to do
The research process will include:
1. Initially the researcher will meet with the teacher participant to obtain background information for the project for example: biographical data, discuss ICT use in the classroom plus ICT planning. (Approximately 60 mins)

2. At a further meeting the teacher will plan a lesson for a class to show the use of ICT in the classroom. (Approximately 60 mins)

3. This lesson will be recorded on video where the focus will be on the teacher, not on the students in the class or classroom management. (Approximately 60 mins)

4. The lesson will be followed with a stimulated recall interview in which the video recording is replayed and the teacher explains aspects of the lesson to the researcher. (Approximately 60 mins)

The basis by which participants will be selected
Teachers will be purposefully sampled based on them being known to the researcher and have indicated to the researcher that they are willing to participate.

In each career stage it is expected that two teachers will be identified from the state and private sectors and these teachers will represent early childhood, primary and secondary. It is hoped that up to 18 teachers will be identified to participate in this project.

The expected benefits of the research
It is expected that evidence will be found of the decisions to incorporate ICT into instructional planning and that this evidence may be termed Technological Pedagogical Reasoning. It is anticipated that the results from this study will be able to improve the understanding of the ICT skills that teachers use in curriculum planning.

Risks to you or your school
As responses will remain anonymous, it is unexpected that there will be any risk to you or your school. You are free to withdraw from the study at any time if you feel exposed to the risks listed above.

Your confidentiality
- No identifiable data will be collected and therefore participants will be not be identifiable in any publication or reporting.
- All responses will remain confidential.
- Interviews will be recorded, will be transcribed and then be used for entry into a suitable qualitative package for analysis. Recordings and transcripts will be stored in a lockable file for the duration of the project and will only be used by the project team.
- The class lesson will be video recorded. This video will be used in a video stimulated recall interview with the teacher where the complete contents of the video will be viewed. The video will then be edited to:
  - remove any referrals to identify;
  - hide any faces of the children;
  - delete an inappropriate comments; and
  - any other material deemed inappropriate by the teacher.
- Once finalised a copy of the video will be reviewed by the teacher before authorising access for university use by the researcher.
- Once the project has been completed all audio recordings and transcripts will be stored for the required time in accordance with university policy and then they will be destroyed in line with this policy.
Your participation is voluntary
Your participation is voluntary. Your participation will in no way impact upon your relationship with Griffith University. You are free to withdraw from the study at any time.

Questions / further information
If you have any questions about the research or your participation in it, please contact Vicky Smart by email (v.smart@griffith.edu.au).

The ethical conduct of this research
Griffith University conducts research in accordance with the National Statement on Ethical Conduct in Human Research. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3735 5585 or research-ethics@griffith.edu.au.

Privacy Statement
In accordance with Queensland Information Standard 42 (which applies where the data will be collected or generated in an identified form and applies to human research conducted under the auspices of the University), the information sheet must include a legal privacy statement.

The conduct of this research involves the collection, access and / or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University’s Privacy Plan at http://www.griffith.edu.au/about-griffith/plans-publications/privacy-plan or telephone (07) 3735 5585.

Feedback to you
As your responses will be anonymous individual reporting will not be possible.

If you are interested in the results of the project please contact Vicky Smart by email (v.smart@griffith.edu.au).
# Technological Pedagogical Reasoning (TPR): The development of teachers' pedagogical reasoning with technology from multiple career points.

## CONSENT FORM – Teacher

**Who is conducting the research**

- A/Prof Cheryl Sim  
  School of Education and Professional Studies  
  3735 5926  
  c.sim@griffith.edu.au

- Prof Glenn Finger  
  School of Education and Professional Studies  
  5552 8618  
  g.finger@griffith.edu.au

- Vicky Smart  
  School of Education and Professional Studies  
  0403 303 187  
  v.smart@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include completion of a series of interviews and a class video;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 5585 (or research.ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project;
- I agree for the researcher to keep a copy of the video for university use beyond the needs of the research project; and
- I agree to participate in the project.

<table>
<thead>
<tr>
<th>Name</th>
<th></th>
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<tbody>
<tr>
<td>School</td>
<td></td>
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<tr>
<td>Signature</td>
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<tr>
<td>Date</td>
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</tbody>
</table>
APPENDIX G – CONSENT PACK – DIGITAL PORTFOLIO

Technological Pedagogical Reasoning (TPR): The development of teachers' pedagogical reasoning with technology from multiple career points.

INFORMATION SHEET – SMART CLASSROOM PROFESSIONAL DEVELOPMENT FRAMEWORK PORTFOLIO

Who is conducting the research
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REMOVETHISTEXT28618
g.finger@griffith.edu.au

Vicky Smart
School of Education and Professional Studies
0403 303 187
v.smart@griffith.edu.au

Why is the research being conducted?
Vicky Smart is conducting this research project as part of the research higher degrees requirements of study for the award of Doctor of Education at Griffith University. In order to complete the doctoral studies, a research project must be completed, a thesis compiled and that thesis submitted for evaluation. A/Prof Cheryl Sim and Prof Glenn Finger are the research supervisors of Vicky Smart and the A/Prof Cheryl Sim is the nominated Chief Investigator for the research project.

As there is pressure for all teachers to develop their Information Communication and Technology (ICT) skills, this research is to obtain an understanding of how teacher across career stages plan with technology. The goal is to see how teachers incorporate ICT into their lesson planning and whether they can develop Technological Pedagogical Reasoning.

What you will be asked to do
Provide access to your Smart Classrooms Professional Development Framework portfolio of work for the researcher.

Neither your name nor the name of the school will be used at any time. The researcher will treat all information collected confidentially.

A case study for each teacher will be constructed and the teacher will be given the opportunity to check that the included information accurately represents his or her point of view.
The basis by which participants will be selected
Teachers will be purposefully sampled based on them being known to the researcher and have indicated to the researcher that they are willing to participate.

The expected benefits of the research
It is expected that evidence will be found of the decisions to incorporate ICT into instructional planning and that this evidence may be termed Technological Pedagogical Reasoning. It is anticipated that the results from this study will be able to improve the understanding of the ICT skills that teachers use in curriculum planning.

Risks to you or your school
As responses will remain anonymous, it is unexpected that there will be any risk to you or your school. You are free to withdraw from the study at any time if you feel exposed to any risk.

Your confidentiality
- No identifiable data will be collected and therefore participants will be not being identifiable in any publication or reporting.
- All responses will remain confidential.
- Data collected from the submission will be used for entry into a suitable qualitative package for analysis. Data will be stored in a secure location for the duration of the project and will only be used by the project team.
- Once the project has been completed all data will be stored for the required time in accordance with university policy and then they will be destroyed in line with this policy.

Your participation is voluntary
Your participation is voluntary. Your participation will in no way impact upon your relationship with Griffith University. You are free to withdraw from the study at any time.

Questions / further information
If you have any questions about the research or your participation in it, please contact Vicky Smart by email (v.smart@griffith.edu.au).

The ethical conduct of this research
Griffith University conducts research in accordance with the National Statement on Ethical Conduct in Human Research. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3735 5585 or research.ethics@griffith.edu.au.

Privacy Statement
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The conduct of this research involves the collection, access and / or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University's Privacy Plan at http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan or telephone (07) 3735 5585.

Feedback to you
As your responses will be anonymous individual reporting will not be possible.

If you are interested in the results of the project please contact Vicky Smart by email v.smart@griffith.edu.au.
Consent Form – Smart Classroom Professional Development Framework Portfolio

Who is conducting the research

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c.sim@griffith.edu.au

Prof Glenn Finger
School of Education and Professional Studies
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g.finger@griffith.edu.au

Vicky Smart
School of Education and Professional Studies
0403 303 187
v.smart@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include access to my Smart Classrooms Professional Development Framework portfolio;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project;
- I agree to participate in the project.

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
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<tr>
<th>Date</th>
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<td></td>
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</table>
### APPENDIX H – DATA SOURCE REFERENCE TABLE

<table>
<thead>
<tr>
<th></th>
<th>Donnatella (Do)</th>
<th>Drago (Dr)</th>
<th>Viviana (V)</th>
<th>Carmelina (C)</th>
<th>Fiorentina (F)</th>
<th>Alessandra (A)</th>
<th>Marcelia (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSRI</td>
<td>1a</td>
<td>1b</td>
<td>1c #1</td>
<td>1d</td>
<td>1e</td>
<td>1f</td>
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<td></td>
<td>#2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>TACMI</td>
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<td>2b</td>
<td>2c</td>
<td>2d</td>
<td>2e</td>
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<tr>
<td>CM</td>
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<td>3b</td>
<td>3c</td>
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<td>3e</td>
<td>3f</td>
<td>3g</td>
</tr>
<tr>
<td>TE-DP</td>
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<td>4b</td>
<td>4c</td>
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<td></td>
<td></td>
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<tr>
<td>DPL</td>
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<td>5d</td>
<td>5e</td>
<td>5f</td>
<td>5g</td>
<td></td>
</tr>
</tbody>
</table>

VSRI – Video-stimulated recall interview

TACMI – Think-aloud concept mapping interview

CM – Concept Map

TE-DP – Teacher education digital portfolio

DPL – Digital Pedagogical License
APPENDIX J – ICSEA AND SCHOOL STATISTICS

The data for briefly describing each school has been obtained from the My School website (www.myschool.edu.au). This data has been used to give an idea of the school size, type and location as "general information only" (Australian Curriculum Assessment and Reporting Authority, 2014c). My School also includes the Index of Community Socio-educational Advantage (ICSEA) value that was created by ACARA and designed to "use family background information provided to schools directly by families, including parental occupation and the school education and non-school education levels they achieved" (Australian Curriculum Assessment and Reporting Authority, 2013, p. 1). It is a figure calculated to provide some sort of comparison of variables, as ACARA believe that these variables have a strong association with student performance. "ICSEA provides a scale that numerically represents the relative magnitude of this influence, and is constructed taking into account both the student- and the school-level factors" (Australian Curriculum Assessment and Reporting Authority, 2014a). The 2013 ICSEA values range from the lowest below 400 to the highest near 1400 (Australian Curriculum Assessment and Reporting Authority, 2014b) and is shown below.

For this study the ICSEA value gives an indication of the socio-economic status of the school environment assuming a higher figure could mean access to more student resources at school and home expressed as educational advantage while a lower figure could represent access to less resources at school and home expressed as relative educational disadvantage. As a comparison each school will be compared to the national average of 1000. Two years of data are shown to highlight that there are variations from one year to the next, but these variations do not significantly
change the school description. To ensure the school remains unidentifiable, the following descriptions (as shown in the figure below) have been used to describe the size of the school in terms of student population and the number of teachers.

<table>
<thead>
<tr>
<th>Number of full-time teachers</th>
<th>School description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>Small school</td>
</tr>
<tr>
<td>50-100</td>
<td>Medium school</td>
</tr>
<tr>
<td>&gt;100</td>
<td>Large school</td>
</tr>
<tr>
<td>Number of full-time students</td>
<td>School description</td>
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<tr>
<td>0-600</td>
<td>Small school</td>
</tr>
<tr>
<td>600-1500</td>
<td>Medium size school</td>
</tr>
<tr>
<td>&gt;1500</td>
<td>Large school</td>
</tr>
</tbody>
</table>

To understand the student population, NAPLAN summary information was obtained from My School. A summary of the NAPLAN results are provided to show the total percentage of students in the top two bands for each year the school has participated and for all assessment areas including: Reading; Writing; Spelling; Grammar and Punctuation; and Numeracy. The Australian school average for the top two bands is shown in an adjacent table to highlight the position of the school in relation to the national average. The top two bands were selected as an example, for no particular reason, except for comparing the schools in this study. The top two bands highlight the number of students scoring highly in NAPLAN. This data has been selected as it easily assessable and provides a simple snapshot of the schools in this study. The NAPLAN results from students participating in this study have not been accessed nor used for this research project.

This information is available to help explain the school environment that some of these teachers work within. This is important in understanding the size of the school, the number of teacher, the type of students in their classes to explain the context of the school.
## Summary of school statistics

<table>
<thead>
<tr>
<th></th>
<th>Campani a College</th>
<th>Milan SHS</th>
<th>Florence PS</th>
<th>Genoa SHS</th>
<th>Rome PS</th>
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</thead>
<tbody>
<tr>
<td>Type</td>
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<td>8-12</td>
<td>P-7</td>
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<td>Metro</td>
<td>Provincial</td>
<td>Metro</td>
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<tr>
<td>Full-time equivalent enrolments</td>
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<td>Medium</td>
<td>Medium</td>
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<td>Medium</td>
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<tr>
<td>Full-time equivalent teaching staff</td>
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<td>ICSEA value</td>
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<td>Significantly disadvantaged</td>
<td>Slightly disadvantaged</td>
<td>Significantly disadvantaged</td>
<td>Significantly advantaged</td>
</tr>
<tr>
<td>Top two band NAPLAN results in comparison to national average</td>
<td>Just below</td>
<td>Well below</td>
<td>Around</td>
<td>Well below</td>
<td>Well above</td>
</tr>
<tr>
<td>Teacher participants</td>
<td>Marcelia</td>
<td>Donnatella</td>
<td>Florentina</td>
<td>Viviana</td>
<td>Drago</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Carmelina Alessandra</td>
</tr>
</tbody>
</table>

**TECHNOLOGICAL PEDAGOGICAL REASONING - THE DEVELOPMENT OF TEACHERS' PEDAGOGICAL REASONING WITH TECHNOLOGY OVER MULTIPLE CAREER STAGES**

References and Appendices

Rome Primary School

![NAPLAN Results - Selected school (2012)](image1)

![NAPLAN Results - Australian school average (2012)](image2)

Venice College

![NAPLAN Results - Selected school (2012)](image3)

![NAPLAN Results - Australian school average (2012)](image4)