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Investigating a best practice model for facilitating Information Communication Technology implementation in the secondary school classroom

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Abstract

The Australian Government initiated the Digital Education Revolution (DER) (DEEWR 2007) to ensure schools incorporated Information and Communications Technology (ICT). This policy was implemented with the intent of embracing 21st Century learning to enable students to live and work in the emerging digital world and better equip them for jobs of the future. The Digital Education Revolution (2007) implied a change in pedagogy to fully capitalise on the potential of ICT to provide improved student learning outcomes. It was anticipated teachers would integrate ICT, and design challenging and stimulating learning activities to enable students to become highly skilled in the use of ICT to communicate, collaborate and problem-solve.

Schools have implemented ICT in a variety of ways, but the extent to which teachers have utilised the technology to underpin and improve students' attainment of learning outcomes is unclear. Furthermore, a significant number of teachers were reluctant to embrace the changes required to pedagogy despite netbooks being provided through the National Secondary Schools Computer Fund (DEEWR 2009).

The current project examined the way teachers incorporated ICT into their curriculum and identified the challenges teachers faced when they endeavoured to embed ICT into their teaching programs. Data were collected from interviews and an action research conducted with a small group of teachers. A number of barriers that impacted teachers' ability to successfully incorporate ICT were identified in the interview phases of the research. The action research allowed for the small group of teachers to consider pedagogy and their use of ICT and to reflect on their practice.

This qualitative research examined the process teachers worked through when embedding ICT. Data were used to inform the design of a model to assist teachers to develop their ICT knowledge and expertise and to minimise perceived barriers to the integration of ICT in the school context. Barriers identified include a lack of time, confidence and technical support, pedagogy,

curriculum limitations and professional development. Identifying the barriers provides a greater understanding of the issues facing teachers, and if schools can work to eliminate or address these barriers the likelihood of teachers integrating ICT into their practices is improved.

As the research progressed it became evident that the barriers for teachers were a small aspect of a whole-school issue. Teachers tended to work in isolation and lacked clarity about what was expected of them. The development of a model that supports a whole-school approach will also support other teachers and leaders in understanding the human and physical resources required to transform teaching and learning with ICT. The findings from this study may assist procedural refinement in ICT implementation within the education system. Educators, leaders and teachers may be more capable in identifying barriers to ICT integration and increasing awareness of the requirements necessary to assist teachers to successfully embrace the use of ICT to enhance pedagogy.

The access issues related to the use of ICT within schools have been well researched (Keane 2012; Larkin 2010; Pitler, Hubbell, Kuhn & Malenoski 2007); however, the implementation of ICT is yet to fully realise its potential to transform the teaching and learning process and to ensure students are successful, confident and creative learners who are able to participate in the global world. The study concludes with a proposed model to support a whole-school approach to the integration of ICT to transform pedagogy.

Doctor of Education declaration

I, Bette Yvonne Prange, declare that the EdD thesis entitled “Investigating a best practice model for facilitating Information Communication Technology implementation in the secondary school classroom” is no more than 70,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography and references. This thesis does not contain any material submitted previously, in whole or in part, for the award of any other academic degree or diploma. With the exception where it is otherwise indicated, this thesis is my own work.

Signature:  **Date:** 12 November 2018

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Contents

Figures and tables

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Abbreviations

ADDIE model	Analyse, Design, Development, Implementation and Evaluation model
ASSURE model	Analyse learners, State objectives, Select instruction method, media and materials, Utilise media and materials, Require learner participation and Evaluate and revise
AusVELS	Australian and Victorian Essential Learning Standards
BYOD	Bring Your Own Device
CBAM	Concerns Based Adoption Model
DEECD	Department of Education and Early Childhood Development
iCARE	Introduce, Connect, Apply, Reflect and Extend model
ICT	Information and Communications Technology
NSSCF	National Secondary Schools Computer Fund
PLC	Professional Learning Community
SAMR model	Substitution, Augmentation, Modification and Redefinition model
TAM	Technology Acceptance Model
TEL	technology-enhanced learning
TPACK model	Technology, Pedagogy and Content Knowledge model
TTPD model	Technology-related Teacher Professional Development model
VCE	Victorian Certificate of Education

Terms

Key terms

ICT, interactive technology, elearning, pedagogy, Professional Learning Community (PLC)

Definition

Information and communications technology (ICT) is a broad term that refers to the use of information technology and communication networks that allow people to share, use, develop, process and store information in the digital age. It encompasses the use of electronic devices such as computers, networks, tablets, personal devices and digital cameras and access to online communication channels including access to the World Wide Web.

A range of terminology has evolved to refer to the use of ICT in the classroom. It has variously been defined as technology, elearning, online learning, mobile learning and blended learning. For the purpose of this study, ICT is used in a generic sense to refer to the use of any interactive technology.

Chapter 1: Introduction

1.1 Background

The strategic plan for Australian schools to transition to 21st Century learning was outlined in the Digital Education Revolution (DEEWR 2007). This four- to five-year plan aimed to "contribute sustainable and meaningful change to teaching and learning in Australian schools to prepare students for further education, training, jobs of the future and to live and work in a digital world" (DEEWR 2011, p. 2). The Joint Ministerial Statement on ICT in Australian Education and Training: 2008–2011 (MCEETYA & MCVTE 2008) outlined a commitment by education ministers to collaborate, share resources and expertise, leverage initiatives and continue to focus on innovation and experimentation. "In practice, this means:

- Students undertake challenging and stimulating learning activities supported by access to global information resources and powerful tools for information processing, communication and collaboration,
- Teachers devise student centric programs of learning that address agreed curriculum standards and employ contemporary learning resources and activities, and
- Parents support students in their learning by monitoring programs and progress and by communicating with teachers online." (DEEWR 2007, p.3)

In summary, the expectation of this Ministerial Statement was that teachers would devise contemporary learning programs that incorporated global ICT resources that both stimulated and challenged student learning. The various governments anticipated ICT would be instrumental in bringing about a change in education.

The Digital Education Revolution (DEEWR 2007) outlined a broad and strategic plan identifying the role digital technologies should play in delivering better educational outcomes for students. Four strands of change were identified for

national action: leadership, infrastructure, learning resources and teacher capability. Whilst all the strands are interrelated this study will focus on leadership and teacher capability.

In particular, the aspirational goals identified in the Digital Education Revolution (DEEWR 2007) for further exploration were the ability of teachers to design curriculum units that allow students to both meet the standards and utilise contemporary resources; and curriculum that engages students and prepares them for success in the 21st Century. It is expected that teachers and students use digital technology to collaborate and share knowledge and, in the process, utilise this knowledge to achieve learning outcomes. The role of the school leader was to plan for the improvement anticipated through the integration of ICT.

1.2 Research problem, question and aims

This research aims to assist in the formulation of a model to support teachers to develop their skill and expertise in utilising ICT to support improved student learning outcomes. A key aspect of this research was to gain an understanding of the factors that impact teachers' use of ICT, define their thinking and decision-making processes in relation to their use of ICT, and to develop a planning model to assist them to integrate ICT to underpin student learning in their classes.

Through collaborative involvement in an action research, the efficacious skills and knowledge teachers require to successfully enhance student learning with the addition of ICT were observed and identified – the aim being to support teachers to improve their expertise in effectively using ICT to facilitate learning experiences that prepare students for the world in which they will live and work.

1.3 The research

This research focused on a small group of secondary teachers in one secondary school and examined the factors that impacted their use of ICT. In particular, it examined the teachers' attitudes towards and experiences with ICT and how they used ICT within their classrooms, and articulated how ICT was being used to support student learning.

An early concern within schools was the lack of access to ICT (Keane 2012; Larkin & Finger 2010; Watson 2001) however, when the National Secondary Schools Computer Fund (NSSCF) initiative (DEEWR 2009) provided students with netbooks, many teachers did not know how to use them effectively and were often frustrated with the ICT when it did not work as they anticipated. This research provided an opportunity to explore ways to support teachers and to delve into the problems they experienced.

1.4 Shaping the research

This research evolved from a deep-seated interest in teaching and learning, and the observations of how ICT was used in the classroom as it was gradually introduced into secondary schools. The National Secondary School Computer Fund initiative (DEEWR 2009) resulted in a marked increase in student access to ICT for students. This initiative allowed schools to provide students in years 9–12 with a digital device. All of a sudden, teachers were confronted with a class of students with a netbook, laptop or computer to support their learning. However, many teachers appeared to struggle with utilising ICT to enhance student learning. Thus, a need exists to review teachers' approach to the learning process with the addition of ICT. The addition of ICT will have little impact unless teachers embrace the opportunity to utilise ICT to transform learning.

The question underpinning the research was: *What models of assistance and support do teachers require to improve the use of Information Communication Technology to change pedagogy to support student learning?*

1.5 Epistemological stance

Taking into account my reflexive experience as a principal, I contend that the development of a model may provide the assistance and support required to effectively enable teachers to better utilise ICT to improve student learning. A transformative change in pedagogy as a result of the increased access to ICT is not yet evident. A framework or model could assist teachers to transform teaching and learning in a manner similar to the extent that ICT has radically transformed the medical field, the travel industry and the financial and banking sector. Having been involved in secondary education for over 40 years, I have observed the introduction of ICT into schools through a number of schemes; for example, the introduction of laptops for teachers and the ICT devices for students in years 9–12. As a school leader, I am keen to explore options that will assist teachers to utilise ICT to transform pedagogy and student learning. This research will explore the development of a model of assistance and support for teachers through working with teachers to gain an understanding of what they require to implement change.

The research process will gain information from leading teachers recognised for their expertise, from teachers within one school setting and from working closely with a small group of teachers. The examination of a number of models used in a variety of educational settings will inform the development of a new model to assist teachers to transform teaching and learning.

1.6 Significance

The access to ICT within schools has increased significantly over the past 30 years, along with the range of ICT available to teachers and students; however, the impact on learning has not reflected the potential of ICT. This research considered the barriers that impacted teachers' abilities to utilise ICT to further student learning. The study provided the opportunity to work closely with a group of teachers within one school to gain an understanding of the factors that impacted their efforts to integrate ICT. The use of ICT in the classroom has the

potential to provide students with the opportunity to engage with 21st Century ICT skills.

By studying the barriers that impact teacher use of ICT, it is anticipated that such barriers can be minimised or eliminated. Having the opportunity to work with a small group of teachers provided an insight into their thinking and decision-making when considering how to incorporate ICT. The action research allowed for discussion and feedback between teachers and provided valuable insight to the process when they reflected on their experiences. This information informed the development of a model. Understanding the barriers teachers face will assist in the elimination of them, and increase teacher capacity to identify the appropriate ICT and the knowledge required to better utilise ICT to support student learning.

The research gap in the knowledge is to identify factors that impact teachers' ability to utilise ICT in a way that transforms the learning that takes place in the classroom. The effective integration of ICT by teachers has the potential to transform pedagogy to ensure students engage in 21st Century learning experiences.

Chapter 2. Literature review

2.1 Introduction

This chapter provides an overview of the policies and practices that have accompanied the integration of ICT within schools and the anticipated outcomes of ICT to support teaching and learning. It provides a context for the increased access to ICT and discusses the literature in relation to the theory and research associated with the integration of ICT within education settings. In addition, it identifies a number of issues that impact teacher efforts to incorporate ICT to transform student learning. This chapter also reviews a number of models used to support the use of ICT for consideration in the creation of a model to support teachers.

2.2 Context

Since the early 1990s the Victorian Department of Education has initiated a number of programs to introduce ICT into schools, such as Classrooms of the Future (1995), the Navigator Schools Project (1995), the teacher laptop scheme (1998) and curriculum@work (2000). The Navigator Schools Project (1995) identified seven areas to develop through the program:

1. Models of best methodologies teachers can use in classrooms in which computers are primarily used as tools for acquiring information, thinking and expression.
2. Increased understanding of how teaching and learning changes in such classrooms.
3. Models of administrative arrangements that facilitate and support improved student learning.
4. Models to increase and improve parent–school interactions.
5. Expanded teacher professional development opportunities to support the adoption of improved teaching practices.

6. Ongoing evaluation of, and advice on, curriculum materials, equipment and software.
7. Support structures for other schools that choose to undergo such transformations. (Toomey & Ekin-Smyth 2002, p. 2)

Over the duration of this four-year project, each of the seven schools involved worked on the development of innovative models of teaching and learning in a technology-rich environment. The overall model was based on student-centred learning underpinned by the integration of knowledge, skills and attitudes. A study of the Navigator Schools Project claimed that ICT can transform schools but only when new models of teaching and learning are adopted (Toomey & Ekin-Smyth 2002).

The Digital Education Revolution (DEEWR 2007) outlined a broad and strategic plan identifying the role digital technologies should play in delivering better educational outcomes for students. Four strands of change were identified for national action: leadership, infrastructure, learning resources and teacher capability. In particular, the aspirational goals outlined in the Digital Education Revolution which identified areas for further exploration were the ability of teachers to design curriculum units that allow students to both meet the standards and utilise contemporary resources; and curriculum that engages students and prepares them for success in the 21st Century (DEEWR 2007). It was anticipated that teachers and students would use digital technology to collaborate and share knowledge and, in the process, utilise this knowledge to achieve learning outcomes.

Since 2008, students in the secondary school sector have increasingly had unprecedented access to ICT as Australian schools integrated technology into the classroom in a variety of ways. Schools are currently working in a transformational environment as society moves from an industrial era to a knowledge-based era. Students have come to regard ICT as a key aspect of everyday life; it underpins everything they do (Prensky 2012). The increased availability of ICT has the potential to transform the learning environment for students and, in turn, significantly change the role of teachers. Teachers need

to move away from a content-based approach to learning and adopt the role of guide, assisting students to find information and develop critical thinking, problem-solving and programming skills (Prensky 2012).

Technological devices, in conjunction with other economic forces, are changing the nature of communication and knowledge. In the early 1990s, ICT was regarded as a tool to support learning, like any other tool used in the classroom (Cuban 1993). However, more recent publications are beginning to reflect a change in thinking (Bain & Weston 2012; Newhouse 2013; Moersch 2014). There is a move away from technology as a way to enhance and support learning to something that impacts the actual knowledge and learning process (Traxler 2009). Traxler contends that mobile technologies in particular are changing the nature of work that is based on knowledge, as the ability to create and distribute different methods of art, performance, learning and commerce emerge. As such, new technology ought to offer discernible benefits in a learning framework that includes an overview, objectives, information, assessments and motivational factors.

The original model for education was fundamentally based on the concept of a group of students of similar age placed in a classroom for instruction delivered by a teacher. This model for teaching and learning aimed to provide basic skills in reading, writing, mathematics and history. The curriculum has generally provided an understanding of the past and promoted a vision for the future (Williamson 2013). Despite being changed and adapted over the years, the school curriculum has remained closely aligned to this original model. However, the world has changed significantly. Within the last 10 years, a move towards the use of ICT as a key component of the way students learn has become evident and brought attention to education policy and practice (Ananiadou & Claro 2009). More recent research has detailed the need to reconsider the curriculum and the way in which students are educated (Pandolfini 2016; Prensky 2012; Williamson 2013). Young people of the current generation are quite sophisticated users of technology, who are able to communicate, create communities and participate using a variety ICT (Williamson 2013).

For many years teaching has been reliant on the printed word, but the introduction of ICT has broadened possibilities to include multimedia, collaborative online spaces, simulations, worldwide communication, social media, gaming and much more. Brown (2004) identified four stages of computer use in schools – the instructional wave, the problem-solving phase, the mind tool wave and the media wave – and whilst teachers continue to utilise each of these 'waves' at various times, the realisation is that 'digital natives' (Prensky 2010) learn in vastly different ways. Students in today's classrooms have changed as a result of their experiences with technology external to the classroom. As a result, the 'telling and testing' educational model used as the foundation of education for so long has become less effective (Prensky 2010). This changed learning environment requires teachers to consider the potential of ICT and to adapt their teaching to incorporate the various ways in which students can learn with ICT.

The development of the internet during the 1990s resulted in an increase in the use of communication and multimedia tools. Initially, ICT was used by teachers to replicate the information they provided or information that they utilised from textbooks or the internet. In his book, *Oversold and underused: Computers in the classroom* (Cuban 2001), Cuban discussed the way teachers in Silicon Valley (US) simply adapted the inclusion of technology within the classroom to fit with their current practices. Cuban concluded that the opportunity existed for teachers to adapt the way they taught to embrace the learning opportunities offered by ICT, but it did not eventuate. Despite the focus on technology in Silicon Valley, the use of ICT in education did not make significant inroads in transforming learning. Likewise, Australian Government departments and policymakers had anticipated that, through the NSSCF (DEEWR 2009) addition of computers to the classroom, computers would be used to change the way learning occurred.

Many of the strategies implemented by the Australian and Victorian Governments were underpinned by the notion that the provision of technology to teachers and students would facilitate the use of ICT to maximise teaching and learning in the classroom (DEEWR 2007; MCEETYA 2008; DEEWR 2011).

Much of the early research in relation to ICT in schools focused on issues of access and the suitability of mobile devices. Larkin and Finger (2010) conducted research on the suitability of netbooks for use in primary and lower secondary schools and concluded that netbooks are robust, practical and cost-effective devices for use in schools. However, they also observed that the teachers involved in their study did not utilise the multimedia functionalities offered by netbooks.

In his study of one-to-one laptop programs, Harris (2010) showed that a netbook program implemented well does bring about improved learning outcomes for students. While this study primarily focused on access for low socioeconomic students, it concluded that in a successful one-to-one netbook program students:

> learned content that exceeded the bounds of traditional classroom instruction, which provided them skills and experience requisite for an increasingly technology centric post-secondary education system and workforce. (Harris 2010, p. 176)

This study also concluded that:

> students learned at deeper, broader, and more interconnected levels. They experienced greater relevancy and retention of instruction, while developing an improved capacity for learning. Laptops also assisted students to become better writers and provided them an increased ability to process information. (Harris 2010, p. 179)

Whilst Harris (2010) found evidence of a capacity for improved learning, he also noted that access to laptops neither guaranteed nor precluded the attainment of improved student learning outcomes, but rather that the transformative gains in education were a result of dynamic teaching from the teacher participants. Harris concluded that the “effectiveness of laptop use in education was directly tied to the attitude, aptitude, and skill of the teachers who designed and delivered this technology infused curriculum” (Harris 2010, p. 186). Thus a key element to effect change, and use ICT to transform learning, is the teacher.

The question then becomes one of how to support teachers to transition their pedagogy to capture the potential of ICT to transform student learning.

2.2.1 Educational reform and ICT

With the issues of access minimised through the Digital Education Revolution (DEEWR 2007) and NSSCF (DEEWR 2009) initiatives, the focus for ICT in schools shifted to the effective integration of ICT to enhance learning and improve student outcomes. When schools first introduced computers they worked on support needs such as infrastructure, hardware, software, speed, network administration and capability. The responsibility for the implementation of ICT in secondary schools was often designated to an ICT leader or an ICT teacher, both with the capability of solving the technical problems that emerged. The emphasis was on ensuring a reliable ICT service that allowed teachers to support their classroom lessons with ICT.

In a reflective review of these ICT initiatives, Bourne (2009) concluded that policymakers assumed that by putting ICT into schools, the ICT would result in the desired outcome of transforming teaching and learning. Jordan (2009) found that system-wide reform was impacted by a number of factors; for example, teacher reluctance to use ICT, a lack of understanding about the nature of teachers' work and the time it takes to effect change. While a range of professional development was provided to teachers, Jordan (2009) noted that bringing about change is a complex process. She also suggested the timing of the accompanying professional development impacted on the success of each initiative.

In general, schools rushed to provide more ICT access for students, thinking this would automatically change teachers' beliefs about the use of technology in teaching and learning. However, the speed with which schools added technology did not always match the development of teacher pedagogy, and thus the ways in which technology was used did not necessarily allow students to explore and construct knowledge. Li and Choi (2013) argue that social capital is a pivotal requirement to effect pedagogical change. Teachers having access to expertise within their school, being supported in a risk-taking environment

and having the opportunity to explore the use of technology would increase pedagogical knowledge. Social trust allows for shared experiences and provides the basis for reciprocal action, mutual support, shared accountability and collective endeavour (Coleman 1990; Van Meal & Van Houte 2011).

Initial studies around the use of ICT in schools highlighted access as an issue that impacted the effective use of ICT to underpin student learning (Keane 2012). However, this problem was addressed in secondary schools to a large extent through the NSSCF program (DEEWR 2009). The ability to utilise ICT to change pedagogy has been a difficult aspect of the ICT revolution in schools, both primary and secondary. Romano (2003) noted that all the money, effort and determination poured into the field of education has not been able to bring about the transformational changes that are evident in the fields of medicine, engineering, architecture, banking and the airline industry. The impact of technology within these industries has transformed the way these professions operate yet in education, that transformation is not yet evident. The cost benefits of ICT were, no doubt, a key determinant for change in the business and industrial sectors. Unfortunately with education, the financial benefit does not return to the system in a monetary sense. After 30 years or more we are still trying to discover the way to connect education and technology so that it is more effective (Romano 2003).

Technology is often seen as a catalyst for change; however, Watson (2001) suggested teachers feel threatened by change. Watson (2001) found that “after many years of national policies and investment in Information Technologies in the UK and elsewhere, technology is still an imposed and novel ‘outsider’ in the pedagogy of schools” (Watson 2001, p. 251). Through his case study, Watson (2001) identified a range of barriers that impacted teachers’ efforts to include ICT within their classrooms. These barriers included lack of access, teachers’ level of confidence in using computers and teachers being unconvinced of the value of ICT in their classrooms. In addition, a lack of good software coupled with a lack of time to explore software applications in relation to their subject area hindered teacher uptake of ICT. Watson did identify a small minority of innovators who recognised and demonstrated the potential of ICT within their

classrooms because it related to their personal philosophy. However, he concluded that many teachers are not in a position to make informed judgements about the value of ICT to support their teaching.

The emergence of new technology created the opportunity to reorganise the way education is delivered. However, the provision of ICT alone does not mean change will automatically occur. The integration of ICT requires teachers to broaden their outlook and examine ICT in conjunction with teaching and learning. Teachers need to become familiar with available ICT and determine how it could be applied to develop new learning, plan for implementation and consider changes to pedagogy and student approaches to learning. Effective teaching is reliant upon teachers responding to the needs of each student and developing tasks that allow students to access the learning. Keane (2012) argued that the successful integration of ICT is reliant on a leader with educational experience, as opposed to someone focused on the infrastructure and technical side of ICT.

The thinking behind the provision of ICT to schools through the NSSCF scheme (DEEWR 2009) was that increased access to ICT would bring about change to the education system. While small pockets of innovative practice occurred, the anticipated transformation did not eventuate; teaching and learning did not change significantly. Orlando (2013) looked at this lack of change from a fresh perspective. From her studies, she concluded that the focus underpinning change should stem from a constructivist approach, essentially the relationship between the teacher and the student, with an emphasis on pedagogy – the constructivist belief being that knowledge is actively constructed by students as opposed to being provided by the teacher, and that students are active in constructing knowledge from their participation in the learning process (Jonassen 1991). There are two aspects to constructivist theory: the cognitive approach and the social approach. Cognitive constructivists believe that learners construct new knowledge by drawing upon their prior knowledge and experiences and new information, whereas social constructivists believe students learn through the interactive process of sharing and discussion.

Initially, ICT was regarded as a tool to support learning like any other tool used in the classroom. However, more recent studies are beginning to reflect a change in thinking. To effect a change in student learning, teachers need to think about ICT as learning tools that students learn *with* as opposed to learn *from* (Jonassen et al. 2008). Ward (2003) affirmed this view as she explored Cuban's (2001) notion of 'teachers as gatekeepers of their classroom', and ultimately concluded that the difficulty lies in changing teacher practice. Traxler (2009) believes ICT devices are increasingly changing the nature of communication and knowledge, in conjunction with economic forces. In his research he highlighted the move from technology as a way to enhance and support learning to something that impacts students acquisition of knowledge and the learning process. He argued that mobile technologies are changing the nature of work, especially work based on knowledge. The availability of ICT has also broadened the ability to create and distribute different methods of commerce, learning and performance.

The world has changed significantly along with each generation of students; however, the education system and schools have not utilised the learning of technology to deepen, accelerate and nurture student learning (Hess & Saxberg 2014). Student exposure to ICT external to schools has impacted the current generation of students, with many becoming highly skilled at accessing information, communicating with ICT and engaging with various functionalities. The lack of pedagogical reform means that as a system we are not educating students "for further education, training, jobs of the future and to live and work in a digital world" (DEEWR 2011, p. 2). It is imperative that change occurs so that young people are engaged in their learning, which in turn allows them to participate effectively in society.

2.2.2 Early research into ICT use in the classroom

Much of the initial research into ICT focused on access, the provision of hardware, software and training, and the ability of school leaders to influence the impact of ICT on learning (Becker & Riel 1999; Moyle 2006; Lee & Gaffney 2008). The focus on using ICT to improve learning has existed for Victorian

schools since the mid 1980s, as outlined in the Australian report of the National Advisory Committee on Computers in Schools (NACCS 1984). Many teachers have struggled to integrate ICT into the classroom due to poor access to computers, constantly changing technology, fear and scepticism about the value of ICT to student learning, and a lack of professional development and leadership (Cuttance 2001; Hennessy, Ruthven & Brindley 2005). Prensky (2012) believed schools rushed to add ICT before teachers were ready with the appropriate pedagogy.

Some of the research focused on the role of the principal and the assumption that leaders had the ability to make the pedagogical and financial decisions to successfully implement ICT (Keane 2012). Similarly, Moyle (2006) found school leaders played a critical role in the implementation of ICT, as outlined in her comprehensive study, “Leadership and Learning with ICT”. Her in-depth study involved 414 participants from Government and non-Government Australian schools. Forty focus groups were established, comprising participants from across all Australian states, to collect the data. The majority of participants were educational leaders drawn from schools, university and education systems. In summary, participants agreed on the importance of having a vision and a strategic plan that encompassed an integrated approach to the ICT philosophy, the pedagogy and the physical learning environment, in order to guide the process in each school. Participants felt it was imperative that pedagogical decisions were made prior to any ICT decisions. However, both Moyle (2006) and Lee and Gaffney (2008) concluded it was unrealistic to expect that principals had the expertise to develop a ‘digital school’. Early ICT implementation in many schools was largely dependent upon ICT leaders and specific teachers with a passion for improving their subject area (Little 1997).

In a comprehensive study of 400 Australian schools, Russell, Finger and Russell (2000) found the majority of teachers surveyed agreed that information technology will inevitably change the nature of schooling. The teachers regarded it as a worthwhile tool to enhance the quality of teaching and learning. However, barriers such as resources, support and the quality of professional development impacted the effective implementation of ICT. This study identified

barriers as the cost of providing adequate hardware and software, followed by the availability of the hardware and software, then technical support.

2.2.3 Implementing change

Change is a complex process and new practices usually require a change in people's behaviour along with a change in their understanding.

> The people who are involved in a change effort have personal reactions and feelings about the change and about their involvement in the process. Acknowledging that the successful implementation of any change is highly dependent upon each individual involved and attending to his or her concerns with appropriate assistance are important keys to successful change. (Hall & Hord 2010, p. 35)

With all change, some people will embrace it immediately, others need more time, and there is usually a small number who will avoid it as long as possible.

According to Hall and Hord (2010), change is often difficult to bring about in educational settings. The issues associated with adapting to ICT and changing practice are complex and embedded in the notion of how learners learn in an ICT-rich environment. Adding to this complexity is the multiple environments in which students easily transition – they move in and out of physical spaces and virtual spaces such as classrooms, online courses and forums – along with the social learning that occurs informally in physical and virtual environments (Milne 2006). The use of ICT in student learning often requires students to learn new concepts in quite different ways, which in turn, requires teachers to work differently. However, for an implementation strategy to be successful and change to occur there has to be a clear purpose for the change and a vision of what the end result will look like. Those involved need clarity and to have their concerns addressed.

Bain and Weston (2012) suggest system-wide change in education is yet to occur, as the ICT focus has been based on faulty assumptions about teaching and learning – assumptions such as the introduction of ICT will change

teaching, access to ICT will make learning happen and ICT will improve student learning outcomes. They believe the 'theory into action' model often used by teachers to implement a change has not been effective, because the anticipated process is premised on a paradigm shift that involves teachers moving from their current practice to a new practice. Bain and Weston also propose that teachers need to make a change to their thinking about teaching and allow for a differentiated curriculum, use ICT in a collaborative manner and ensure a focus on providing "rich, immediate and specific feedback" (p. 12) to students in relation to their learning. The key message from their research is that teachers need to make changes in relation to their thinking about ICT and do things differently in relation to their teaching. Furthermore, Bain and Weston believe that greater understanding is achieved when teachers view technology as part of their teaching and an essential component of student learning.

Since information technology was first introduced into schools, the general approach has changed from specific ICT classes to an expectation that all subjects use ICT to develop solutions for problems set. School leaders are often regarded as the directors of change, with the responsibility to create the culture, and develop the direction for pedagogy. Leadership needs to support the upskilling of teachers, and teachers need to be conversant with 21st Century technologies. Not only do teachers need to create a culture that addresses the various aspects of change, but leaders often need to contend with additional organisational challenges such as plagiarism and the cost and management of digital copyright (Moyle 2006).

The use of ICT can support new instructional practices and it has the potential to improve student learning (Agal 2013), however, success is dependent upon the capacity of teachers to implement programs that are challenging, diverse and actively engage students (Ainley, Banks & Fleming 2002). Student learning can be supported with ICT tools that have the potential to extend and deepen instructional practices and provide access to knowledge. Bain and Weston (2012) report that teachers reconceptualise their view of ICT, from how they access it to a purposeful use of ICT to enhance student learning (p. 12). They argue that ICT is integral to how the pedagogy and curriculum can be shaped to

meet the different needs of individual learners. Ertmer and Ottenbreit-Leftwich (2010) believe teachers are yet to fully use ICT tools and resources to support student-centred instruction, which is promoted as the most beneficial pedagogy to support student learning.

For schools to successfully integrate ICT, there needs to be a better understanding of the role of school education in the context of a knowledge society and the interdependence of conditions which facilitate improved student outcomes. Teachers need to adopt a positive mindset towards ICT and focus on the links between teaching, learning and ICT. Initially, many teachers tended to review their units of work and determine how to add ICT to improve innovation and engagement; for example, use of ICT to present an assignment or for simple online research. For teachers to effect change they need to see the relevance of ICT and the purpose and role in the teaching and learning process. The metacognitive approach outlined by Phelps and Graham (2013) encourages teachers to reflect on their values, beliefs and experiences to help them identify factors that affect their learning. This insight can assist individual teachers to realise that change often relies on attitudes and learning strategies. They are also asked to view themselves as technology learners.

Action comprises the intention to change and change occurs when there is a clear vision of what successful change looks like, along with a safe opportunity to trial new processes (Hattie 2012). Action is required to bring about change; talking about it is one aspect but implementation requires action. Hattie (2012) promotes coaching as an effective strategy to ensure a change in practice and as a strategy to support teachers in interpreting the impact of their teaching. The role of a coach is one of a facilitator of the learning process, assisting teachers with changing their perception of their role in the classroom and supporting them during the transformation. A coach should assist the teacher to interpret and understand their student data, which in turn will help determine and inform the action to take. Beetham (2002) found that teachers who actually changed their practice identified a crucial turning point in the change process. This often occurred with the opportunity to observe others in action, such as at a workshop or demonstration where they could see ICT tools in action.

2.2.4 21st Century learning

Teachers need to build their capacity to cater for 21st Century learning and be mindful of the pace of technological change. This century has seen a rapid rate of change driven by ICT, which is creating a new culture of learning; one that is continually reshaped through participation. However, education systems are yet to articulate how to accommodate this constantly changing ICT environment and make digital learning visible. While ICT offers the potential for a changed educational system, the overly structured nature of current schools often hampers the opportunity for more instructional learning approaches.

The Melbourne Declaration on Educational Goals for Young Australians (MCEETYA 2008) noted that globalisation and technological change is placing greater demands on the education system and the skill development of young people.

> Rapid and continuing advances in information and communications technologies (ICT) are changing the ways people share, use, develop and process information and technology in this digital age, young people need to be highly skilled in the use of ICT. While schools already employ these technologies in learning, there is a need to increase their effectiveness significantly over the next decade.
> (MCEETYA 2008, Preamble p. 5)

The Declaration (MCEETYA 2008) identified some of the skills required by successful 21st Century learners as:

- the ability to be creative and productive users of ICT in addition to the essentials skills in literacy and numeracy
- a capacity to study in a range of disciples, develop, obtain and evaluate information, and to think deeply and logically
- creativity, resourcefulness, innovation and problem-solving
- to act independently, collaborate, communicate and work in teams.

To increase teachers' understanding of what they could or should be doing to support 'digital natives' (Prensky 2010) teachers need a clear view of what the future learning environment looks like. A need exists to clarify the actual skills and knowledge required of current and future learners, so that schools and teachers can shape the new learning, knowledge and skills required for students to operate in the 21st Century.

The digital age has allowed students to communicate in a global world via a range of media, providing the opportunity to engage students in collaborative learning and authentic problem-solving. The proliferation of ICT tools, programs and resources has allowed users to access, record, store and send information in a range of formats. This in turn enables different forms of communication requiring skills in processing and analysing knowledge. Terms often applied to the current generation of young people, or the skills and attributes expected of future workers, include 'adaptive thinkers', having the ability to make sense of knowledge, model good practice and demonstrate social intelligence, 'globally connected', and a need to be aware of and understand the mindset and social norms of other cultures (Cuttance 2001; Bain & Weston 2012; Moersch 2014; Prensky 2010). The challenge for schools is to define the new learning required for students to successfully participate in and contribute to the constantly changing global environment.

New and innovative learning technologies have challenged the traditional face-to-face view of education, to one where students can participate in online, flipped, mobile or virtual learning environments that can be accessed anytime and from anywhere. In this evolving learning environment the move towards personal learning further challenges the notion of common assessments, as technology allows for adaptive and experiential learning. Providing clarity on the current student profile and classroom environment enables teachers to see what it is they need to promote in their classrooms and allow for in their teaching to ensure students develop. In some schools, the 21st Century classroom has students grouped in collaborative spaces, learning with the assistance of smart phones, netbooks, tablets and iPads, connected to the web and storing work in the cloud. Technology allows students to communicate and

collaborate using a range of social media platforms to share information quickly and at all times of the day or night from any number of locations.

Twenty-first century skills are variously described as critical thinking, problem-solving, communication and collaboration. Moersch (2014) referred to 'digital age best practices', a term used to encompass the ability to problem-solve collaboratively, increase purposeful inquiry, and allow for networked collaboration and differentiated instruction through personal and global content – practices that utilise integrated technology, use formative assessment and promote the creation of student-centred learning environments (Moersch 2014). Keane, Keane and Blicblau (2013) put an expanded definition of 21st Century skills forward; their definition combines critical thinking and problem-solving, stipulates effective communication, pairs collaboration and team building, and adds creativity and innovation. For them, the traditional 3Rs and these 4Cs – collaboration, communication, critical thinking and creativity – are required for the transformation of education, along with the development of personalised learning.

There is some agreement on the skills that should define 21st Century learning; however, there is not a universal set of instructions or strategies to guide schools in achieving this. Twenty-first century skills should not be viewed in isolation, as the aim is to develop 21st Century learners who are able to manage ICT in a responsible manner, be innovative and adapt to a range of learning devices. It is important that pedagogy, ICT and content are interwoven, as each school develops a renewed school ICT learning culture.

A range of interested groups including policymakers, employers, educational researchers and teachers also shared a belief that the learning future required students to develop a different set of skills and competencies (Ananiadou & Claro 2009). A number of initiatives evolved to define 21st Century skills. In 2008, major ICT companies including Cisco, Intel and Microsoft determined that school and university graduates were not equipped to participate in a digital age. In response, these companies joined with the University of Melbourne to establish a project for the assessment and teaching of 21st Century skills

(ATC21S 2012). The University of Melbourne's Assessment & Teaching of 21st Century Skills (ATC21S) took up the challenge to transform education for the 21st Century, leading an international study conducted from 2009 to 2012 (Griffin & Care 2015). The intention of this study was the identification and development of 21st Century skills, skills regarded as essential in education and work. It was envisaged that these skills would be developed in conjunction with content learning embedded in curriculum programs. The project identified 10 skills required for people to effectively participate in society, the workforce and leisure activities. These skills were ICT literacy, creativity, critical thinking, problem-solving, communication and collaboration, along with citizenship, personal and social responsibility and decision-making (Griffin & Care 2015). ATC21S offered recommendations to education systems on teaching and learning resources and assessment strategies.

The initial focus of the study identified two broad categories: collaborative problem-solving and ICT literacy, which encompassed six of the 10 skills identified initially. The six conceptual 21st Century skills identified in ATC21S were ways of thinking, ways of working, tools for working, living in the world, ways of learning and ways of teaching (Griffin & Care 2015). Assessment tools were devised, along with teaching strategies to form the basis for 21st Century curricula. This international study devised a system based on assessments for 21st Century skills, the results of which would inform the classroom teacher of the student levels within the class.

Whilst schools continue to maintain a focus on literacy and numeracy, the identification of these 21st Century skills, along with a measurement instrument, marked a new direction for education. Another initiative, the Partnership for 21st Century Skills, was established with input from teachers, education experts, and business leaders so that "all learners acquire the knowledge and skills they need to thrive in a world where change is constant and learning never stops" (P21 2018).

The concept of 21st Century education is more than the adoption of a set of skills and increased use of ICT; it requires a change in pedagogy from the

traditional teacher-centred approach to a more student-centred focus (Zmuda 2009). How students learn is equally as important as what they learn. The 'digital natives' are generally more proficient in a range of technologies that have the potential to enhance teaching and learning. Increasingly, they are more comfortable with ICT than their teachers and parents (Prensky 2001). "The capacity of digital technologies to capture student learning as a process as well as student achievement is vast" (Griffin & Care 2015). Teachers not only need to know these 21st Century skills, they also need an awareness of the changed world students will be part of, so that the teaching and learning can prepare them to live and work in the changed environment. Communication skills will be essential, written, oral and digital, so that students can operate at local, national and international levels. Invariably, students will need thinking skills that encompass critical analysis, creativity, decision-making and problem-solving. They will need to collaborate and work as part of a team, a family, a community or within an organisation. They will need to be able to adapt to new emerging technologies and ways of communicating and working.

Fraillon, Schultz and Ainley (2013) investigated the ways in which young people were developing computer and information literacies that supported their capacity to participate in the digital age. Their measure of an effective user was defined as "an individual's ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace and in society" (p. 17). This study investigated the ways in which students and teachers used ICT in the classroom and examined the extent to which young people were developing computer and information literacies that supported their capacity to participate in the digital age. It also revealed ICT coordinators reported teaching support and personal issues as factors that impacted teacher use of ICT more so than resource issues.

Whilst there is little research that actually measures the impact of ICT on student learning, Fraillon, Schultz and Ainley (2013) did examine student achievement by administering a computer-based assessment tool measuring computer and information literacy. The study also collected data on student attitudes and use of computer and other digital devices. Moersch (2014)

suggests there is not one single variable that can be attributed to improved practice within any school. He refers to a common set of ‘digital age best practices’ as a means of achieving academic success. These digital principles include a focus on underpinning student learning with ICT, embedding purposeful inquiry and the development of shared collaboration through digital networking, personalising content in a global context, use of formative assessment to gauge student understanding, and the creation of student-centred classroom learning environments.

The focus on ‘digital age best practice’ should address collaborative problem-solving, differentiated instruction, technology integration and formative assessment to provide a solid foundation for instructional practice (Moersch 2014). According to Law (2010), the key to transforming teaching and learning is teacher knowledge and ICT pedagogical competence. To facilitate student learning, teachers should select appropriate content, use available resources to scaffold student learning and involve students in collaborative learning. However, the specific knowledge and skills each teacher requires differs according to their level of knowledge and expertise and the purpose of ICT. The teacher intention behind the selection of ICT can vary from improving student learning through to developing 21st Century skills such as collaborative problem-solving. Pedagogical design is an ongoing process.

The work for principals centres on how to best support teachers in understanding how modern technologies can be used more broadly in the classroom, and help them access intuitive technologies that break down learning barriers. Principals need to support teachers with their technology decision-making to ensure that the school is set up for the future and is able to take advantage of technologies that students are engaging with outside the classroom. Globalisation and technological change require educational reform; schools need to move away from a prescribed set of content information and promote learning to learn through a student-centred approach where students become more engaged and motivated.

The modern technology-enabled education system is available to provide students with a positive learning experience, that is, something that forms a critical foundation for lifelong learning and the modern workplace. Students are generally more comfortable than their parents and teachers in using current technologies, which are also the technologies of the modern workplace. If we are to prepare students for that workplace, it is essential to invest in and drive the use of ICT in the classroom to engage students with these technologies.

2.2.5 Teachers and ICT

Change

Continual change within the field of ICT, along with the demands of different subject areas, different demographics and different school systems, added an additional layer to the complexity of embracing ICT. The integration of ICT had the potential to reform classroom practice and facilitate educational change, to make learning engaging and to strengthen educational relevance. The use of ICT technological tools and resources allowed teachers and students to create, store, manage, disseminate and communicate information (Burton 2006) in unprecedented ways. The increase in ICT in schools changed the way information was accessed and resulted in a greater flow of information. In adapting to a changed expectation, it is difficult to articulate what support teachers require, as the nature of teaching is diverse and change is a multifaceted and complex process.

For many teachers, the introduction of ICT has emerged since they completed their teacher training. As a result, many teachers do not feel confident or sufficiently prepared to use ICT in the classroom (Koehler & Mishra 2009). “Teachers must have a sound knowledge of the best pedagogical approaches to use along with a strong understanding of the curriculum and its requirements when implementing any technology” (Goodwin 2012, p. 81). Thus, effective teaching requires teachers to understand not only what to do but also why to do it. This is further reinforced by Ertmer (2005), who believes teachers need to picture the pedagogical benefit and see a direct advantage for student learning in their classes before they will engage in professional learning and new ICT

knowledge. Whilst pedagogical design is an ongoing process, it is often difficult for teachers who are not confident with ICT to appreciate the value and relevance of ICT in the classroom. In addition to selecting the content focus, teachers need to consider how to utilise ICT to support their teaching and to scaffold student learning.

The International Society for Technology in Education (ISTE) revised the 1998 National Education Standards to produce the National Education Standards 2008 (ISTE 2008). This publication identified a set of performance standards describing ICT knowledge and skills for student learning, teachers and administrators. The standards outlined the expectation of teachers to enrich their professional practice and adapt their teaching to ensure they designed appropriate learning experiences to engage students for improved learning outcomes in the digital learning environment (Solar, Sabattin & Parada 2011). The work also identified the standards students need in order to participate effectively in an increasingly global digital world. The student standards are grouped as creativity and innovation, communication and collaboration, research and information, critical thinking, digital citizenship and technology operations. Thus, teachers need to encourage students to build their capacity in each of these areas while they engage with the content.

In 2008, UNESCO developed an ICT Competency Framework for Teachers, which was updated in 2011 in conjunction with Microsoft (UNESCO 2011). The UNESCO framework outlined the role of the teacher as one who is able to assist students to become collaborative, problem-solving and creative learners through the use of ICT. The framework provided an international benchmark and identified the skills required by teachers to teach effectively with ICT. To assess the level of ICT in education and integration into schools, Solar, Sabattin and Parada (2011) developed the ICT in School Education Maturity Model (ICTE-MM). This model identified five leverage domains and described standards and performance indicators within each domain. The five teacher domain standards and performance indicators were student learning and creativity; digital-age learning experiences and assessments; digital age work

and learning; digital citizenship and responsibility; and professional growth and learning.

Technology allows students to engage in meaningful learning when they learn with the technology as opposed to learning from it. The use of computers in the classroom in the 1980s tended to focus on word processing, desktop publishing, databases, spreadsheets and graphics packages and allowed for a lot of 'drill and practice' activities. The emergence of electronic textbooks became prevalent, along with computer-assisted instruction tools that provided online tutorials and allowed students to work through exercises at their own pace. Both these approaches were a substitution of current class practice. The use of ICT was often imposed on students (Baskin & Williams 2006) rather than allowing for the creative, inspired and proactive use of ICT as promoted by Cuban (2001).

A number of research projects explored reform-based science teaching (Bell, Maeng & Binns 2013; Campbell & Hamid 2013; Hsu, Wang & Runco 2013); all studies found teachers continued to use technology more for administrative purposes and to support the teaching of traditional instruction in science rather than for transforming student learning (Campbell, Longhurst, Wang, Hsu & Coster 2015). However, given the ability of students to use ICT to network, communicate and socialise, and in conjunction with the ways technology is reshaping aspects of society, the consideration of ICT in science education could significantly enhance teaching and learning in science classrooms.

The increased use of computers in schools during the 1980s, along with increased access to the internet in the 1990s, quickly changed the nature of education and increased access to communication and multimedia tools (Moursund 1992). An approach to curriculum design that provides opportunities for students to explore and investigate in ways that were not possible without the use of new technologies is required to engage this generation of digital natives (Prensky 2001) in an interactive and collaborative learning environment (Yelland 2007). Teachers need to provide the opportunity for students to acquire the set of 21st Century skills.

When reviewing the impact of ICT in the Korean education system, Heo (2006) concluded that learning materials in electronic format are beneficial when directly linked to the curriculum and when learning theory and methods are applied to the development of units. He recommends the provision of guidelines for the development of ICT units for teachers, to avoid the addition of ICT without consideration of quality and educational value.

More recently, research has shifted from a focus on learning how to use ICT towards a focus on the changed classroom dynamic that can be achieved as a result of using appropriate ICT. Instead of ICT being used as a 'substitution' tool, it is used to 'transform' the learning experience. The focus has subtlety changed to consideration of context, and exploring what could be used to enhance student learning rather than master an aspect of ICT and implement it. "Technology use must be grounded firmly in curriculum goals, incorporated in sound instructional process, and deeply integrated with subject matter content" (Romano 2003, p. 29). However, to achieve this successful integration requires a level of confidence and competence from teachers. With units designed for online delivery, teachers are less focused on the delivery of content and more focused on coaching students (Hess & Saxberg 2014). This demonstrates a change in mindset. Romano (2003) suggests that determining how to empower teachers with ICT is the key to achieving broad-based, quantifiable improvement in how ICT is used to support student learning.

A classroom that challenges students to think creatively and critically is essential in a 21st Century learning environment; an environment where students examine information, gain understanding and generate reflection. Pedagogy is often referred to as the art and science of teaching (van Mannen 1999); it is a broad definition that examines the interplay between the teaching and learning that occurs in the classroom. In examining the interplay between teacher and student, pedagogy is more than the provision of information; rather, it is about how knowledge and understanding is fostered through teaching practice. Teachers are critical to achieving change. According to van Mannen (1999), the lack of clarity around what an ICT-rich classroom looks like impacts the rate of change.

Teachers are constantly confronted with a range of emerging technologies, programs, hardware, new devices and changing expectations from the education system. ICT companies are producing a range of products and programs that teachers could use to support student learning, and teachers continue to trial products, programs and strategies. However, when designing curriculum units, teachers tend to refer to the curriculum framework to guide their unit planning. They identify the key skills and knowledge that form the basis for the success criteria. Teachers then map the concepts and scaffold the learning for students to achieve the learning outcomes. It is usually at this point that teachers look for appropriate ICT tools, information and procedures that will enrich the learning process. The next step for teachers in unit planning is to create inquiry-based questions which require students to produce factual, conceptual and debatable information to reinforce the concepts embedded in the learning task. To summarise the learning, teachers plan an assessment task that will allow students to demonstrate their learning.

Curriculum

Content continues to be a key consideration for teachers in developing relevant curriculum to support the use of ICT to improve student learning. Along with content, other aspects to consider include the use of ICT to access, create and share information and learning, the use of ICT to reinforce learning (e.g. through use of self-paced learning programs) and the use of mobile devices to facilitate learning within and outside the classroom. All of these considerations are, in turn, impacted by the students' skill and level of expertise with ICT. In considering the 2016 Australian curriculum (ACARA 2016), the ICT domain has been absorbed into other domains (with the exception of Victoria, which has its own curriculum). The ICT general capabilities component encompasses the users of technology, so it follows that teachers in a 21st Century classroom need to know 21st Century technologies.

At the 2010 Big Ideas Global Summit 'Right to Learn' convention, real change was defined as profound, difficult and messy (Dixon & Einhorn 2011, p. 15). Those who work in schools need to acquire a new perspective that looks at technology with fresh eyes and considers what might be possible. Participants

at the summit agreed that change could not be accomplished with a checklist. Change requires rethinking the role of technology for where, when and how learning takes place, as opposed to a strategy of adapting current practice to achieve an outcome. The authors suggest the need for reframing learning so that students can learn through the exploration of topics and issues that are of interest to them via unlimited access to people, information, ideas and conversations to provide knowledge and develop deep understanding. This approach was premised on each child's right to learn.

In reviewing a number of studies, Ertmer and Ottenbreit-Leftwich (2010, 2013) considered teachers as the agent of change, believing a transformation to teacher mindset was the key to bringing about new practice. Their research explored teachers who use ICT in a constructive manner that allows students to use ICT to support their learning. The constructivist approach evolved from the work of Dewey (1938) and Piaget (1973) and is premised on the teacher's ability to build links between the curriculum and student experiences, and plan learning tasks that allow each student to make sense of the learning and construct new knowledge. The constructivist approach requires the teacher to adopt a differentiated approach; this is invariably referred to as student-centred learning. While not advocating that a change in teacher mindset can be achieved via professional development, Ertmer and Ottenbreit-Leftwich (2013) do suggest that such development can support development in teachers' pedagogical beliefs. They also suggest supporting teachers to adopt new practices may be just as effective.

The most productive and meaningful learning will occur when students are engaged in the construction of knowledge, conversation, collaboration, articulation and reflection (Jonassen et al. 2006). Meaningful learning requires learners to articulate their learning goals in working through real-world tasks, to interact with an environment and synthesise their new experiences and interpretations with their prior knowledge. To facilitate this, ICT should be used in a way that requires students to think about and design their learning tasks; then the ICT should be used to interpret, organise and represent their ideas, thinking and learning. The constructivist approach to teaching and learning

provides the opportunity for problem-solving, research and design and allows students to engage with their learning (Ertmer & Ottenbreit-Leftwich 2013).

Professional development

Education and professional development programs that focus on teacher knowledge, self-efficacy, pedagogical beliefs, and subject and school culture are more likely achieve improvements in teacher practice (Ertmer & Ottenbreit-Leftwich 2010, 2013). However, a problem exists in gaining consistency in data in this area due to the difficulty in measuring beliefs. Linking teacher beliefs and technology use is complex and multidimensional. Even when resource issues are removed, there are a host of other variables that can have direct and indirect effects on a teacher's ability to translate their pedagogical beliefs into practice, including teacher-related knowledge, motivation and confidence. School-related variables such as leadership and ICT policy, and cultural and societal variables such as parent expectations, standardised testing and curriculum frameworks add to the complexity. An individual's decision to integrate ICT is affected by multiple factors including those related to the ICT itself, the user and the organisational context. It is becoming more apparent that the change requires teachers to move away from content learning, to engage students in learning how to learn and, in the process, engage and connect with the current world and focus on the global economy.

2.2.6 Teachers and change

Change is about people and how they adapt to the implementation of new practices. It is a necessary process, and ensures that quality of education continues to expand to motivate and engage students (Agal 2013). Achieving change is a highly complex, multivariate and dynamic process which requires time; in education, this can take between three and five years (Hall & Hord 2001). However, many teachers feel threatened by change, especially change in the classroom dynamic that results in a perceived loss of control and a changed perception of themselves as the leader in the classroom. When confronted with change, there is a natural tendency for people to defend their circumstances in the first instance rather than embrace the change and learn

how to use it for improved outcomes (Hall & Hord 2001). Each teacher brings their own perspective, understanding and ideas to the process.

It is not simply the use of ICT in the classroom but, more importantly, the use of ICT to meet the needs of 21st Century learners that is the focus under consideration in this research. As the needs of current and future students emerge, teachers need to adapt the manner in which they approach teaching and learning in the classroom. “Teachers need to be able to help the students become collaborative, problem-solving, creative learners through using ICT so they will be effective citizens and members of the workforce” (UNESCO 2011, p.3). The UNESCO ICT Competency Framework for Teachers (2011) identifies three successive stages to a teacher’s development in relation to ICT: the development of technology literacy, knowledge deepening and knowledge creation. Technology literacy involves enabling students to use ICT to learn more efficiently, knowledge deepening focuses on the acquisition of knowledge for problem-solving, and knowledge creation is the use of ICT for society’s current and future requirements (UNESCO 2011). These three approaches to teaching with ICT focus on student learning and using the knowledge acquired with ICT to solve problems and create new knowledge.

Change can be examined through behaviour, as each teacher has different intentions and resources. According to Hattie (2012), change requires both talk and action; and to achieve action, an intention to change must be present. “The successful integration of ICT into the classroom depends on the ability of teachers to structure their learning environments in non-traditional ways, merging technology with new pedagogies” (Hennessy, Harrison & Wamakote 2010). To integrate ICT effectively requires new knowledge and skills, and to achieve this, time is necessary: time to understand what is required, time to plan, and time to deliver and reflect. Accordingly, teachers need to change their perceptions of their role in the classroom and their approach to classroom organisation, and invest time in devising new learning arrangements. Most importantly, teachers need to determine which ICT adds value to their learning area and their teaching.

Teachers are a key element in this move to include ICT to improve student learning. For teachers to change the way they “teach and use materials” requires time, commitment, risk-taking, adequate resources and consistent and patient support (Frazier 2012). It is difficult for teachers to embrace the use of ICT without a clear understanding behind the need for educational change. In addition, not having a sense of what is involved and how to proceed impacts the change process (Cox, Preston & Cox 1999). Other factors identified by Cox, Preston and Cox that impacted on the teacher’s ability to change included a fear of losing control in the classroom when ICT was used, inadequate resources, technical training in the use of the ICT rather than on how to incorporate it, and the impact on pedagogical practices. Alternatively, the motivating factors for teachers to both use and sustain the use of ICT were to make their lessons more diverse and interesting for students, and using ICT to improve presentation materials and make administration more efficient.

Whilst it is acknowledged that ICT by itself brings little to the learning process, as it is a tool to be utilised by teachers, it is difficult to establish one process as each teacher has different skills and knowledge. The challenge is to determine the vision and the right focus to meet the needs of all teachers. To support teachers effectively, more knowledge is required about how to enable them to develop appropriate and relevant ICT practices. Teachers need to gain an understanding of the relationship between meaningful and appropriate ICT classroom practices and improved learning outcomes. In addition to increasing ICT in the classroom, to educational change with adequate support for teachers needs to be considered. Also, there needs to be recognition of the developing nature of the change process, as teachers learn while teaching: they learn from the delivery of the lesson, they learn from students, and they learn by reflecting on their lessons.

As ICT was integrated into schools, the technology was often overlaid onto the existing curriculum framework. However, Prensky (2012) highlighted the need to reinvent the learning process and design new pedagogy and curriculum suited to the digital generation. He examined how to motivate and reinvigorate teachers to develop future-oriented curriculum that included problem-solving,

collaboration, video making and programming. Educational context changes with the addition of ICT, and teachers need to adapt to the new environment and develop new perspectives and ideas that work with ICT. Prensky (2012) suggested teachers need to change from focusing on teaching their subject to teaching their students. As a group of professionals, teachers tend to keep adding more initiatives, programs and technologies but rarely discard any outdated practices.

The extent to which a school can embed ICT to cater for 21st Century learning requires a multilayered approach; it requires a reorientation and a sense of renewal as teachers are transitioned into new ways of doing things (Somekh 2007). Schools need to provide clarity through a vision for the change, provide support through the transition, and be prepared for a number of transition phases as teachers do not necessarily transition to new ways of teaching and learning through one cycle. Efforts to implement change in schools have long been ambiguous, and lack of a vison has been a primary reason for the absence of successful widespread change (Hall & Hord 2001). Successful implementation of any initiative is highly reliant on each individual and their attitude towards the change.

A clear vision of the intended outcome is required to bring about a transformation; teachers and administrators need to know the end result. Hess and Saxberg (2014) examined this problem through the lens of learning engineering. The learning engineering approach requires teachers and curriculum designers to ask how technology might enhance, expand or improve learning and what that requires. The use of ICT should enable a new way of thinking and learning. This strategy applies the same problem-solving approach used by engineers.

One of the limitations in measuring the impact of ICT on teaching and learning is the difficulty in measuring the extent of the phenomenon. Whist it is quite easy to identify internet speed, establish the ratio of computers to students or list available software, it is far more difficult to find a measure of pedagogical change. Barajas et al. (2004) designed a tool to measure three aspects of ICT

use when applied to curriculum and pedagogy: operation (learning to use the ICT competently), integration (ICT is used on current practice and curriculum) and transformation (the use of ICT changes the teaching practice). In practice, this measurement tool is applied to teachers in the same curriculum area and for the same practice criteria. The tool records teacher change and the extent to which ICT has allowed for a transformation in the approach to teaching and learning.

In summary, change is complex, takes time and requires an understanding of the dynamics of change and transformation. Change is described as a three-phase process, letting go of the old ways, going through a transition process and making a new beginning (Bridges 2003). New practices require a change in a person's behaviour and their understanding of the change, be it a practice or a process. A frequent problem for teachers is that they are not clear about what is required of them and what the change will look like when it is fully implemented. Acknowledging their feelings and concerns and providing the appropriate assistance are important aspects to support the change process.

2.2.7 Similar research

The challenge concerning the integration of ICT in the classroom is how to support teachers to embrace the potential of ICT. Teachers need to develop expertise and devise strategies to bring about change within their classrooms to allow students to use 21st Century skills that equip them for future study and employment. A model that supports teachers to use ICT to transform the ways in which students learn, and to be more effective creators of both the curriculum delivery and the learning environment, will ultimately support student learning. The identification of barriers will allow school leaders and teachers to implement strategies to eliminate or minimise them.

Royle and Hadfield (2012) conducted research, with a similar research question and methodology, in the primary school sector in the United Kingdom. They utilised action research to examine two key questions: how could netbooks be used to support independent and personalised learning, and what implications did this have for the role of the teacher as a leader and facilitator of learning?

The model used in this research was based on three interconnected factors: the educational status of the technology, the capacity for innovation within the organisation and by groups and individuals, and the extent to which technology could be aligned with the needs of teachers and their pedagogical approaches. Royle and Hadfield (2012) concluded that pedagogical reframing was necessary for teachers to adapt to ICT in the classroom. However, they believe reframing is reliant upon teacher reflection, and teachers understanding their use of technology requires them to make changes to their teaching.

Similarly, Trinidad, Newhouse and Clarkson (2005) set out to develop a framework that would support, describe and promote good practice in the use of ICT in learning and teaching for Western Australian schools. They reviewed a range of technology adoption models used in leading school change. Their findings were used to inform the development of a framework to support schools and teachers in the use of ICT learning. They concluded “aspects of Learning Micro Models appeared to have a more appropriate orientation for teacher development and school change, in particular, mapping teacher pedagogy and capabilities” (Trinidad, Newhouse & Clarkson 2005, p. 7). They developed a three-tiered framework to assist teachers in developing their ICT expertise, with the layers as the overall outcome, the components of the outcome and the elements of the components. Each layer has a subset of the stages of teacher development which act to support and measure the change in teacher development. The framework described the development stages teachers would progress through to achieve quality pedagogy as inaction, investigation, application, integration and transformation. Trinidad, Newhouse and Clarkson (2005) contend that this structured approach to the development of each teacher’s ICT capabilities is more likely to result in changes to pedagogy and school reform. Their framework described quality pedagogy for the use of ICT, and provided a process to describe and map strategies and teacher ICT progress for the integration of ICT into various learning environments. In addition, their framework outlined a process to provide opportunity for teacher dialogue regarding progress and concerns.

Trinidad, Newhouse and Clarkson (2005) also developed a holistic, structured approach to the development of teachers' professional ICT capabilities. Their framework incorporated professional development and a process for formative feedback to support continuous progress with the integration of ICT. The framework was designed to be flexible and multifaceted, for use by individuals, groups, schools and educational organisations, and it aimed to support, describe and promote good ICT practice. It was premised on the understanding that "teachers always look for better ways to do things and the integration of ICT should support effective learning and quality pedagogy" (Trinidad, Newhouse & Clarkson 2005, p. 10). However, they did acknowledge that no model would meet the needs or perfectly describe the process and circumstances for every teacher.

An action research study was conducted in four Tasmanian primary schools to examine the impact of ICT on pedagogy (Webb, Robertson & Fluck 2006). The findings suggest it is possible to develop an in-school professional learning program based on pedagogy and ICT. A key finding from this research was the value of professional development being informed by the ability and interests of the teacher. The use of action research supported the research design for this study.

Phelps and Graham (2013) conducted an action research that aimed to prepare trainee teachers for a career in education, a career in which participants would face continued technological change. As the focus of the research was teachers learning to think about the 'how' and the 'why' of what they do, the researchers adopted a metacognitive approach. They based their research on the premise that the best way to help teachers survive and thrive in the constantly changing technological environment was for the participants to develop confidence and effective learning strategies. A positive response to their initial findings resulted in an expansion of the research to include teachers in primary and secondary schools from government and independent systems across one education region.

It is often assumed that a key to the successful implementation of ICT is changing teachers' perceptions of the value of ICT and providing them with time to work with it. Li (2010) and Sugar, Crawley and Fine (2005) believe teachers will adapt their practice and adopt new approaches when they see ICT used in classrooms similar to their own. They suggest that professional learning that allows teachers to see a direct benefit to student learning will change teachers' perceptions of ICT. Reiber and Welliver (1989) examined the phases teachers progress through as they integrate ICT: familiarisation, utilisation, integration and reorientation. They suggest it is in the reorientation phase that the focus moves from the ICT to the learner. However, while teachers may see the value in the use of ICT, this does not necessarily result in changed practices. Despite an increased awareness of the value of ICT, some teachers continue to display a reluctance to try new practices (Li 2010; Karagiorgi 2005).

The study of obstacles that impact the integration of ICT in education may assist teachers to become successful adopters of ICT in the future. In her study on the integration of online learning in New South Wales secondary schools, Neyland (2011) explored factors that impacted teachers as their attention moved from the ICT to the learner. She concluded that the positive attitude of decision-makers and teachers within schools seemed to correlate with a higher level of successful integration of online learning. Similarly, Li and Choi (2013) found that social capital plays a pivotal role in pedagogical change; factors such as collegiate trust, support for risk-taking and access to support within the school assisted the change process. They conducted a comprehensive study of 1100 teachers to gauge the impact of social capital, teacher receptivity to ICT and professional learning.

2.2.8 Factors that inhibit teacher use of ICT

A number of theories have emerged to explain why teachers have not embraced the use of ICT to underpin student learning. Bain and Weston (2012) identified five 'faulty assumptions' (p. 7) that have been an ongoing focus in the ICT debate related to the use of ICT in schools. The first assumption relates to access: it was presumed that with access, students would learn how to use ICT

and transfer these skills and knowledge to all of their learning. The authors found that while most students use ICT quite competently, for social media they do not use ICT in a transformative way in relation to their learning. The next assumption was that teachers would automatically change their teaching practice when they gained access to ICT. Likewise, there was no evidence to support the notion that increased access to ICT leads to improved quality of ICT use. Bain and Weston (2012) also queried the assumptions that improved ICT use brought about improved student learning outcomes, and that professional learning for teachers would result in improved student outcomes.

Romano (2003) studied the relationship between teachers, learners and technology and determined that "the empowerment of teachers with technology would achieve broad based quantifiable improvement in how our youth learn" (Romano 2003, p.13). However, he identified six barriers that prevented teachers from using technology effectively. In summary, they are:

1. No common clear vision of how technology can be used in the classroom.
2. Teachers have not been provided a convincing explanation of how technology would empower them.
3. Misconceptions regarding the teacher's role in adapting technology to teaching and learning.
4. The critical significance of course-specific software has not been understood.
5. Little attempt to analyse and then profit from the many failures of the last 50 years.
6. Ample evidence that leaders in education lack a full grasp of technology's capacity to make teaching and learning more effective and efficient. Consequently, their potential impact on promoting the use of technology is not fully realised. (Romano 2003, p. 22)

The impact of ICT on teaching practice within the Australian education system is varied, with pockets of creative use through to limited use in some subject areas. The assumption that more technology equalled more learning was flawed; more technology is effective only if it promotes good teaching and

learning (Cuban 2001; Ward 2003). According to Cuban (2009), the majority of teachers employed technology to sustain existing practices rather than develop a new approach or innovate to enhance learning. It is a common misconception that access to technology, on its own, motivates teachers to apply it in their teaching (Hennessy, Harrison & Wamakote 2010).

An additional recurring problem for teachers who are expected to implement change is that they are unclear about what is required. While innovation can involve products and processes (Hall & Hord 2001), the introduction of ICT involves both aspects, with ICT being the product, and enhanced learning the process. Enhanced learning requires teachers to undergo a change process, to redesign their teaching. Researchers such as Hess and Saxberg (2014), Williamson (2013), Jonassen et al. (2006) and Romano (2003) have increasingly expanded on the potential of ICT as a key component of the ways students learn and communicate. Prensky (2012) suggests the need to reconsider the curriculum and the way in which students are educated.

While Australian schools are well resourced, with students having ample access to computer-based information and interactive digital learning resources, along with access to the World Wide Web and electronic mail accounts, issues remained that impacted the uptake of ICT. A number of researchers identified factors that impacted teachers and their efforts to integrate ICT. Table 1 provides a summary of the issues identified by Mumtaz (2000), Romano (2003), Hew and Brush (2007) and Thomson (2015).

Table 1: Issues impacting the integration of ICT

Mumtaz (2000)	Romano (2003)	Hew & Brush (2007)	Thomson (2015)
Lack of teaching experience with ICT	Lack of a coherent vision illustrating how technology could be used in the classroom	Lack of resources	Lack of ICT skills among teachers
Lack of onsite support for teachers using technology	Lack of a convincing explanation of how technology would empower teachers along with misconceptions about how teachers adapt ICT for teaching and learning	Limited teacher skills and knowledge	Insufficient time for teachers to plan lessons
Lack of help supervising children when using computers	Lack of time to plan	Poor vision within the school of the role of ICT	Perceived lack of professional learning resources for teachers
Lack of ICT specialist teachers to teach computer skills to students	Lack of national policy on use of computers in school	Negative teacher beliefs and attitudes	Lack of incentives for teachers to adopt ICT and integrate it into their classrooms
Lack of computer availability	Lack of technical support	Weak assessment strategies	
Lack of time required to successfully integrate ICT into curriculum	Teacher lack of expertise in using ICT	Inability to see a broad application for ICT	
Lack of financial support	Reliable internet connection		

From her study of factors that impacted ICT adoption, Thomson (2015) concluded that, overwhelmingly, obstacles were connected to skills and resources, the biggest problem being a lack of ICT skills amongst teachers. She reported that there was a perceived lack of incentive to incorporate ICT into teaching, a lack of effective professional learning and insufficient time to plan lessons, all of which inhibited teacher use. Teacher resistance to computer use fell into several broad-based themes: resistance to overall change, resistance to outside intervention, lack of support from administrators, issues related to time, teacher perceptions of ICT and personal and psychological factors (Robertson, Caldert & Fung 1996).

Through a review of the literature, Bingimlas (2009) identified a range of similar barriers that impacted the successful integration of ICT. The key barriers he identified were teachers' lack of confidence and competence, and access to resources. He concluded that the provision of ICT resources and professional development, along with sufficient time and technical support for teachers, would assist teachers; he found they had a strong desire to integrate ICT but the barriers impacted their efforts. Bingimlas believes that barriers can be removed or reduced through collaboration between school leaders and teachers to provide time, resources, technical support and training.

When looking at school change and technological innovation, key elements impacting teaching and learning identified by Whitehead, Boschee and Decker (2013) were summarised as time, relationships, technology, teaching style, learning style and flexibility. However, Brown (2004) considers a broader whole-school view of the issues associated with integration of ICT. He identified areas such as curriculum integration, pedagogical integration, temporal integration, spatial integration and attitude. Curriculum and pedagogy relate to the learning goals and content, and how the ICT choice is aligned with the teaching approach. Temporal relates to how ICT connects to learning, and spatial considers how ICT is embedded in the learning. Attitude takes into consideration the extent to which teachers and students view ICT. Using a whole-school approach, an improvement in all aspects would collectively contribute to the integration of ICT.

The curriculum framework has often been defined as the knowledge, skills and attitudes planned for student learning. A need exists for schools to move beyond an information-centred view of education to one that embraces the pervasiveness of ICT. The introduction of ICT requires teachers to structure their classroom learning differently; successful integration is reliant upon the ability of a teacher to structure their learning environment to allow for the merging of ICT and pedagogy (Hennessy, Harrison & Wamakote 2010). Romano (2003) suggested the need to recognise that substantial learning can occur while teaching and learning with the students. The *Right to Learn* whitepaper (from the 2010 Big Ideas Global Summit; Dixon & Einhorn 2011)

promoted the adoption of a new perspective that requires educators to rethink how, when and where learning occurs, and to consider knowledge construction and how to empower learners.

Despite investment in ICT by various governments, many teachers are yet to use ICT to transform their classrooms to a student-centred, inquiry-based learning environment (Moersch 2014). The teacher-centred instructional approach continues to prevail. While some teachers effectively embrace ICT, system-wide reform in the way ICT is used in the classroom is not yet evident. The ability to change pedagogy has often been regarded as the difficult part of the ICT revolution in schools. Researchers such as Cuban (2001), Harris (2010), Romano (2003) and Watson (2001) identified teachers as having a pivotal role in effecting change. An improvement in approaches to meet current and future student needs requires teachers to rethink what they do in relation to teaching and learning and consider the impact of ICT on pedagogy.

2.2.9 Factors that support teacher use of ICT

As outlined above, it is apparent that teachers play a key role in the successful integration of ICT into the classroom. Mumtaz (2000) identified a number of factors that influence teachers' decisions to use ICT. These factors include access to resources, the quality of software and hardware, ease of use, incentives to change, support and collegiality within each school, national and school policies, and each teacher's commitment to personal learning and background in formal computer training. In particular, Mumtaz (2000) concluded that teacher beliefs about teaching and learning are central to the successful integration of ICT, along with a strong focus on pedagogy. He suggested greater success could be achieved using three interconnected frameworks for change: teachers, the school and policymakers.

Teachers play a crucial role in determining the extent to which ICT is used effectively in the classroom to underpin student learning. In his study of elearning, Selim (2007) identified four categories of acceptance and highlighted eight critical success factors. The success factors covered teacher attitudes towards and control of technology, teaching style, computer competency,

interactive collaboration, elearning course content and design, ease of access, infrastructure reliability and effectiveness and support. Inan and Lowther (2010) also examined factors that influence teacher adoption of ICT. Their research identified computer proficiency, teachers' beliefs, teacher readiness and technology integration as variables for their model. They concluded that all their variables had a contributing impact but the first four were critical for successful ICT integration. In conjunction with these variables, they also looked at teacher age, years of teaching, computer availability, and technical and school support.

The Horizon Report: 2011 K-12 Edition (Johnson, Adams & Haywood 2011) identified five key drivers that impact the adoption of technology. They are summarised as:

1. The abundance of resources available through the internet challenges educators to review their role in education.
2. The ICT both teachers and students use is no longer confined to the school server; increasingly the information is stored in the cloud.
3. Technology continues to affect the way educators work, and the ways teachers and students communicate, collaborate and learn.
4. The perception of schools as the place where learning occurs is changing as people expect to work, learn and study in a variety of places at all times of the day or night.
5. The value of creativity and innovation is increasing. (Johnson, Adams & Haywood 2011)

Teachers are regularly encouraged to connect classroom learning to the world beyond the classroom and to do this effectively it is essential to utilise ICT. Knowledge and experience of ICT is no longer sufficient to change practices in the classroom, as ICT encompasses a range of tools and applications and the decisions about what to use, how and when to use it is quite complex. Adding to this is the rapid rate of ICT change, which can further impact the way curriculum is taught. The role of the teacher is to take information and develop it into a more visual and active learning process (Cummings 1998). The need exists to clarify what is required to support student learning in the 21st Century.

2.2.10 Rethinking pedagogy

Teaching and learning are very different aspects of the education process. To engage students in their learning and meet their educational needs, education needs to acknowledge and utilise the skill set students possess and to connect students' educational needs to real-life learning (Prensky 2012). In his paper, "The emerging online life of the digital native" (2012), Prensky claims that 'digital natives' learn differently, search for information differently, analyse differently and report differently. He noted their ability to program and the way they socialise. In his opinion they are evolving and growing up differently. The educational context has changed significantly, and the new context requires a new approach. Prensky (2012) believes that, since introducing the term 'digital natives', the process of learning remains poorly understood. In the new environment, the outdated lecture style where the teacher imparts knowledge and tests for understanding does not appeal or stimulate students when they are continually connected to ICT. The access students have to ICT, especially mobile devices, is changing traditional pedagogical practices, as students can supplement classroom learning with information programs and tools available through the internet.

Politicians, policymakers, employers, teachers and educational researchers generally share the widely held belief that the current century will require a different set of skills for people, to participate in the work environment and in leisure activities (Ananiadou & Claro 2009). The theoretical underpinnings of the Programme for International Student Assessment (PISA) (OECD 1997) identified the necessary knowledge and skills required by students aged 15 to solve real-life problems and to participate fully in society (Ananiadou & Claro 2009). Ananiadou and Claro referred to these as 21st Century skills and "those skills and competencies young people will be required to have in order to be effective workers and citizens in the knowledge society of the 21st Century" (p.6). They grouped the skills and competencies into three categories: ICT functional skills, that is, the ability to master ICT applications; ICT skills for learning, which covered the ability to use and manage ICT applications that require higher order thinking skills; and the 21st Century skills, a category which

may not necessarily require ICT. The elements of higher order thinking, critical thinking, problem solving and the transfer of knowledge provide a strong foundation for students to participate in the 21st Century.

To find what 'digital natives' want from education, Prensky (2010) interviewed over 1000 students from various age groups, backgrounds and locations. He concluded that students want to learn differently; they want learning that is meaningful to them, that allows for collaboration. In addition, they want to connect with their peers and share their opinions, pursue their own interests and create, using tools with which they are familiar. Prensky (2010) suggests the challenge for teachers in moving forward is to change their pedagogy and become comfortable with ICT; he refers to this as 'partnering'. In a partnering pedagogy approach it is the students who use the ICT and the role of the teacher is to guide and coach them in the use of ICT for effective learning.

The educational process is changing as a result of technology. Subsequently, learning how to learn is becoming a necessary focus for teachers as well as students. Teaching is often regarded as a practice and, according to Kemmis (2009), "understanding and changing practice requires work outside the heads of practitioners as well as inside them" (p. 3). Similarly, schools need to reconceptualise the role of ICT within pedagogy, as opposed to within each school or viewed in relation to the work of teachers. To bring about a shift within schools, each level of responsibility – the principal, the leaders and the teachers – need to examine their processes and practices and design integrated pedagogy-based solutions to apply within the school. Teachers must adapt as the nature of learning in the 21st Century is different.

It was during the 1990s that ICT in schools became more accessible and focused on personal devices (Crompton 2014). In his research on mobile technology, Traxler (2009) found that the mobile ICT device not only enhanced and supported learning in a variety of environments, but was also impacting the actual knowledge and learning process. A pedagogical shift toward more student-centred learning, in particular problem-based learning, was emerging. Mobile learning placed learning in the hands of the students and marked a shift

away from the formal classroom lecture-based instruction format. The ability to access information immediately to facilitate collaboration and communication provided a sense of immediacy that was not available in the traditional classroom. Current students are both consumers and creators of information and have a level of digital competency. It is evident students are increasingly well connected and practiced in the use ICT; however, they are not necessarily skilled in using it to support their learning. Traxler concluded that transformational change is required to ensure teachers do not retain old practices with new equipment.

Shulman (1986) highlighted a need to realign pedagogy. This led to the development of his Pedagogical Content Knowledge Model, which was later further developed by Mishra and Koelher (2009) to become the TPACK model. In the new education environment it is clear that ICT is strongly entwined in the educational experience; thus the use of the TPACK model directs attention onto all aspects of curriculum planning. The approach required to effect change is to capture ICT for education as opposed to education capturing ICT, an approach which can tend to focus on content delivery. ICT in education has changed the way students think about, design and manage their learning.

The integration of ICT is complex and often presents significant challenges for teachers. Successful integration depends on a range of factors such as time, attitude, professional development, leadership and smooth implementation. Time and collegiate support allows teachers to work collaboratively and learn from each other while developing course material. The dilemma for teachers is not only to discover how to use ICT, but how to scaffold the theoretical support for implementation in the classroom.

In addition to a whole-school approach to teaching, learning and organisational change, a pedagogical change is necessary; a shift from a teacher-centred focus to a student-centred focus (Moyle 2006). Participants in Moyle's study identified a number of pedagogical approaches that support the meaningful inclusion of ICT in the teaching and learning process, such as authentic learning activities directly related to the students, access to online environments

and multimedia for problem-solving tasks using ICT functions for data entry and analysis, and the opportunity to learn directly about other cultures and world perspectives. The results indicated that students tended to be more motivated and engaged when involved in problem-solving tasks that involved ICT. Moyle (2006) believes a student-centred approach provides opportunities for both individual and collaborative learning, in particular individual learning within the context of teamwork. She concluded that the use of ICT has the potential to broaden student understanding of different cultures and their world view, and allows student to collate their work into digital portfolios for assessment and reporting.

The anticipated outcome of the NSSCF (DEEWR 2009) initiative was to have classrooms where students learnt at a deeper and broader level, with an increased ability to process information and retain instruction. To achieve this, teachers need to know how to use ICT to provide relevant instruction and enhance student capacity for learning, and engage students in their learning through collaboration and connection to others. That is, provide learning that caters to the needs of students who live and learn in a society that utilises ICT to access information, communicate, learn and work. Twenty-first century ICT learning can facilitate new instructional approaches and allow for innovation in teaching and learning.

2.2.11 Professional development

Many educational reforms rely on teachers' willingness to continue their learning, and high quality professional development is considered fundamental to improvement. Professional development is defined as those processes and activities designed to enhance professional knowledge and the skills and attitudes of educators, so that they might in turn improve the learning of students (Guskey 2000). Guskey defined professional development as a systemic process that is intentional and ongoing. He believes the need for professional development often stems from a deficit perspective, meaning there are perceived deficiencies in the knowledge and skills of educators, especially classroom teachers.

Effective professional development can challenge teachers to rethink their current practice and encourage them to teach in new ways and create new expectations about how students learn. Change is more likely to occur when professional development is situated within the context of a teacher's own curricular needs (Koehler & Mishra 2005; Robertson, Webb & Fluck 2007). It results in improvements in teachers' knowledge and instructional practice, which in turn results in improved student learning outcomes (Darling-Hammond & McLaughlin 1995) and teacher attitudes towards ICT, along with their pedagogical beliefs, influence whether and how they will embrace ICT (Ertmer & Ottenbreit-Leftwich 2010; Phelps & Graham 2013). Additionally, experiences with technology can have a strong influence on teachers' subsequent efforts to achieve technology integration (Ertmer, Ottenbreit-Leftwich & York 2006).

According to Elmore (2007), changing the core process of schooling requires an explicit theory of how teachers learn to teach. Elmore advocates that professional development needs to result in sustained improvement in instructional practice, and suggests teachers are more likely to learn to change their practice by engaging in the new practice when working with others who have expertise in the area, and by observing others who are engaged in the new practice. The creation of professional learning teams, professional learning communities (PLCs) or communities of practice (CoP) with a specific focus on the use of ICT is one of many strategies that can be applied to all schools (Ward 2003; DuFour & Fullan 2013). An emerging and accepted view of teacher learning is the interactive and social discussion with colleagues (Hattie 2009).

Professional development is a broad field and it covers a myriad of focus areas and delivery options. During their careers, teachers experience a vast array of interactions and activities that increase their knowledge and skills, improve their teaching practice and contribute to their social, emotional and personal growth (Cohen, McLaughlin & Talbert 1993). Schools have traditionally trialled a range of professional development activities to enhance teacher learning, invariably with mixed outcomes. The broad range of professional development programs and activities makes it difficult to measure both effectiveness and impact. The success of professional development has for many years been measured by

teacher feedback; their satisfaction and changes in attitude or commitment to innovation. However, this does not correlate to improved student learning (Bain & Weston 2012).

Phelps and Graham (2013) believe distinct aspects should be considered first when planning professional development to support the successful integration of ICT. For example, it is necessary to understand the role of ICT in the teaching and learning process, then consider the skill development required to implement ICT in the classroom and be aware of a sense of constant change. Professional development rarely takes a 'big picture' view of the creation of 21st Century teachers, as the professional development agenda is often driven by various ICT products instead of the educational change required to support the learning needs of students (Frazier 2013; Prensky 2012). The constantly changing environment resulting from the introduction of new ICT devices and programs, along with constant hardware and software upgrades, presents ongoing challenges for many teachers. Teachers can best be supported to utilise 21st Century ICT learning through professional development that facilitates change to teacher knowledge, self-efficacy and pedagogical beliefs (Phelps & Graham 2013).

Facilitators of effective change employ strategies and take action such as making staff aware of the impending change, stimulating interest and providing a timeline and explicit information around the purpose and need for the change (Whitehead, Boschee & Decker 2013). The end users of the new change need to understand the concept, the possibilities and the implementation processes. Rosenholtz (1989) concluded that teachers who feel supported in their own ongoing learning and classroom practice were more effective and committed. Similarly, teachers who work together, share their learning experiences, collaborate on issues of concern and problem-solve, adopt new classroom practices more readily (Darling–Hammond 1996).

School facilitated professional development

Moyle (2006) suggests school-based and self-directed professional development should cater to the varied staff needs and include the opportunity

to focus on changing pedagogy, such as developing individual and collaborative learning and increasing awareness of various ICT applications. To meet the needs of 21st Century learning, a paradigm shift is required for teachers to embed advanced ICT skills across all aspects of the curriculum (Russell, Finger & Russell 2000). However, it is often difficult to ascertain the professional development required, as teachers are invariably at different levels of ICT development and implementation. Teachers often have a clear preference for professional development based on the current resources they have access to (Glenn, Finger & Russell 2000). In their study of 400 schools, Russell, Finger and Russell (2000) noticed that professional development tended to focus on the development of low level ICT skills. Whilst this may have resulted in the increased use of ICT in the classroom, it did not bring about the anticipated paradigm shift. Lawless and Pellegrino (2007) observed that technology-based professional development for teachers still has a long way to go in understanding methods of effective practice with respect to the various impacts of ICT on teaching and learning.

The issues related to increased use of ICT by teachers to underpin student learning is not unique to Victorian or Australian schools. In their UK study, Haydn and Barton (2008) provided two groups of secondary science and history teachers with a day release from classes to explore ways they could incorporate ICT. The teachers met at the beginning of the year to discuss ICT use in the classroom, used the day release to explore their ideas and interests, and then met again at the end of the year to discuss and share their findings. In this research there was no recommended model; it was left to the teachers to explore what was available and of interest to each teacher. Approximately three-quarters of the teachers reported a positive but modest impact on their use of ICT through participation in the project. In this study, the combination of time, along with the opportunity for discussion with colleagues, provided impetus for change.

Haydn and Barton (2008) concluded there was no clear difference between the participants who commenced with high level ICT skills and those who identified as having little ICT experience. Whilst there was a mixed response in relation to

ICT learning, one key outcome shared during the final meeting was the positive response from the participating teachers – they enjoyed the opportunity to be involved and to share their learning. Teacher participants felt there was merit in meeting to discuss their new found expertise in ICT, along with added opportunity for social interaction. Haydn and Barton (2008) suggested this finding was similar to Younie's (2006) research, which concluded that fostering collegiate practice through the establishment of CoPs may be a contributing factor in the development of teacher ICT expertise.

A professional development model for science teachers to support their teaching with ICT, and that used technology-supported instruction as the vehicle for change, formed the basis for the Campbell et al. (2015) research project. In particular, the study focused on how teacher pedagogy and development change through participation in ongoing and sustained professional learning. Teachers and students were introduced to new ICT capabilities and literacy skills, with educative curriculum (Davis & Krajcik 2005) being the framework used to underpin this professional learning model. The objective was to investigate both teacher learning and student learning. Campbell et al.'s research used inquiry as a key strategy for the teaching of science, as that allowed students to use a range of ICT tools, use search engines, collect and manage data in spreadsheets, map locations, create and develop charts, present their findings and share outcomes using a collaboration tool. This approach allowed for the use of a range of ICT applications to underpin student learning.

The gap between those who are knowledgeable about teaching in schools and those who are inadequately prepared creates an educational challenge (Whitehead, Boschee & Decker 2013). The constantly changing ICT learning environment resulting from the introduction of new devices and programs, along with regular hardware and software upgrades, presents continuing challenges for many teachers. Webb, Robertson and Fluck (2006) conducted action research to examine the professional learning that best supported teachers to integrate ICT. They adopted a collaborative professional learning approach with a focus on specific classroom practices.

Ongoing professional development will remain a necessity of current reforms as teachers work in a constantly changing ICT environment. Achieving a 21st Century educational learning environment in settings that allow for learning online over distance and time requires acceptance of a changed approach to teaching and learning as previously understood by teachers. Teachers need to accept the role and value of ICT as an instructional tool and demonstrate a willingness to adopt and adapt their teaching practice. The ever-changing ICT landscape provides a lens through which to reconceptualise schooling in the 21st Century (Moyle 2006). Teachers can best be supported to use ICT to support 21st Century learning through professional development that facilitates change to teacher knowledge, self-efficacy and pedagogical beliefs (Phelps & Graham 2013). The support of leadership within schools becomes an important factor associated with the success of ICT and change strategies.

2.3 Instructional design models to support change

In designing a model that could support teachers to better utilise ICT to transform teaching and learning, it was important to examine the models currently available to gauge their effectiveness in transforming learning. A number of pedagogical models were based on the assumption that there is a body of information that can be learnt and applied; some assumed sociocultural learning theories that build on the work of Vygotsky (1962) with a view that learning is often embedded in social and cultural events and collaboration. In examining pedagogical theory, an instructional model refers to the process of planning and structuring a sequence of learning tasks that ultimately lead to the acquisition of the learning goals (Jonassen 1991).

Over the years, a number of instructional design models have been developed to explain and support the adoption and implementation of ICT and to provide a framework for teachers to embrace the use of ICT (Heinrich et al. 2001; Hall & Loucks 1977; Hoffman & Ritchie 1998). When using an instructional design model, it is assumed that materials are designed, developed and delivered to make learning more appealing, effective and efficient (Crawford 2004).

Generally, the process consists of the teacher identifying the learning needs of each student, then designing tasks that will transition the student to achieve the set learning goals. Providing a learning process tailored to the needs of individual students should assist in the promotion of deep learning. When teachers collaborate with each student to identify their level of knowledge, they can plan the learning within the student's zone of proximal development (Vygotsky 1962). Then, as each student increases their knowledge and learning confidence, the teacher reduces the level of support to allow the student to work independently.

The emergence of the term 'technology-enhanced learning' (TEL) was used to refer to the integration of ICT for teaching and learning. Originally, the emphasis of TEL was on teaching and learning but it now has application in a broader range of areas (policy development, knowledge management) to assist in reducing the 'digital divide'. The digital divide is a term used to describe the gap between the younger competent users of ICT and generally, the older non-users. Factors such as age, gender, education and economics are major factors structuring the digital divide (Broos & Roe 2006). The technology component encompasses an expanded and diverse view of ICT including software and hardware, online learning environments and gaming forums, personal learning environments and learning management systems. The pedagogical assumption behind TEL is that people have the capacity to acquire new knowledge and skills. However, in exploring this concept, it is necessary to examine how each learner's background knowledge and experience, along with the situation and environment, affect the learning process. The examination of specific instructional strategies designed to increase learning efficiency can help participants to achieve their learning goals (Devedzic 2013). TEL became the terminology to refer to the infiltration of ICT into the various realms of education.

Another pedagogical theory discussed within TEL is activity theory, which contextualised the interaction between humans and computers. The theory proposes that new knowledge, forms of practical activity and artefacts are created in the process of tackling real-life projects or problems. Learning that is not yet known is constructed through questioning existing practice. The process

of learning occurs through complex cycles of learning actions, in which new objects and notices are created and implemented, opening up wider possibilities for participants involved in that activity. Devedzic (2013) suggests this perspective on teaching and learning highlights the potential impact of new tools as vehicles for transforming activity procedures.

The models selected for further investigation include the Analyse, Design, Development, Implementation and Evaluation model (ADDIE); the Concerns Based Adoption Model (CBAM); the ASSURE model (as developed by Heinrich et al. 2001); the SAMR model (Puentedura 2006); the iCARE model; and the TPACK model (Mishara & Koehler 2010). These models were all used within a range of education settings to further the integration of ICT. The various models provide a framework to assist teachers in the development of units of work that utilise ICT to enhance student learning.

2.3.1 ADDIE model

The ADDIE model appears to be “a colloquial term used to describe a systematic approach to ‘instructional development’ which has evolved over time through oral tradition and thus is not attributed to any one person” (Molenda 2003, p. 35). This model provides an instructional design framework which allows for a more holistic overview of the instructional design process. It guides educators and trainers to work through the clearly defined stages of analysis, design, development, implementation and evaluation that support the implementation of instruction.

The analysis phase requires teachers to identify the audience and their needs, articulate the expected outcome, identify the learning constraints, determine the delivery options and the pedagogical requirements, and consider the timeline for the module. The design phase requires an ordered focus on the content, the lesson planning and selection of media to be used and the assessment tools. In this stage, graphics and interface images are designed and sequenced and prototypes are developed. The interactive learning module is created in the development phase. The training of facilitators occurs in the implementation phase, remembering that this model is used predominantly for online learning.

The evaluation phase concludes the planning process and includes provision for formative and summative measures. The summative evaluation includes assessment tools to test student performance (Molenda 2003).

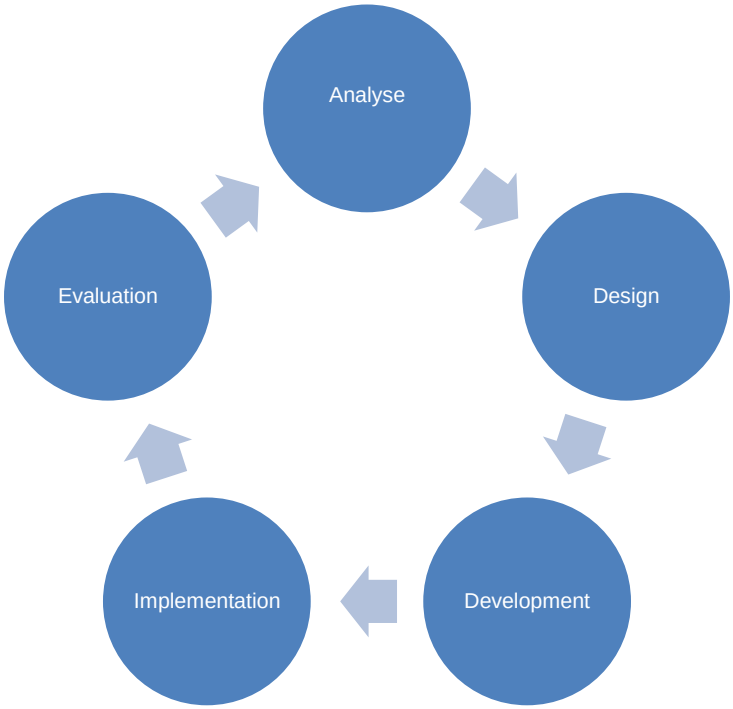

Figure 1: ADDIE model

This model has a clearly outlined development process and is underpinned by excellent design principles. Teachers are encouraged to adopt an iterative cycle of educational design and practice, reflecting on the modules as they are delivered and making modifications in response to the evaluation process. It is a flexible model based on a cycle of development which allows users to easily revisit and refine actions within each stage (Crawford 2004; Molenda 2003). The model has been used in the development of a wide range of training programs, in particular, for multimedia projects, online courses and the development of websites, as it moves away from the teacher-centred approach and allows for greater emphasis on the learner (Peterson 2003). It has a strong focus on educational content, requiring the use of ICT to access, create and disseminate information.

2.3.2 ASSURE model

The ASSURE instructional model is regarded as a student-centred model based on cognitive theories of ICT learning (Heinrich et al. 2001). The stages are: analyse learners, state objectives, select instruction method, media and materials, utilise media and materials, require learner participation and evaluate and revise. In planning to incorporate ICT, the model requires teachers to work through the stages of the model in a considered manner. The first stage asks teachers to consider the learning needs of each student in their class, then the stated objectives stage asks teacher to articulate the anticipated outcomes for the lesson, and then select the appropriate teaching approach and the ICT from what is available and appropriate. The next stage requires each student to participate in the learning task and on completion the teacher evaluates the unit of work and determines the level of student achievement.

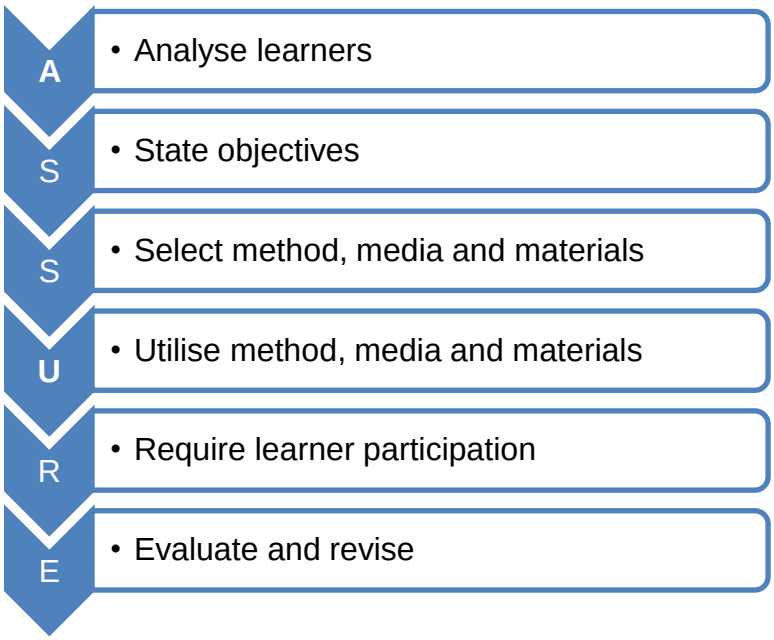

Figure 2: ASSURE model

(Heinrich et al. 2001)

This instructional model is premised on teachers systematically working through each stage of the model. The stages are clear and directly relate to the planning and development of a unit of work. It is regarded as an appropriate model for beginning teachers as it provides them with a staged process. The model is

also regarded as an effective process for experienced teachers who are able to quickly identify appropriate content. In their comparison of a range of models, Willcockson and Phelps (2010) identified one detracting feature: the selection of ICT is not directly linked to the learning problem. The teacher usually selects ICT from available options, which may or may not be instrumental to the learning.

2.3.3 Concerns Based Adoption Model

The Concerns Based Adoption Model (CBAM; Hall & Loucks 1977) was designed to describe how the change process affects individuals and to inform change efforts (Hall & Hord 2010). It is a model that primarily looks at the concerns of the participants and assists practitioners and policymakers to predict the effect of change and to plan for positive outcomes when implementing change. This model has been used extensively by researchers in education to evaluate the adoption and implementation of innovations. It outlines seven stages of concern, grouped into two phases that teachers move through: teachers involved in the innovation experience ‘self-concerns’ such as how the change will affect them, then ‘task concerns’ which relate to using the innovation and impact issues (Hall & Loucks 1977). The measures for teacher change used in this model are the stages of concern about the innovation, and levels of use of the innovation.

CBAM has a set of instruments that are used to diagnose the needs of teachers and administrators in the implementation of change. One of the underlying principles is that change is a process that participants work through and, over time, participants gradually increase their understanding and develop their skills and competency. This model is premised on the principle that the process of change is highly personal and an organisation does not change until the individuals within it change. Although schools and other organisations may achieve overall success through the implementation of an innovation, change occurs at the individual level (Hall & Hord 2010). Thus the emphasis on the concerns of the individuals.

	CBAM Stages of Concern
1. Awareness	The potential user is not concerned.
2. Informational	The potential user would like to know more.
3. Personal	The potential user asks, “How will using this affect me?”
4. Management	The user asks, “Am I spending all my time getting materials ready?”
5. Consequence	The user asks, “Is the use affecting the learner?”
6. Collaboration	The user asks, “How can I relate what I am doing to what others are doing?”
7. Refocusing	The user thinks, “I have some ideas that would make things even better.”

Figure 3: Concerns Based Adoption Model

(Hall & Loucks 1977, p. 264)

CBAM outlines a process for change where investment in terms of people, resources and time are required to allow for development over a three- to five-year period. Change is a team effort and change in education implemented to a high level will take three to five years (Hall & Loucks 1977; Hall & Rutherford 1976). It is recommended data be collected during that time to inform the change process, so that administrators can plan effectively to support the change process. This model reinforces the notion that change is a process and that it takes time. When using the model to examine teachers’ stages of concern and levels of use, Loucks and Hall (1979) found that the curriculum constantly changes and is therefore developed in a continuous manner.

2.3.4 iCARE model

This pedagogical learning model was developed predominantly to assist teachers to design courses in online learning. Entire courses were designed using the iCARE principles: introduce, connect, apply, reflect and extend (Hoffman & Ritchie 1998). Within the online learning modules, a different web page was created in each iCARE stage. In a typical module the first web page, the introduction, would include the learning outcomes, prerequisites, readings, equipment and software for the set activity. The next element, connect, would outline the concept, the principles and processes related to the task. The apply element requires learners to apply and practice the knowledge gained in the connect phase to tasks and problems from the real world. The learning tasks should offer challenges and activities that are aimed at and allow each student a level of challenge; tasks, for example, can be embedded in activities such as simulations, games and quizzes to scaffold specific learning. For the reflect stage, teachers develop a range of tasks such as self-evaluations and questionnaires so that students can review their learning progress from the connect to reflect stages. The extend phase allows for the addition of extension tasks.

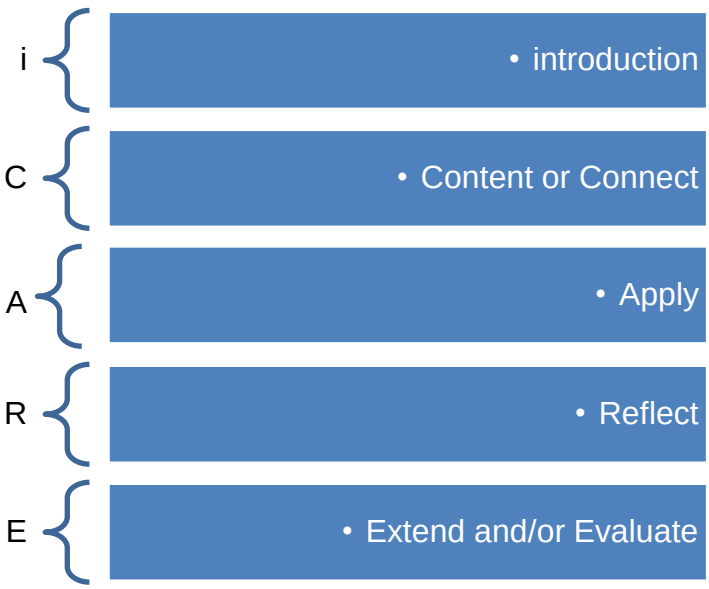

Figure 4: iCARE model

(Hoffman & Ritchie 1998)

In this linear model, students work through each stage systematically. The model is premised on the completion of each stage before moving to the next one. It requires teachers to think carefully about the learning process, and to focus on each stage in the development of unit planning to justify the selection of the ICT and ensure it supports the instructional process.

2.3.5 Generic model

In his review of the literature, Wang (2008) found studies conducted by Mishra and Koehler (2006) and Neiss (2005) identified that teachers trained in the use of linear models were often reluctant or unable to transfer the learning to their classroom. As a result, Wang (2008) developed a generic model to support teachers. The generic model consists of three key components: pedagogy, technology and social interaction. The pedagogical aspect requires teachers to consider the content and activities underpinning the learning, as well as the resources required to scaffold the learning for each student. The technology component requires a fast and reliable online learning environment and an easy to use interface design that motivates and engages students. The social interaction aspect values the learning opportunity which occurs when students learn together, discussing information and designing solutions.

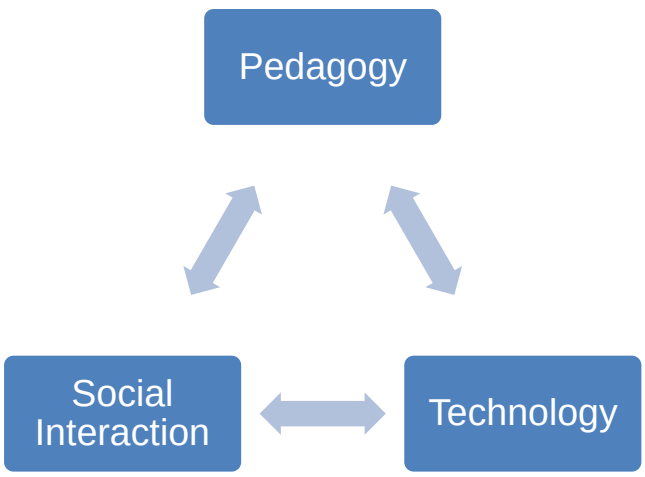

Figure 5: Generic model

(Wang 2008)

Wang (2008) believes teachers need to choose the right ICT tools and programs to suit the learning context and plan carefully for a smooth implementation. In addition, for successful implementation, teachers need to create new learning environments and be conscious of scaffolding strategies for student-centred learning. The generic model can be used in a number of ways; for example, in an instructional planning process it can be used to assist teachers with the selection of appropriate ICT for each learning task. It can also be used to facilitate online discussion or to guide the design of online learning environments.

2.3.6 SAMR model

The SAMR model was developed by Puentedura (2006) to encourage and support the use of ICT in education. It identifies four stages that adopters of educational technology might progress through as they embrace ICT: substitution, augmentation, modification and redefinition. In the substitution phase, there is no definitive change to teaching and learning as the ICT is used to perform the same task as was done before the use of ICT; for example, writing by hand being replaced by word processing. The augmentation phase allows for an enhancement of a task as the use of ICT requires a small adaption – it may make some aspects of teaching quicker; for example, a task could be emailed or completed online. The modification stage requires the use of ICT to complete the classroom tasks; thus, a change to pedagogy is beginning to occur. In the redefinition stage, new tasks are designed for the students that were not possible to complete without the use of ICT. Both the modification and redefinition stages require significant redesign and the creation of new tasks, so it is within these two stages that a transformation to teaching and learning starts to dramatically impact on pedagogy.

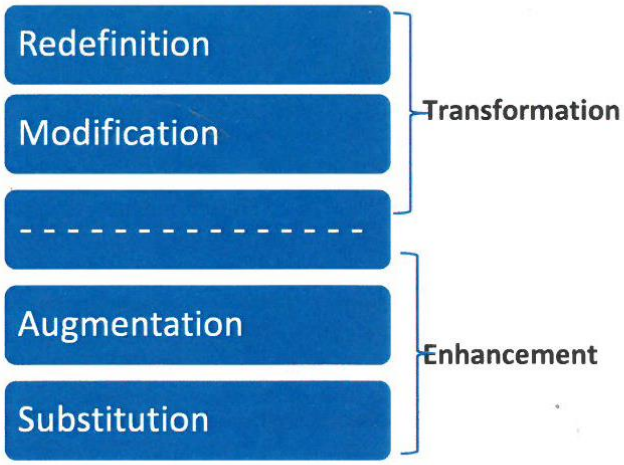

Figure 6: SAMR model

(Puentedura 2006)

The SAMR model has been used by some schools as an evaluation tool to illustrate the way teachers use ICT. Once teachers establish the stage they are located within, they can examine what is required in their practice to progress to the next level and articulate what assistance they require to support their progress. As teachers increase their understanding of ICT and become more competent users, they aim to move into the transformation stages as they redefine their teaching and learning.

A comprehensive review of mobile learning using the SAMR model was conducted by Romrell, Kidder and Wood (2014). This research examined the use of mobile ICT in each stage of the SAMR model. For example, the use of podcasts for reviewing course material prior to exams (Evans 2008) and the use of mobile phone videos in English language classes (Gromik 2012) illustrated the use of ICT in the substitution stage. The use of SMS messaging in the field of nursing (Chuang & Tsao 2013) and the use of a DVD player to view reference material on field trips (Pfeiffer et al. 2009) demonstrated the use of ICT in the augmentation phase. The use of mobile devices to redesign a flood disaster simulation application (Cornelius, Marston & Gemmell 2011) and a social elearning program for use in a speech and debating course (Wang, Yu & Wu 2013) illustrated the use of ICT in the modification phase. The Liu and Tsai (2013) case study demonstrated the use of ICT in designing a new augmented

mobile phone English learning program for Chinese students, and an instant personalised feedback mobile learning system for nursing students (Wu et al. 2012) showed how ICT was used in the redefinition phase.

The research examples not only demonstrate the different ways ICT is used in the delivery of curriculum and learning, they also clarify ICT use in each stage of the SAMR model. These examples, whilst predominantly from the tertiary sector, show a move away from traditional learning approaches to very creative ways ICT can be used to meet the needs of 21st Century learners. While the activities in the substitution and modification stages have not changed the approach to teaching and learning, the examples demonstrate a new approach to ICT which connects to the 'switched on' nature of the current generation. The use of ICT is more likely to engage the students, as they are constantly connected to their personal devices (Prensky 2012). The augmentation and redefinition phases bring a sense of immediacy to the learning, as they allow for connected and personalised learning situated in the students' world.

2.3.7 Systematic Planning model

Wang and Woo's (2007) model has the topic as the key driver for the integration of ICT into teaching and learning. It is a linear model that consists of problem statement, outline of the learning objectives, the technology, the rationale, strategies, assessment and reflection. The Systematic Planning model is easy to follow and depends on the completion of each stage before moving to the next one. In using the model, teachers are advised to preview a range of ICT and justify the selection of the ICT based on improvement to teaching and learning. The questions posed for teachers are: Why is the technology needed? What value does the ICT add? And How does the ICT support the teaching? This model looks at the integration of ICT on a micro, meso and macro level (Wang & Woo 2007). The micro stage involves the application of ICT into a few lessons to help students better understand concepts, the meso stage refers to ICT supplementing the learning and macro describes the classroom environment where ICT is used throughout a unit to support the complete learning experience.

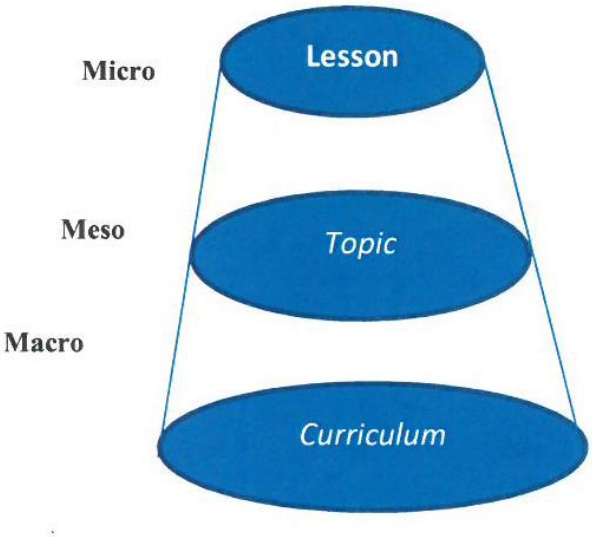

Figure 7: Systematic Planning model

(Wang & Woo 2007)

2.3.8 Technology, Pedagogy & Content Knowledge (TPACK) model

The Technology, Pedagogy and Content Knowledge (TPACK) model expands on Shulman's (1986) construct of pedagogical content knowledge (PCK) to include technological knowledge (Mishra & Koehler 2006). Schulman (1986) introduced the theoretical framework to guide teachers to go beyond the teaching of specific content knowledge. According to Shulman (1987), effective teaching requires access to knowledge, flexibility to adapt to changing needs within the classroom, and knowledge of subject matter along with an overview of how students think and learn. As a consequence, teaching requires teachers to constantly change and evolve their thinking and understanding (Shulman 1987). Shulman felt it was important for teachers to consider the relationship between content and pedagogy to inform how to teach particular content. Koehler and Mishra (2006) expanded the PCK model to include technology and popularised it as a framework for articulating and improving teaching and learning.

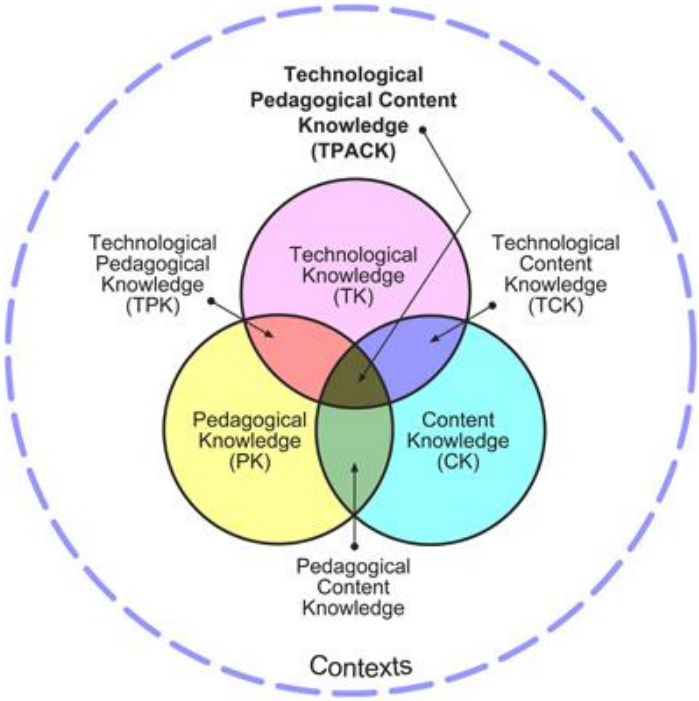

Figure 8: TPACK model

(Mishra & Koehler 2006)

“Good teaching requires more than the addition of ICT; and thus the TPACK model evolved from the PCK model” (Mishra & Koehler 2006, p. 134). The TPACK model is premised on the interrelationship between pedagogical knowledge, content knowledge and technology knowledge; as such, it directs teacher attention to the three distinct types of knowledge and the interconnections between each. It requires teachers to consider their subject content and the ICT they will use and then determine how the pedagogy will support the delivery of the learning task. The TPACK model requires a focus on each component and then further consideration of the interrelationship between each component. The conscious consideration of the relationships between components of this model should result in more considered teaching and high quality instruction (Mishra & Koehler 2006).

As teaching is a complex practice, it requires the application of specialist knowledge in a variety of contexts. Koehler and Mishra (2009) recognise that the TPACK model supports teachers to produce the flexible knowledge needed to successfully integrate technology into their classrooms. This model is used to

direct teacher focus onto each component: the content, the technology that will best support the teaching and learning, and the pedagogical approach best suited to the delivery of the content. For thorough development of a unit, and to support effective teaching, it is essential that each of the components of this model be considered. It is a comprehensive approach as, with the interrelated aspects of the model, there are seven areas to consider. However, a concern about the validity of results when using the TPACK model due to the lack of clarity between the dimensions was identified by both Graham (2011) and Archambault and Barnett (2010). Other researchers (Cavanagh & Koehler 2014; Graham 2011) regard the model as too complex due to the difficulty in distinguishing between the content and knowledge components.

2.3.9 Technology Acceptance Model

The Technology Acceptance Model (TAM; Davis 1985) was developed in the 1980s in response to concerns that workers in various industries were not using available ICT. This model examined the target user, the context and the technology. The model provided general information in relation to each individual's opinions about ICT and their intention to use it in relation to their work. The intention to use ICT influences its actual use. The perception participants held regarding the perceived ease of use and perceived usefulness influenced whether they actually used ICT. The model evolved from work on the Theory of Reasoned Action (Fishbein 1979) and the later model of Theory of Planned Behaviour (Azjen 2011), both of which examined understanding behaviours.

Knowing people's motivation and intentions in relation to ICT use becomes a critical implementation and management issue within an organisation. Research using the TAM attempted to identify individual factors that influenced the acceptance of ICT, as ICT cannot be effective if there is a reluctance to use it (Morris, Davis & Davis 2003). Factors considered in relation to perceived ease of use include the mental and physical effort required to learn the ICT, how easy it is to learn, familiarisation with the system, remembering the ICT functions, and using an instruction manual or online tutorials. Factors

considered in perceived usefulness include the ability to complete tasks quicker, improve productivity and enhance job performance. The knowledge gained using this model provides an early indication of success to inform the purchase and implementation of ICT, as it considers the usefulness of the ICT and the likelihood that workers will use it. The model was devised specifically to predict the acceptance of ICT; however, it also assists with the identification of barriers and factors to support use of ICT (Davis & Davis 2003).

Variations of the TAM were often based on more general technology acceptance theories; for example, the unified theory of acceptance and use of technology model (Venkatesh et al. 2003). TAM was used extensively in the field of health and at the tertiary level in relation to the acceptance of elearning. Perceived usefulness was found to be a determinant of attitude and intention, but perceived ease of use proved less relevant in relation to an individual's intention to use ICT (Venkatesh et al. 2003). Legris, Ingham and Collarette (2003) suggest the TAM should be used in conjunction with other human and social change processes.

2.3.10 Technology Together model

The Technology Together approach is not a model as such but is regarded as a flexible framework to support the implementation and integration of ICT and professional development. Phelps and Graham (2013) regard it as a general approach to teaching and learning which can be adjusted to individual school contexts. The intention was to design a flexible professional development program that is adjusted and modified to meet the needs within each school (Phelps & Graham 2008). Phelps and Graham conducted an action research study that explored the creation of a culture where teachers were able to identify their ICT learning needs and take responsibility for identifying their professional development needs in relation to ICT integrated learning. They adopted a whole-school metacognitive approach that assumed learning is influenced by three key dimensions: affects, motivation and strategies.

The initial part of their research was conducted in the tertiary environment, to inform the preparation of trainee teachers for a career in education where they

would face continued technological change. The research was based on the premise that the best way to help teachers survive and thrive in the constantly changing technological environment was for participants to develop confidence and effective learning strategies. A key aspect of the study was teachers learning to think about the 'how' and 'why' of what they do. On completion of the initial stage, the research expanded to include a regional education system, with practicing teachers from both primary and secondary schools. The expansion of the research allowed Phelps and Graham (2013) to examine the full potential of the model within a whole-school context. They sought to develop a flexible and holistic approach to ICT professional development for teachers that acknowledged the importance of leadership, the school culture and each teacher's level of expertise.

The most success was gained through supported professional learning, reflection and discussion along with a climate of collegiality and trust (Phelps & Graham 2008). The creation of a supportive environment encouraged experimentation and risk-taking. The professional development aspect brought about professional and personal change for teachers, which resulted in cultural change at the school level. This approach is premised on a culture of 'lifelong learning' with an emphasis on learning capability.

2.4 Discussion of models

The models selected for discussion represent the more prominent pedagogical models developed for use in primary, secondary and tertiary settings to support the integration of ICT into the classroom. The origin and purpose of each model differs. The iCARE model is used predominantly to design online courses, while the generic model promotes the creation of a new learning environment. Other models were used as an evaluation tool to examine current practice, identify teachers' requirements and establish a starting point for unit development. Some of the models promote the interconnectedness between curriculum content, pedagogy and ICT, as demonstrated with the TPACK model. Both the ASSURE and ADDIE models break the planning process into specific stages for

teachers to work through. The ASSURE and iCARE models provide guidelines for incorporating ICT into units of work, but teachers are not required to justify the selection of ICT used in the units.

Of the models discussed, the generic model (Wang 2008) and the TPACK model (Koehler & Mishra 2006) have a direct focus on the interrelationship between pedagogy, technology and content. CBAM (Hall & Loucks 1977) concentrates on the teacher and the identification of concerns, so that concerns can be diminished or eliminated. The ASSURE (Heinrich et al. 2001) and ADDIE models are quite structured, with specific steps for teachers to work through. Both models require an analysis of student learning needs, which teachers need in order to establish the level appropriateness of the task, the level of ICT expertise and the skills required to complete the learning. Most models require teachers to consider the selection of ICT for each learning task. Teachers can use the SAMR model to reflect on their current practice and establish if they are using ICT to enhance student learning, or whether they are at a stage where the use of ICT is transforming the way students in their class learn.

All the models have a framework with clear stages that outline a process to assist organisations, curriculum planners and teachers to utilise ICT to support learning. Each model outlines a staged process to support curriculum planners to work through the stages in a systematic manner. Within each model, teachers are encouraged to explore available technology and ascertain the suitability of the technology to enhance the learning in their classes. A key consideration in the planning stage is for teachers to allow for students to develop the skills to use the chosen ICT; for example, to use the ICT to collect and store data, model, create virtual environments, record or program. The research on each model revealed how each was used in practice and highlighted a range of approaches, attitudes and practices adopted to provide support and influence change.

Alternatively, Bain and Weston (2012) argue that the field of education has failed to utilise research-based models of practice for use in schools. They

suggest a need to reconceptualise teacher use of ICT away from a focus on administration to a focus on ICT, in order to design and deliver a differentiated curriculum, facilitate collaboration with students and focus on continuous learning improvement facilitated through feedback. A model that allows for the development of higher level critical thinking skills and provides for flexible student-centred learning is more suited to the digital age. In their research with trainee teachers involved in the field of further education, Attwell and Hughes (2010) concluded there was no consensus around the definition of digital pedagogy as "the effective and purposeful use of technology in teaching and learning" (Attwell & Hughes 2010, p. 4). They also noted that the use of technology may enhance learning but it is not guaranteed.

2.5 Continued challenges

According to Prensky (2005), there are two key barriers impacting the adoption of ICT: access, and a reluctance to change. He feels the 'digital immigrants', having operated in a system prior to ICT, retain an outmoded perspective of many ICT functions; for example, banning mobile phones in class and blocking social media sites. When new technology appears, the first instinct for many teachers is to use the technology to continue to do things the way they have always been done (Prensky 2005). Prensky views this outmoded mindset as a significant barrier to the education of 'digital natives' and their 21st Century learning needs. To create a 'future oriented' approach in schools, he suggests teachers consult students then combine what they know about digital technologies with what teachers know and require in education. This approach requires more than adoption of ICT. Teachers need to revolutionise their teaching and experiment with, adapt and maximise the potential of ICT. Teachers who are used to working in a certain way and a way in which they are gaining desired results will have to change their practice and let go of expectations and assumptions they hold about their teaching.

Data from a study conducted in New Zealand by Adhikari and Parsons (2012) reinforced the 'digital divide' in relation to the integration of ICT. This study

identified two major limitations: one being equity, so that all students have access to a device; and two, the need for equity in learning outcomes – that is, having the skills to apply the knowledge accessed. The findings indicate factors such as student attitude towards ICT, the way technology was used and the ability of students to make meaning from their learning impacted on the success of Bring Your Own Device (BYOD) initiatives (policies which encourage students or workers to bring their personal digital devices to use in their school or workplace). Another key finding was the lack of understanding around the impact of ICT on learning activities and the learning environment. This is further supported by Salomon (1993), who argued that the learning environment is changed through the introduction of ICT so there is a need to reconsider the learning environment as a result of the addition of ICT.

In a longitudinal study on the 'digital divide', Adhikari, Mathrani and Parsons (2015) found that initial teaching was focused on processing and applying existing ICT into learning as opposed to creating new learning content. They also found students "identified and appreciated the way they are learning and reported that the BYOD classroom is clearly more relevant and useful in today's modern society" (p. 8). Adhikari et al. (2017) propose that one-to-one learning devices do have the ability to transform the teaching and learning process, and that learning is constantly evolving. However, they note that current practice is focused on processing and applying existing information in the context of an ICT-rich classroom. They conclude that, in addition to BYOD programs, students need the ability to think critically and creatively. This research was extended into a longitudinal study to allow Adhikari et al. to investigate the changes in pedagogical approaches that maximise student knowledge and skill development.

In reviewing the addition of ICT into the classroom, initial research focused on access to ICT and, as students gained greater access, research increasingly looked at pedagogy, barriers and improved student learning (Ross, Morrison & Lowther 2010). In the process of identifying four areas for future education and technology related research, Ross, Morrison and Lowther (2010) list integrating technology as a learning tool in classroom instruction as one of the priority

areas. The other areas include distance learning, social networking and teaching students to become skilled and confident users of technology. The exploration of learning and technology and the need to identify support mechanisms for teachers to improve teaching and learning is the key to transforming education to meet the needs of 21st Century learners. They also suggest a change in focus from an examination of the effectiveness of technology to the identification of how teachers can use technology to facilitate learning in a range of contexts.

Inan and Lowther (2010) surveyed 1382 public school teachers and examined the direct and indirect characteristics and environmental factors that influenced the integration of ICT as the foci of their research. They suggest technology in schools can be grouped into three broad categories: technology for lesson preparation, technology for lesson delivery and technology as a tool for learning. They used a path analysis model to examine causal factors in teacher traits to see if they impacted on the extent to which each teacher embraced ICT to underpin learning. Factors such as gender, teacher training, years of experience, computer proficiency and number of computers were examined to determine possible predictors of technology integration. They concluded that teacher beliefs, teacher readiness and computer availability had a direct effect on the level of technology integration in the classroom. Teacher beliefs encompassed the extent to which each teacher believed technology could influence student learning and impact their classroom instruction. Teacher readiness referred to how teachers felt about their level of ICT competence in relation to integrating ICT into their classes.

Of the variables assessed in the teacher demographic characteristics, it was interesting to note that years of experience as opposed to the age of a teacher was a determining factor for integration of ICT. However, it was not years of experience alone, but coupled with the teacher's level of competence with a computer, their beliefs and readiness to bring about change, that contributed to an increase in ICT use to change learning (Inan & Lowther 2010). Teacher belief was found to be one of the essential factors for the successful integration of ICT to enhance student learning and learning outcomes.

The addition of ICT into the classroom requires a change in relation to the perception of the role of the teacher and of classroom instruction. If a teacher continues to teach as they did with pen and paper, then ICT may not add any value (Hess & Saxberg 2014; Cuban 2001). The presence of ICT allows teachers to engage with ICT as an instructional tool to promote and improve student learning. To achieve this, teachers need to consider the use of ICT to solve learning problems and to personalise student learning so that each student can progress. This requires a change in teacher thinking. Somekh (2007) believes innovation is required by teachers and they need to disrupt their established routines; however, this can be challenging and is often stressful. Teachers need to identify what they want students to learn and then gain an understanding of how ICT can assist in the learning process. A change in teachers' mindset is necessary, so that they regard ICT as an opportunity to rethink teaching and learning and allow students to use ICT to gather data, conduct research, generate ideas, collaborate, assess progress and reinforce learning.

The challenge in this research is to examine what it is that will assist teachers to create 21st Century learning and transform their classrooms. Teachers need to develop competencies that will bring about change, and use it to engage students in knowledge construction, conversation, articulation, collaboration and reflection (Jonassen et al. 2006). Law (2008) argues that technology has the potential to transform learning but teachers need to actively involve themselves in that process. Teachers who do not realise the advantages of using ICT in their teaching are less likely to make use of it (Cox, Preston & Cox 1999). According to Hess and Saxberg (2014), a learning engineer would think clearly about the learning challenge and how ICT could support better teaching and learning.

The ability of each teacher to create a classroom learning environment that considers the role of technology requires a distinct mindset. Teachers need to consider ICT in the classroom as an integral aspect of the learning process, as opposed to an 'add on'. Ertmer (1999) categorised the barriers impacting teacher ICT integration as first-order barriers (those which were beyond the

control of the teacher) and second-order barriers, which were internal to the teacher and included factors such as confidence, perceptions about the value of ICT in the classroom and beliefs about how students learn.

Hattie (2012) asserts there is a 'practice of teaching' and describes the first stage in this practice as 'mind frame', which covers the self-perception a teacher has of their role; for example, their perception of themselves as a change agent. When teachers adopt that mindset and believe they are the major factor in encouraging students to feel confident and work through the learning challenges, their achievement is enhanced (Hattie 2012). The learning achievement of all students can be maximised with ICT through differentiated curriculum, collaborative learning and immediate and specific feedback (Bain & Weston 2012). In *The Learning Edge*, Bain and Weston (2012) show that when teachers regard technology as part of their teaching and part of student learning, there can be significant gains in both surface and deep understanding.

Alternatively, faulty mindsets such as thinking access to ICT will ensure learning happens or that teaching will change with the addition of ICT is fundamentally flawed (Bain & Weston 2012). Furthermore, Bain and Weston note perception influences motivation and personal performance. A growth mindset, premised on the belief that talents and abilities can be developed, allows for change whereas a fixed mindset limits growth. When people have a positive mindset there is potential to improve, learn new skills and take on new challenges. Alternatively, an unconscious bias can influence thinking; and selective thinking that results in reaffirming negative ideas, based on experiences, stifles change. For example, if a teacher experiences difficulties when trialling ICT then this experience influences the teacher's willingness to continue. Hattie (2012) suggests the predominant mindset of teachers is one where teachers control the flow of lessons and continue to talk at students. He suggests teachers do not use ICT because it does not fit into the way they have always taught.

Traditionally, technology has been regarded as a tool to enhance and improve existing practices within the existing education system, but progressively it is becoming a tool to assist in transforming teaching practice. The transformation

is not just about the technology, but about more meaningful education for current and future generations (Zhao et al. 2015). Zhao et al. believe a real shift occurs when teachers have pedagogy as their focus and use various ICT devices and applications to enable more interesting, engaging and creative learning. To assist teachers with the transformation process, a need exists to challenge teachers and their traditional thinking and practices. Factors that assist teachers with change are a belief and commitment, professional development, support with course design, support in the classroom and personal support for teachers in the change process. Schools need to stimulate new thinking about the future of education, where ICT is an integral part of the learning process.

More recent research explored the pedagogical digital competencies teachers require in educational settings to transform how they teach with ICT (From 2017; Howell 2012; Krumsvik 2012). Howell investigated how teachers teach with ICT and examined competencies together with pedagogy. Krumsvik (2012) explored teacher ICT expertise and teacher awareness of pedagogy, and the implications of ICT to support various learning strategies. From (2017) argued that teacher digital competencies should not be viewed in isolation and restricted to teacher skills, but should rather be considered in the broader whole-school context.

The integration of ICT to transform classroom learning continues to be a challenge for the education system. An ICT learning environment that allows students to access, gather, manage and manipulate information and then synthesise, present and communicate it in a variety of formats reflects the digital classroom of the 21st Century. A new approach to curriculum is required that allows students to explore and investigate in ways that were previously not possible without the use of ICT (Yelland 2007). The ICT-rich learning environment requires teachers to constantly adapt their current skills and to develop new skills. Embedding digital literacies within their learning will allow teachers to utilise 21st Century skills while engaging students in authentic learning (Summey 2013). Visible learning and teaching takes place when learning is the explicit goal, feedback is provided and when there are

enthusiastic, engaged and active participants involved in the learning (Hattie 2012). Hattie also suggests that the biggest impact on student learning is when teachers are active learners of their teaching.

Summey (2013) identified five digital literacies that form a framework to support teachers to integrate ICT and that allow teachers to manage ICT in a variety of forms and contexts. The five literacies are locating and filtering, sharing and collaborating, organising and curating, creating and generating, and reusing and repurposing. Creating and generating implies that all 21st Century users of ICT are creating and contributing content; reusing and repurposing refers to the ability to synthesise information from a range of multiple online sources. As ICT has allowed students and teachers to locate and access information quickly, they also need to be able to discern what is useful and reliable. He believes this set of digital competencies equips teachers to operate in the constantly changing ICT environment.

The increase in ICT has enabled information sharing and collaboration which encompasses a variety of communication forms, in particular, social media. Thus, increasingly, digital literacy requires users of ICT to organise and categorise information and to make sense of the information, context and resources – all of which leads to new meaning and deeper understanding of ICT, as the analysis and evaluation of resources and content require higher order thinking (Summey 2013). These digital literacies closely align with 21st Century learning skills.

In a comprehensive review of digital competence in educational contexts, Pettersson (2018) concluded that international research had considered policy, organisational structures, strategic leadership and teacher practices. Her analysis revealed that research tended to focus on the specific digital competences required by teachers; however, the research on organisational infrastructure and strategic leadership was sparse. Pettersson proposed three areas for further research, which bring together digitally competent leadership, organisational infrastructure and theoretical frameworks that enable digital competence to be considered as part of the broader school context.

2.6 Conclusion

The lack of ICT pedagogical reform means that, as a system, we are not "educating students for further education, training, jobs of the future and to live and work in a digital world" (DEEWR 2007, p. 2). The pedagogical integration of ICT across the curriculum provides scope to maximise student engagement, motivation and independence, as well as provide for individual challenge in teaching and learning. More importantly, it has the potential to create new learning opportunities and extend interaction with local and global communities. The ability to create and deliver 21st Century learning is reliant upon the successful integration of emerging ICT, so that students can maximise their capacity to live and work within globally competitive, technology-driven economies. However, in the years since the Digital Education Revolution (DEEWR 2007) there is little evidence of a transformed teaching and learning classroom environment.

Much of the early research in relation to ICT investigated access and barriers for teachers in using ICT. There is less research that examines the ways in which the integration and impact of 21st Century ICT skills can transform teaching and change the ways students learn. Research continues to highlight issues associated with teachers' ICT skill level and confidence (Barrera-Osorio & Linden 2009; From 2017; Howell 2012; Krumsvik 2012; Russell, Finger & Russell 2000).

Further research has focused on the impact of ICT in specific subject areas; for example, mathematics (Zuber & Anderson 2013), science (Crook et al. 2013) and the arts, and there is a substantial amount of research on mobile learning (Morgan 2010; Romrell, Kidder & Wood 2014), one-to-one learning (Larkin & Finger 2011; Lei & Zhou 2008; Keane, Keane & Blicblau 2016; Keane, Lang & Pilgrim 2013) and the development of online learning (Jamieson-Proctor & Larkin 2012). Various professional development programs have been examined to measure the extent to which they support teachers in using ICT. More recently, research has emerged on how ICT can be used to improve learning and measure student achievement.

Over time, there has been a significant move towards student learning rather than a concentration on ICT, and this has resulted in a change from examining what technology can do for the student to what the student can do with the ICT. Students and teachers readily use ICT to access and store information, and to support the teaching and learning process. Teachers appear to be comfortable with using learning management systems to complete administration tasks such as recording attendance, writing reports and placing work online. A change that helps move the focus from barriers and factors that affect teachers, to an emphasis on 21st Century practices such as collaboration, communication, adaptive learning and formative assessment, will support change. However, the constantly changing ICT landscape continues to present challenges to school leaders and teachers.

As the various ICT tools are always in a state of flux, teachers will never have complete knowledge of the available ICT (Ertmer & Ottenbreit-Leftwich 2010). It is difficult to transform teaching and learning to meet the needs of 21st Century learners in the constantly changing digital world. Teachers need to contend with constantly changing ICT, and students who are usually more adept at using ICT. The change process requires a focus on teachers, on the ICT, on professional development and on pedagogy. Bringing these aspects together to transform education is the challenge. Whilst pockets of ingenuity and creative use of ICT are evident within some schools, an ad hoc approach permeates the education system. To adequately prepare students to operate effectively within society we need to consider the opportunities provided by ICT (Newhouse 2013).

With the introduction of the NSSCF (DEEWR 2009) program, the Australian Government provided funding to secondary schools in the government, independent and Catholic systems for the purchase of ICT devices and supporting infrastructure but little investment for implementation. In this technologically rich environment, it is not simply a matter of mapping the use of new technologies into an old curriculum (Yelland 2007). A new approach is required that allows students to explore and investigate in ways that were not possible prior to the introduction of ICT. In the new ICT learning environment,

students should be provided the opportunity to decipher meaning and express ideas using a range of ICT devices and programs. The effective use of ICT within the classroom has the capacity to provide real-world learning that includes problem-based and collaborative learning experiences. Roblyer, Edwards and Havriluk (2002) suggest ICT has the potential to engage students in the learning process and their construction of knowledge, and believe it can assist students to visualise their learning tasks, increase motivation and help map their learning progress.

A further important consideration is to ensure a learning theory underpins the development of the learning content, so that the theoretical and practical interaction between the student and the external world is articulated (Whitehead, Jenson & Boschee 2013). Without a clear view of what a new 21st Century learning environment looks like, there is reluctance from teachers to move away from the didactic view of classroom teaching (Bain & Weston 2012; Moersch 2014; Somekh 2007). A vison of the end result would support teachers in the development of ICT-rich units.

The advent of the internet and the increased use of social media is changing the nature of education as learning occurs constantly, not only within school but external to the classroom (Bain & Weston 2012). The changing nature of 'digital natives' (Prensky 2012) sees them adept at internet use, tending to scan information quickly in text, images or video format from a range of sources simultaneously. As a result, students increasingly have autonomy over their learning. Consequently, teachers who do not engage with the technology to support learning are doing a disservice to students (Prensky 2010).

Compounding the issues around the integration of ICT is the changing nature of education. The emerging terminology for using ICT to teach collaboration, manipulation of data and effective communication in the digital world is 'digital literacies'. There is an increasing focus on new employability and life skills such as the '5 Cs' – creativity, collaboration, comprehension, communication and critical thinking. This involves a move away from content-based learning to a focus on developing these 21st Century skills. Teachers need to contend with

the changing nature of their role as a teacher and are increasingly required to think differently about their role in the classroom (Gillen & Barton 2010). This requires teachers to develop a new skill set that is effective in the digital environment.

The focus of this study was to develop a model to facilitate the implementation of ICT in secondary schools to enhance student learning. The findings informed the development of a model to assist teachers to bring about change. Developing a framework informed by the research findings may assist teachers to adopt ICT and adapt their teaching to transform their practice. A support strategy is required to assist teachers to develop the skills to integrate and use ICT effectively in the teaching and learning process. There is no one ‘quick fix’ solution to bring about change in pedagogy. This study will examine strategies and practices required to support teachers to incorporate ICT. A need exists to further explore teachers’ approaches to pedagogy for learning in the digital age.

Chapter 3: Research design

3.1 Introduction

The research design and the process for meeting the ethical requirements for research are outlined in this chapter, along with the approach adopted and the stages of the research. The research is a qualitative study with an action research component. Qualitative research is suited to this inquiry as it allows for a description of the actions and opinions of the participants involved in the study. The research design was developed to address the research question. The reasoning behind the decision to conduct a quality phase interview stage is made clear, along with the reason for the selection of action research. The data collection process encompassed two interview stages and an action research stage conducted over an extended period of time.

3.2 Research question

The research question for this study was:

What model of assistance and support do teachers require to improve the use of Information Communication Technology to change pedagogy to support student learning in the secondary school classroom?

A sub-question posed was:

What are the barriers for teachers in embracing ICT?

3.3 Methodology

Research is used to solve ‘real world’ problems and, in the process, create or expand knowledge to inform actions (Gray 2009). Thus, understanding research and knowing how to conduct it is essential for those who rely on the findings to assist with their understanding of a problem, behaviour or situation.

Gray (2009) further outlined that research is underpinned by academic theories developed over time, a theory being a set of constructs that together provide a systematic view of phenomena informed by the relationships among the variables used to create new knowledge. Traditionally, studies are conducted by researchers who are distanced from the situation or environment and who seek explanations for existing phenomena in an objective manner (Gay & Airasion 2003). A research framework is essential to provide structure to the research design and ensure the planned process provides data that is trustworthy and able to produce reliable results. The philosophy of research and the different philosophical perspectives inform the selection of the research methodology and method (Gray 2009).

This research is dealing with relativist knowledge, as groups of people are involved, and the study takes a constructivist epistemological stance. A constructivist approach ensures meaning and understanding are constructed in the participant's mind as they are actively involved in the process of learning. Phenomenology is the theoretical perspective adopted, as the research looked at understanding teachers' thinking and decision-making in relation to factors that impacted their use of ICT in secondary school classrooms. The challenge for this research was to develop a model to assist secondary teachers, informed by factors that impacted their adoption of ICT to improve student learning.

The methodology used was action research as, through the action research process, knowledge was created as the participants interacted and created meaning from the work they produced. Action research provides a framework to support participants to examine issues of concern and assist with the analysis of the situation, which informs the consideration and design of options to bring about a change in practice, with the emphasis on the process rather than the outcome. Action research can be analytical, investigative or evaluative. In this instance, the research takes an investigative approach. Further, using the inductive approach, it was anticipated that data gained would inform the construction of a model for use in secondary schools. The sample size was small and the primary mode of data collection was interviews, participant journal records and the action research component.

3.3.1 Action research

Action research was the framework used to guide this study in order to contribute data to address the research question. Since the early part of the twentieth century, action research has been a method used to investigate real problems in education and the social science fields. It was a strategy used during the 1970s and 1980s in the UK to make clear connections to develop pedagogical and curriculum reforms in an attempt to increase student involvement in their own learning (Noffke & Stephenson 1995). The action research process is suited to studies in education, as a key aspect of teaching is developing student learning; the approach allows teachers to analyse and reflect on their practice (Koshy 2010). Action research is often used to examine and change professional practice. The purpose and the processes underpinning each action research shape the production of knowledge (Cochran-Smyth & Lytle 2009).

The action research process is grounded on collaboration between the researcher and practitioners, as it allows for evaluation and reflection of practice in order to implement change (Cochran-Smyth & Lytle 2009). It is important to establish strong connections between the researcher and practitioners in order to contribute to the development of shared knowledge. In conducting an action research, participants are able to develop knowledge through observation, questioning, analysis and involvement. The new knowledge generated informs future directions and actions. Action research supports practitioners to seek ways in which they can provide good quality education by transforming the quality of teaching-related activities (Koshy 2010).

The work of Schon (1983) has influenced the notion of reflection in action and reflection on action in teaching. Elliott (1991) was another influential contributor to the teacher research movement, as he traced the development of action research, described its methodology and explored the relationships evident in a classroom when compared to centralised policymaking, with theories being validated through practice. He distinguished between research on education and educational research, with educational research being a way of constructing knowledge about teaching and learning with the intention of

changing a situation for improvement. The process of teachers within a school setting sharing and developing their practical insights into an identified problem and reflecting on solutions creates insights and reflections to inform further actions (Elliott 1991). Participants must collaborate, as part of the planning process, in both theoretical and practical discussion to create a shared understanding of how they will analyse and improve their practice in the research situation. Within the school setting, this involves teachers examining either school-based issues or their classroom practice.

Kemmis and McTaggart (1988) defined action research as a "form of collective self-reflective inquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and situations in which they are carried out" (p. 5). Action research allows participants to engage in a deliberate process of inquiry to extend their understanding of a situation or problem.

A number of researchers (Kemmis & McTaggart 1988; Calhoun 1994; Stringer 2007; Hendricks 2009) have proposed various models for the action research process, each with slight variations. However, all models have the common elements of a main problem, observation and monitoring of current practice, the collection of information and data, followed by reflection and evaluation. Action research is a cyclical process that begins with participants observing and analysing the current situation. The research process requires participants to work through the stages of planning, acting and reflecting, observing, describing and explaining their practice in a rigorous manner that goes beyond that required in daily practice. Once the participants work through the 'plan, act and reflect' cycle, they consider the data to assist in the identification of an action. The next stage of the action research repeats the cycle: the taking of action, the observation and monitoring of the action, the collection of data and then evaluation and reflection.

An action research provides a simple but powerful framework for participants to commence an inquiry into an identified problem and to build greater detail into

the procedure, as the complexity of an issue emerges or the creation or implementation of a strategy is developed. Action research explores action and research outcomes simultaneously. Thus the research is responsive to the action taken and emergent as the cycle of reflection unfolds. The reflective cycle requires critical reflection, which provides the opportunity for participants to reflect on the action and the outcomes, both intended and unintended (Dick 2000). This study relied on Kemmis and McTaggart's (1988) model of action research, comprising the stages of plan, act, and observe and reflect.

Findings emerge as participants work through the cycles, the action develops and knowledge is created based on the problem investigated within the specific context. The teachers participating in this action research examined their practice in relation to the use of ICT in their classes. The data collected was a subjective account of their experiences as they worked through each cycle of the action research. The data collected provided unique and personal accounts of their experiences. What the participants say, and how what they do and say is interpreted, provide the basis for knowledge creation.

Throughout the research, participants need to consider the social, cultural, interactional and emotional factors that affect all human activity (Stringer 2007). As such, the research should be based on the fundamental principles of relationships, communication, participation and inclusion to ensure participants are not exploited. The type, nature and quality of relationships directly impacts the quality of experience for all humans, so research has a vested interest in establishing and maintaining positive working relationships. The establishment of positive relationships, open communication, active participation and inclusion creates a supportive environment where participants feel comfortable in discussing their ideas and work, which contributes to the collection of quality data. The principles ensure that a climate for effective research is developed and maintained.

According to Habermas (1971), effective communication is a key requirement for people to work together productively to achieve positive change. He suggests four fundamental conditions are necessary: understanding, truth,

sincerity and appropriateness. Understanding is facilitated through the use of plain language; truth is gained through reliable information and the declaration of ‘conflict of interest’ or ‘hidden agendas’. Trust is diminished when information is distorted or misrepresented. It is important that the forms of communication are appropriate to the task, the people involved and the setting.

Research is occasionally conducted by people who are removed from schools and the classroom; however, action research is a process that directly involves the participants, most often the teachers as the practitioners, in both collection of data and analysis of their practices. The participants are involved in all aspects of the research process and the research is conducted with the participants rather than on them. In an action research, participants work through a number of cycles to test their own assumptions about what is happening. They gather data, examine it, plan and take action then evaluate, to test the assumptions made and applicability to other teachers or schools. The teachers become focused on what they are doing and reflective about what occurs in their classrooms.

The action research process allows for information to be collected through a scientific method using a systematic process to provide valid information and ensure reliability. The action research generates emergent theory, as the theory develops from the synthesis of what emerges from the data and what emerges from the application of theory of practice that informed the intervention (Coughlan & Coughlan 2002). Action research effectively contributes to changes in the social, organisational and personal dynamics of the research, as participants communicate and build positive working relationships as they contribute to the development of knowledge.

Action research is an approach often used in education, as it allows educators to deal with problems identified within an educational setting such as a school and it directs the work onto the improvement of practice. It is a participative process that encompasses a systematic and planned approach to review school practices such as the teaching and learning process. Teachers who consistently reflect on their actions and the consequences of their practice

acquire new knowledge relevant to the teaching and learning process (Mertler 2014). The process requires an open mind and critical reflection about one's practice. Participation in an action research not only contributes to the improvement of educational practice, it also contributes to the professional development of the participants (Mertler 2014).

An action research usually studies a real-world problem of interest to the researcher (Mertler & Charles 2011). Unlike other forms of research, action research is an interactive process and requires the researcher to be involved in the research, usually as an agent of change. In this study, the researcher becomes a 'trusted observer' (Mertler 2014) who not only observes and conducts research but also has the opportunity to participate in the action research process. While the researcher remains primarily an observer, a level of interaction occurs as the opportunity exists to observe participants, contribute to discussion, seek clarification and assist in directing the action research process (Glesne 2006). The role of the researcher in this study was twofold: as an active participant in the action research and as a critical and analytical observer. The participation role is less directive and more one of a facilitator of the process, assisting participants in working through the phases of the action research and monitoring and supporting them to analyse their situation and reflect on their practice.

The evolution of the actions within each cycle of the action research is guided by focus on the action that will bring about improvement in practice, as the action taken generates the data. Throughout each cycle, the participants and the researcher look for connections to the research question. The data analysis process for action research is premised on the understanding that the participants have a thorough knowledge of the organisation, and that they can judge what effective practice is and determine what has worked to effect change. Their level of understanding contributes to the quality of the research, as they determine what action to take and reflect on its effectiveness. Participant reflections on processes within the action research cycle and the extent to which the actions, in the form of interventions or new practices, have brought about the change provide a valuable contribution for the data analysis.

Qualitative studies rely on a broad holistic approach to data collection which can include systematic observations, interviews, journal entries and meeting transcripts. An inductive approach to data is more commonly used, where the observations assist in the creation of knowledge for the purpose of gaining understanding and planning action. The collaborative nature of action research allows participants to interrogate their experiences, discuss misconceptions and create constructive views of their situation. Solutions that emerge may be more sustainable due to the collaborative nature of the research.

3.3.2 Research context

Phase One of this study was designed to inform the development of Phase Two, which comprises two parts: classroom teacher interviews and an action research. In Phase Two, the question was framed at a local level, within one secondary school, and is premised on the assumption that the participants have the authority to make decisions in relation to their practice, are keen to bring about changes to their practice and are proactive about their ongoing professional learning. The use of an action research intervention ensured the participating teachers had the opportunity to examine their practice in depth, take action and reflect on the process, with the support of their participating colleagues. The action research process had an emphasis on improvement, and allowed for cycles of planning, action and reflection that led to further planning, action and reflection.

Increased access to ICT supported through the NSSCF initiative is yet to be fully achieved due to constraints impacting on teachers' adoption of ICT. The anticipated role of digital technologies in delivering better educational outcomes for students as outlined in the Digital Education Revolution (DEEWR 2007) has been constrained by the lack of change evident in the classroom. This research endeavoured to identify the various factors affecting this problem and consider whether these factors are interrelated. Explanatory and analytic research strategies were used to 'delve deeper' and attempt to identify the cause of the problem. A number of data collection methods were used throughout the research including interviews, meetings, observations and reflective journals.

3.3.3 Data collection context

The research school introduced a one-to-one netbook program in 2010 for year levels 10–12. In following years, the program expanded to cover all year levels. It became evident that the ICT was underutilised in supporting student learning. Anecdotal evidence from teachers suggested they were having difficulties in working with ICT. Many teachers expressed a high level of frustration when they could not deliver lessons due to technical issues. Other teachers felt they did not have sufficient time to learn new programs and expressed annoyance when technology was unreliable. The situation arose with some year levels where the students did not bring their netbook to class, as teachers did not use ICT, then teachers did not attempt to use ICT as students did not bring their netbooks to class. Pedagogy did not appear to change, as the netbooks were predominantly used for word processing, research and class presentations. Observations of the implementation of the ICT program at the research school identified areas for further exploration to bring a focus onto using ICT to allow students to utilise contemporary resources to prepare them for success in the 21st Century.

3.3.4 Merit

The research proposal was developed in response to the situation in the research school not matching the anticipated outcomes of the NSSCF initiative and the investment of ICT in secondary schools. The anticipated widespread use of 21st Century ICT skills to transform teaching and learning was not evident. This research aims to make a contribution to the ongoing implementation of ICT by teachers in the secondary education system through the development of a model to assist schools and teachers which, in turn, will benefit students.

3.3.5 Respect for human participants

The Victoria University Higher Research Ethics Committee procedures for working with human beings were adhered to throughout the research. All participants were provided with a plain language information sheet (see appendices 3 and 7) that outlined the aims of the research and their

involvement. Each participant was informed that their involvement was voluntary and that they could withdraw from the research at any time. Participants were also advised that there was a psychologist available if they felt, in any way, a need to consult with them as a result of their involvement in the research.

3.3.6 Potential risks

For the first phase of the research (see Figure 9), involving quality interviews with leading teachers at four different schools, there was a risk that the participating schools could be identified. This was conveyed to the principals at each school when seeking permission to interview one of their staff members, and was outlined in the information for schools document. The risk to each school was regarded as low. The possibility of identification was clearly outlined in the application to conduct research submitted to the Victorian Department of Education (see Appendix 1) and when seeking ethics approval from Victoria University.

Risks associated with the second, action phase of the research centred on confidentiality and the perception of a power relationship due to the role of the researcher within the research setting. The researcher holds the position of Principal at the research school, so it was necessary to distinguish between the role of Principal and the role of researcher. For the interview part of this phase, an interviewer external to the research setting was recruited to provide a level of distance between the researcher and the participants within the research setting. In addition, the Associate Supervisor attended the action research meetings to act as a critical colleague and ensure the researcher stayed in 'researcher mode'.

The lack of confidentiality and loss of anonymity are potential risks for the participants, those interviewed and those involved in the action research. Participant anonymity was preserved through the allocation of pseudonyms, but participants within the research centre may be able to identify other participants. The risks associated with this were drawn to the attention of participants during the interview preliminaries discussion.

The way the participants were represented in the research had the potential to be a risk if they were misrepresented. Participants were provided the opportunity to review their interview transcript and make changes. Careful consideration was given to participant quotes, and the translation of the intent when gleaning information from transcripts and from the action research journals, meeting notes and recordings.

3.3.7 Benefits of this research

Research is undertaken for a purpose, usually to increase understanding (Grey 2014) and discover new knowledge. At the research school, students and teachers had a high level of access to ICT to support student learning. It was apparent to the researcher that a situation had arisen where the students did not bring their netbooks to class, as the teachers did not set tasks that required them to use them. However, difficulties arose when a lesson required the use of ICT and many students had not brought their netbooks to class. From the researcher's, perspective the addition of ICT had not resulted in transforming teaching and learning. This research allowed for the identification of barriers that impact teachers and an exploration of ways to assist and support teachers to use ICT to transform the learning. Possible benefits include the development of a model to support a whole-school approach to assist teachers to expand their use of ICT to enhance learning in the classroom.

3.4 Research design

This study has two phases and three components: a quality interview phase to determine that the problem is not exclusive to the research setting; and then a second phase which includes a teacher interview component to identify factors that impact teacher use of ICT, along with an action research component to work with teachers to explore their decision-making and actions in relation to their use of ICT.

As mentioned, the first part of Phase Two involved a set of interviews with teachers working within the research school. The interviews were followed by a single school study utilising an action research intervention with the principal (as researcher) and a small team of volunteer teacher participants. The action research intervention explored the process the teachers worked through to embed ICT to support and enhance their pedagogy. The data gained was used to inform the creation of a curriculum planning and implementation model.

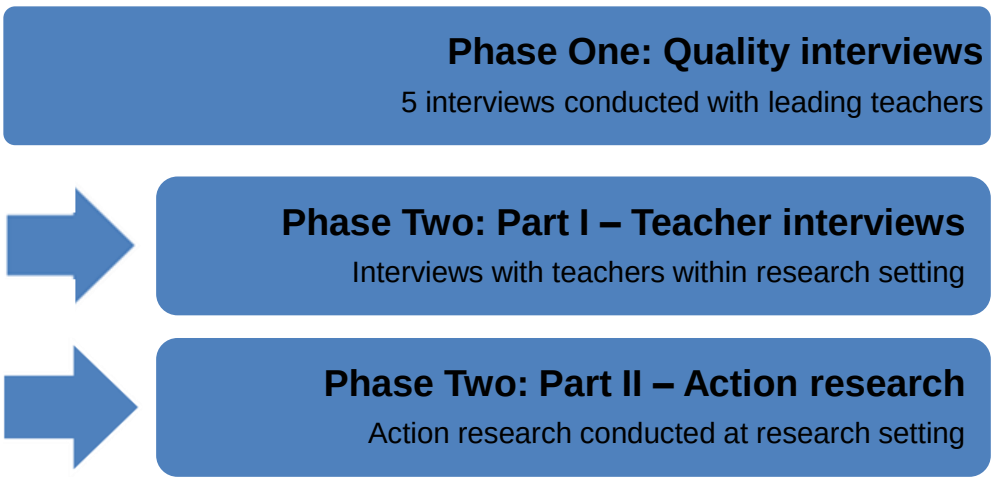

Figure 9: Research design phases and parts

3.4.1 Phase One: Quality interviews

Method

The study commenced with a quality phase component to inform the design of the action research. Interviews were conducted external to the research setting with experienced leading teachers who held the responsibility for ICT within their school. The ICT leaders were from four secondary schools known for their successful ICT programs and practices. These leading teachers and their schools had experienced ICT implementation at an earlier stage, thus these experienced ICT leaders were able to contribute knowledge of implementation processes and support strategies, discuss their approach to the integration of ICT and identify any factors that impacted teacher efforts to integrate ICT.

The use of interviews is suited to small scale studies (Gray 2009) and provides the opportunity for participants to engage in professional dialogue as opposed to answering a questionnaire or providing a written response. Interviews also assist in building a rapport and a sense of trust with the interviewer, thus encouraging discussion and a sense of sharing experiences. Semi-structured interviews were used to allow the interviewer to seek further clarification or to encourage participants to expand on their response (see Appendix 5).

This quality interview phase assisted in establishing perceptions of the extent to which ICT impacted teaching and learning in other schools, and allowed an overview of the issues encountered where netbook or one-to-one programs were implemented. The information gained was used to inform the second phase of the research. The quality research phase provided an overview of what occurred in these leading schools and data for comparison to the situation at the research school. It also provided an overview of how ICT was used in these leading schools and identified barriers teachers encountered when bringing ICT into classrooms. The research perspective was framed on a phenomenological exploration designed to contribute to an action research which utilised interview and focus group methods (Gray 2009). It was anticipated this quality phase would establish that the research question was not unique to the main research setting.

Participants

As discussed, this research commenced with a quality phase component to gain an understanding of the ICT implementation process at a number of schools recognised for their ICT program. The principals from four government secondary schools were approached to seek permission to interview leading teachers who held responsibility for ICT. This stage would provide information about how leading teachers perceived teacher use of ICT in the classroom to underpin student learning, and identify problems experienced by teachers when incorporating ICT. It would also allow an insight into the strategies leading teachers used to support teachers to increase the use of ICT and to minimise the barriers teachers encountered when endeavouring to use ICT in classrooms. The quality research phase was conducted to provide data to inform the development of the next phase of the research.

All of the leading teachers were identified by their principal and selected due to the position they held in overseeing the use of ICT within their school. Five leading teachers were interviewed, three male and two female. Each leading teacher was provided with a pseudonym. The leading teacher from School A was given the pseudonym Paul. The leading teacher interviewed at School B was provided the pseudonym Nick. Two leading teachers were interviewed at School C on the advice of the school principal and they were provided the pseudonyms Kevin and Kate. Kevin had been heavily involved with the introduction of ICT into the school, thus was able to provide a picture of early implementation, while Kate was newly appointed to the ICT leadership position. Her role was to assist teachers in developing their knowledge and expertise in using ICT in the classroom. The leading teacher interviewed at School D was provided the pseudonym Meg.

While each leading teacher held a leadership role for the management of ICT, their roles differed slightly. For example, Kate and Meg had a stronger role in developing ICT pedagogy while Kevin was more involved with access and the hardware and software aspects of ICT. The length of time each leading teacher had been at their school varied. They also came from a range of teaching areas. Paul had been at School A for three years, having joined the staff when

appointed to the position of leading teacher for elearning. His approach was to engage with teachers first, so he “implemented a lot of professional development around particular programs”. His teaching area was information technology. Nick had been at School B for five years, where he taught mathematics and media in addition to his leadership role. The leadership position at this school was Head of Academic Studies, which encompassed the responsibility for the curriculum. At School C, Kevin was a long-standing member of staff, having been there when the school became a Navigator school, whereas Kate was both relatively new to the school and to the role of leading teacher – she had been in the position for six months. At School D, Meg’s leadership role was elearning and supporting teachers with using ICT to underpin student learning. Her teaching area was music.

School settings

School A

School A was a large metropolitan coeducational secondary school with a staff of 120 teachers and approximately 1200 students. In 2010, ten teachers were provided with an iPad and were encouraged to explore various applications to see how the iPad could support learning in the classroom. The following year the majority of those teachers worked with the students in a Year 7 select entry class. The students in the select entry class were required to purchase an iPad. The following year the iPad initiative expanded to two Year 7 classes and the year 8 class. In addition, netbooks were provided to the senior students through the NSSCF scheme. Subsequently, the school implemented a Bring Your own Device (BYOD) program for all students and all teachers were provided with and iPad. The school strategic plan guided the expansion of ICT within the school program, the aim being to embrace the 21st Century learner using the available technology.

This school-based initiative was designed to increase the use of ICT within the school and there was no pressure for teachers to demonstrate a level of expertise with the iPads; the initial requirement of teachers was to mark the roll electronically using the iPad. Without specific demands, the teachers were free

to learn how to use the iPad and explore how it could be used to support learning in their classes. The focus on the administration functions that allowed reporting attendance was a precursor to the introduction of a parent portal, which was an initiative outlined in the school's ICT plan.

On appointment to the ICT position at the school, Paul was required to extend the iPad trial program to all teachers. All teachers were expected to become familiar with the functionality of the iPad and try various applications. The teachers from the initial trial delivered professional learning sessions for other staff and were able to suggest applications that would be useful in the classroom. In addition, they shared their experience of problems encountered and offered solutions. School-wide professional learning was also available for teachers to support the initiative. Paul used a range of strategies to support teachers to embrace ICT, including whole-day professional learning, short workshops, ICT experts and one-on-one professional learning. He felt the variety of options allowed individual teachers to select sessions suited to their needs.

After the two years of Year 7 and one Year 8 iPad trial, the principal implemented a school wide BYOD program. Subsequently, and to coincide with this initiative, the school moved from using textbooks to ebooks. This school had identified ICT as a priority in their strategic plan and had employed Paul in an ICT leadership position to implement the plan. The school was successful in creating a culture where teachers collaborated within their learning area about the use of ICT and students regularly shared interesting applications they discovered with their teachers.

School B

School B was a metropolitan secondary specialist school with a curriculum focus on performing arts. The school has a relatively small student population with 300 students and 42 teachers, many of whom were part-time. Improving student achievement was the catalyst for change at this school and the strategy adopted was based on 'collective efficacy' (Goddard, LoGerfo & Hoy 2004). This school used iPads but broadened its approach to allow students to work on

any device, including their phones. Some problems emerged when the school opened access to all devices, as their infrastructure did not fully support the increased number of devices.

Teachers were organised into teams to develop interrelated units of work, support each other in the use of ICT and develop curriculum related to real-world problems. A team approach was adopted and time was provided for teachers to work together to analyse student outcome data, and discuss pedagogy and the appropriate use of ICT to engage students and adapt the curriculum. Small groups of teachers developed ICT expertise and shared it within the team. The aim of an increased focus on the use of ICT at this school was to improve student learning outcomes and to develop school-wide responsibility for the improvement of student data, which coincided with a region-wide effort to improve student data in literacy and numeracy.

School C

School C was a very large metropolitan secondary college with an enrolment exceeding 1500 students, with 130 teachers. The school was one of the first schools in Victoria to provide school-wide access to computers through the Navigator Schools Project (1995). The Navigator Schools Project was part of the Victorian Department of Education Classrooms of the Future initiative, designed to promote the use of ICT and reform approaches to teaching and the delivery of curriculum. The seven schools in the program were expected to model ICT practices and deliver professional development for other schools to access. Kevin had been at School C for 20 years, having held a key role in implementation of the Navigator School initiative. Kevin was able to provide an overview of the early introduction of ICT and the transformation to the curriculum and teaching – in recent years he gained a promotion; the ICT leadership position was currently held by Kate, who was new to the school.

The school has maintained a long-standing interest in the role of ICT within the curriculum, as all students have access to ICT, with students in years 7 and 8 using iPads and students in years 9–12 using laptops through a BYOD program. Teachers were provided with an iPad with access to various

applications and software programs. Kate estimated “probably 70–90% of staff are using them but difficult to say whether they’re using them in terms of enhancing their pedagogy and linking up with the real world and doing rich tasks”. The most recent development in this school was the introduction of a new learning management system.

School D

This school was a relatively new, small metropolitan coeducational senior secondary college with a staff of 20 teachers and students enrolled in years 10–12. From its inception, the school was established with an embedded focus on learning through ICT. A level of ICT expertise and an enthusiasm for teaching with ICT guided the recruitment of teachers. All teachers and students at the school had their own ICT device and there was a school-wide emphasis on delivering the curriculum through ICT.

Formulation of interview items

A semi-structured interview process was chosen as the method of data collection for a number of reasons. The format provided greater opportunity to establish a rapport with the interviewee and to assist in building trust (Arksey & Knight 1999). In addition, it allowed for the collection of rich data from participants, as it draws upon a combination of their views, experiences, observations and reflections (Gray 2009). An important consideration that influenced the selection of interviews, as opposed to a questionnaire, was that the role of a teacher is a very busy one, and a questionnaire may be put to one side. As teachers are known to enjoy talking about their work, scheduling an interview and meeting with each leading teacher provided the opportunity to meet with each leading teacher to discuss their situation and experiences and it ensured the collection of data.

This method allowed the interviewer to seek clarification from participants and to expand on a response during the interview as required. Additional questions can clarify any aspect of a response immediately and allow the interviewer to delve deeper. This is important “when a phenomenological approach is taken where the objective is to explore subjective meaning that respondents ascribe

to concepts or events" (Gray 2009, p. 373). The selection of the semi-structured interview format added to the validity of the research process, as the questions directly related to the research objectives.

Interview questions were grouped into three categories, beginning with background information about the school, size of staff, how long the interviewee had been involved in the implementation of ICT and what ICT programs were in place. The next group of questions related to teaching staff, problems they encountered and perceived barriers identified in bringing about change. The last group of questions referred to strategies introduced to assist staff to embrace ICT. The process of gaining an overview of the various strategies implemented and the extent to which individual staff members expanded their use of ICT provided information to inform the teacher interviews conducted in the first part of the second phase of this study.

Procedure

Prior to the commencement of the research, ethics approval was gained from both Victoria University and the Department of Education and Early Childhood Development (DEECD) to undertake this research (see Appendix 1). Four secondary colleges were selected for this quality phase based on the reputation of their ICT program. All four government secondary schools were identified as worthy of contributing knowledge to this study as they are recognised for the role ICT played within their student learning programs. In the first instance, the principal at each school was contacted by telephone to outline the research proposal, request permission to conduct an interview with a staff member within their school and to seek their assistance in identifying the appropriate staff member for interview. Following the phone call, each principal was requested to sign forms to acknowledge their permission to allow research to be conducted within their school.

Once each principal advised who the appropriate contact was, the nominated leading teacher was contacted by telephone to explain the research project and seek their willingness to participate. Each leading teacher contacted agreed to be interviewed and to share their experience. Following telephone contact, an

email was sent to confirm their involvement, along with a participant information form and ethics approval information. This email was followed by a further telephone call to reconfirm the leading teacher's participation and to arrange an interview time.

Interviews were arranged at a mutually convenient time for the interviewee and the researcher. Each interview occurred at the interviewee's workplace in an interview room organised by them. Each interview commenced with an overview of the research, signing of paperwork and the outline of the interview process. The interview format used semi-structured questions to allow for follow-up questions or clarification as required during the interview. Consent was sought to record the interview and participants were advised they would receive a transcript of the interview to confirm the accuracy of the transcript and to provide further clarification or corrections as needed. The interviews varied from 20 to 48 minutes. Each interview provided an opportunity for professional discussion and reflection on the process for the implementation of ICT to support student learning, including observations about difficulties teachers experienced and strategies implemented to increase the use of ICT.

All interviews were digitally recorded and later transcribed by a professional transcription service. The interview transcript was then returned by email to the participants for verification and further input or correction. No changes were made to any of the transcripts by the participants. The validity of the research data is strengthened through involvement of the interviewees in allowing them to confirm the interpretation of the information and to check for accuracy (Gray 2009).

Procedures for data analysis

Thematic analysis was used to code the information from the set of five leading teacher interviews conducted across four settings. Thematic analysis enables researchers to use various types of information in a systematic manner to interpret the observations about people, situations and organisations (Boyatzis 1998). It is a way of seeing the data. Parsons and Brown (2002) refer to a three-step approach so that the data can be better understood. The

organisation, description and interpretation phases assist with the sorting of the findings to enable a clearer understanding of the information gained. The process of analysing qualitative data attempts to view the phenomenon of interest in a holistic manner (Parsons & Brown 2002), factoring in not only the data but the setting, the participants and anything else that contributes to the uniqueness of the specific context under investigation.

A common criticism levelled at the process of coding is that “it tends to fragment the data as it loses the connection between the text and the context” (Gray 2009, p. 496). Careful consideration was given to the development of the codes to ensure that the factors that impeded teachers’ use of ICT were captured. Each interview transcript was read to gain a perspective on each school, the approach to the implementation of ICT and the program in place. This process also provided a view of the work undertaken by each leading teacher, along with an overview of their experience, level of expertise, attitude towards technology and perceptions of problems encountered by teachers in implementing ICT. Each transcript was read a number of times and keywords were highlighted to commence the process of forming codes. A list of themes emerged and these were used as codes to identify the challenges, behaviours, actions and factors that impacted teachers. The perceived barriers were not grouped according to predefined categories.

To further assist in the process of developing themes, all interview transcripts were imported into the qualitative data analysis computer software package NVivo (produced by QSR International). In working with NVivo, an interactive and iterative process then unfolded, with the keywords and phrases aligned to the initial codes. During this process new codes were added as required. “Coding can be thought about as a way of relating our data to our ideas about these data” (Coffey & Atkinson 1996, p. 27). The core categories were identified in order to ‘tell the story’ in relation to what impacts classrooms teachers’ ability to use ICT to underpin student learning. The use of NVivo not only assisted with the identification of perceived barriers for teachers in embracing ICT, but also assisted with identifying the level of concern expressed by the leading teachers.

Each factor that impacted teachers' use of ICT was regarded as a barrier and the number of references indicated an increased level of concern.

In working through the transcripts of interview using NVivo, categories of concern emerged and were then identified and grouped into themes. During this process some codes were merged due to apparent overlap. Factors that impacted teachers became apparent and were grouped into the following six categories: time, professional development, changing pedagogy, curriculum limitations, skill level and confidence, and technical reliability. A number of interesting points were made by the leading teachers so a node, labelled observations, was added to capture these comments. The comments provided valuable insight into the process of ICT implementation at each school.

The NVivo program assisted with compiling a list of similar comments and concerns to support the analysis of the data. Whilst the use of a computer-assisted data analysis program helps with the organisation of themes, data analysis remains a subjective and interpretive process. The decisions made by the researcher continue to influence and shape the research. Categories undergo content and definition changes as the comments are compared and categorised, and as understanding of the properties of categories and the relationship between categories are developed and refined over the course of the analytical process. Throughout the constant comparative process "the researcher refines these concepts, identifies their properties, explores their relationships to one another, and integrates them into a coherent explanatory model" (Taylor & Bogdan 1998, p. 126).

3.4.2 Phase Two: Part I – Teacher interviews

Participants

All teachers from the research setting were informed of the research project through presentations at staff meetings, information for participants (appendices 2, 3 and 7) and via email. Volunteers were sought. Nine teachers from a range of teaching areas and with varied years of experience volunteered for the interview stage. There were seven females and two males. By

interviewing a broad range of teachers with varied years of experience and expertise, the research would provide deeper understanding of the nature of barriers experienced by teachers in the research school.

Procedure

Preceding the action research component, interviews were conducted with teachers at the research setting. The interviews were conducted to identify factors that impacted the teachers' use of ICT to underpin student learning within the research school. This provided an overview of the perceived barriers the teachers at the one school felt impacted their efforts to use ICT in the classroom. It was anticipated the interview participants would be involved in the next stage of the research, the action research component.

All interviews were conducted at the school setting in a conference room by an interviewer from outside the organisation. The use of an external interviewer created a more formal approach to the interview and removed the sense of familiarity. It also aided in distancing the researcher from the research participants, which encouraged the teachers to talk openly about any concerns. The interview process used the semi-structured interview format. The interview questions incorporated reference to issues identified in the Phase One: Quality interviews. This allowed participant responses to be further explored during the interview, enabling the interviewer to appreciate the perspective of the interviewee (Patton 2002). Each interview was recorded and transcribed. The length of interviews varied from 30 minutes to 50 minutes. The interview data were interrogated using thematic analysis (Miles & Huberman 1994) to identify themes teachers felt impacted their ability to utilise ICT to underpin student learning.

Each interview commenced with introductions, followed by an explanation of the interview process and the completion of necessary consent documentation (Appendix 4). Participants were informed that the interview would be recorded. A pseudonym was allocated for each teacher. All interviews were provided to the researcher and then transcribed. Each transcription was returned to each

participant to verify the transcript and to provide an opportunity to make any changes or provide clarification on any points they had made.

Each interview was read to gain an overview of each teacher, their years of teaching and level of expertise and to gain a perspective of their attitude towards technology, the school program and perceived problems in integrating ICT. Following this, all interviews were imported into the qualitative data analysis computer software package NVivo (produced by QSR International). Using NVivo assisted with the identification of barriers and gaining an overview of the level of concern provided by the teachers, as indicated by the number of references to each barrier. The interview responses were not grouped according to predefined categories.

Whilst participants were fully informed of both phases of the research, a number expressed a willingness to only participate in the interview. The information gained was used to inform the action research process and contribute to the development of a model to support the integration of ICT in secondary schools. On completion of the interview stage, all of the teachers interviewed were asked if they wished to participate in the action research component.

3.4.3 Phase Two: Part II – Action research

Method

Action research is an approach that allows educators to deal with problems identified within an educational setting such as a school, and it directs the work onto the improvement of practice. It is a process grounded on collaboration between the researcher and the participants (Voogt et al. 2011). This participative process encompasses a systematic and planned approach to review school practices such as the teaching and learning process. The process requires an open mind and critical reflection about one’s practice. Participation in an action research not only contributes to the improvement of educational practice, but also contributes to the professional development of the participants (Mertler 2014). Action research effectively changes the social, organisational and personal dynamics of the research, as participants communicate and build

positive working relationships as they contribute to the development of knowledge.

Action research provides a framework to support participants to examine issues of concern. The stages of the action research cycle of 'plan, act, and observe and reflect' helps with the analysis of the situation, the planning and implementation, and the reflection, which all work together to bring about change in practice. Two cycles of the action research were conducted over 12 months.

The emphasis in an action research is on the process rather than the outcome. Unlike other forms of research, action research requires the researcher to be involved in the research process. The researcher guides participants to review their practice, and accept a need for improved practice or change (Gray 2009). The role of the researcher as facilitator is to develop and maintain positive relationships, open communication and inclusive participation (Stringer 2007). The researcher as facilitator manages the action research process, assisting participants and monitoring and supporting them in analysing their situation and actions. The role is less directive and more that of a facilitator of the process.

Action research participants

All participants involved in the interview stage were invited to participate in the action research, however only two teachers volunteered. Both volunteers were female, and very experienced teachers with over 25 years of teaching in the humanities curriculum area. They regarded themselves as competent users of ICT with a middle to upper level range of ICT knowledge. One teacher taught mostly in the junior school and the other exclusively in the senior school. The teachers retained the pseudonyms allocated to them in the interview stage: Sally and Joanne.

Procedure

Participants were recruited via a circulated email (Appendix 2) followed by an explanation at a staff meeting. The information gained from the Phase Two Part I interviews conducted at the research setting was used to inform the action

research process. The barriers identified were used as a focus for discussion; in particular, how to minimise them to allow greater use of ICT to underpin student learning. The action research continued over a 12-month period.

Research discussion meetings were held at the end of the school day in the college conference room. An agenda was set by the researcher for each meeting and the meetings lasted for 60 to 90 minutes. On average, two meetings a term were held. The research comprised two cycles of the action research process, with one cycle being the three stages of plan, act, and observe and reflect.

The nature of an action research requires ongoing analysis and development of thinking, processes and actions. In addition to the audio recording of each meeting, the researcher made notes. After each meeting the researcher listened to the recordings and made journal notes to reflect on the process and the comments of the participants. Thematic analysis (Miles & Huberman 1994) was used to identify themes connected to participant teachers' thoughts and opinions, curriculum planning and implementation, and journal content and discussion.

Data collection

Participants kept a journal of their experiences throughout the action research process outside of the meeting time. A template and topic starters were provided, along with an example for participants to help them develop their own variation. The template was a guide to assist the participants to generate notes and comment on their thoughts and decision-making processes. The researcher also maintained a journal to provide a factual description of the meetings, record personal reflections and to note comments and points of interest throughout the process.

Meeting process

The action research was conducted at the school where the researcher and participants were based, with the researcher facilitating each meeting. The researcher set the agenda for each meeting and provided email reminders to

each participant in the week prior to the meeting. For the first cycle of meetings, the two teacher participants, the Associate Supervisor and the researcher were present. As the researcher was in a position of authority within the school, the Associate Supervisor acted as an observer to ensure the action research process was not compromised by perceived power conflict issues. Also, having the Associate Supervisor present was a strategy to ensure transparency and further contribute to the validity of the data collected.

Professional readings were provided at each meeting to guide the research process, extend or challenge the participants' thinking and generate discussion. For example, a diagram of the Technology Together model (Phelps & Graham 2013) was provided at the first meeting to illustrate the influences on technology learning. It showed the metacognitive approach to technology learning and identified the three factors – motivation, strategies and affects – that the participants could refer to in their journal entries. The data gained from the preceding interview phase was shared with the participants to generate discussion and determine the barriers of major concern to all participants. The interview data were discussed at various times during the regular meetings.

Subsequent meetings commenced with a discussion on what had occurred since the last meeting. Each participant was asked to reflect on the task set at the previous meeting and to report on their observations and the challenges involved. Discussion was generated to explore their views, interpretations and assumptions about their teaching. The reading material provided for each meeting linked to the task set; for example, a copy of the TPACK model was provided to each participant to create discussion on the links between technology, pedagogy and content knowledge. The SAMR model was provided so participants could locate themselves in a stage of the model. To increase the participants' understanding of the action research process, there was also some discussion on reflective practice.

The meeting transcripts, researcher notes and participant journal entries provided an account of the participants' ideas, plans, concerns and actions. The researcher used these documents in order to understand the process they

worked through to eliminate the factors that impacted their use of ICT. In addition, the role of the Associate Supervisor at the meetings provided an independent perspective and confirmed that interpretations made by the researcher reflected the discussion and conclusions drawn from the meetings and actions.

Action research data analysis

The meetings allowed the participants to explore problems, discuss their intentions and describe what they planned to do to increase their use of ICT. The data collected from meeting records and journal notes was analysed to inform each stage of the action research cycle. As described, during each meeting the researcher made notes in addition to an audio recording. A process of content analysis was then conducted by working through the meeting transcripts and the researcher's journal notes. On completion of the first action research cycle the participants shared their journal notes with the researcher. The data analysis process is both iterative and collaborative. Collaboration is premised on the belief that participants know the organisation, and know what will work and are the ones who will implement actions, thus their involvement in the analysis process is critical (Coughlan & Coughlan 2002).

As the action research process is used to effect change, it was important to maintain a focus on the interventions the participants introduced. Having the participants articulate what they learnt, along with their observations and perceptions of the change process provided a personal perspective. The interpretations and conclusion drawn by the participant in relation to their actions were continuously challenged at each meeting. The suitability and possible application of the suggested strategies for other teachers was also discussed.

The transcripts and journal notes were examined to identify the processes each participant worked through, and to ascertain what they felt worked in the classroom and how their thinking in relation to ICT implementation changed through their involvement in the action research process. The actions, discussion and reflection were constantly referenced back to the research

question – *What models of assistance and support do teachers require to improve the use of Information Communication Technology to change pedagogy to support student learning?* Additional questions to maintain the focus and articulate the actions were, *What type of change is required and what support is needed to assist with bringing about the change desired?*

3.4.4 Reflexivity

Qualitative research is interpretative research, with the researcher typically being involved in a sustained inquiry (Creswell 2009). As qualitative research is a subjective and interpretive process (Gray 2009) it is essential that the data analysis is worked through consistently and objectively. In qualitative research, a selection process occurs as the researcher extracts the information from the data collected. The observations and interpretations made by the researcher are determined by the selection of information that directly relates to the research question (Coffey 1999). Thus, reflexivity refers to the researcher and the influence they exert on the research due to their interest in the topic (Ryan & Golden 2006). Particular attention should be attributed to the creation of knowledge derived directly from the data collected.

In the case of action research, the researcher is often directly involved in the research process and personal and ethical issues may bring a bias to the research. As a researcher both concerned with the implementation of ICT to better serve the learning needs of students and working within the research setting, a personal interest is evident. The challenges of my role as a leader within the school and as a researcher were identified in the initial stage of candidature. The decision to employ an external interviewer was made to provide distance between my role and the teachers. The presence of the Associate Supervisor at the action research meetings was a control measure to ensure my role as a researcher was maintained. However, the data analysis remains a selective process and interpretations may be influenced by the stance of the researcher. Thus it is important that the data analysis is dealt with consistently and objectively.

As a leader within the research setting, I have a strong interest in pedagogy and student learning and a vested interest in the overall performance of each student. As an educational leader, delivering the best possible standard of education where students engage in 21st Century learning and achieve to the best of their ability is a priority. I am interested in the efficacy of how students learn and the pedagogy required to support this. As such, it is important to acknowledge the possible influence this may have on the interpretation of the data. My decisions as a researcher are implicit in the construction of knowledge through my involvement in the research process. In acknowledging personal reflexivity, I need to be aware of how my personal values, beliefs and attitudes served to shape the research. Continual reference to the research question and the research process contribute to the ongoing integrity of the research and minimise the undue influence of my dual roles as researcher and a leader within the school.

3.4.5 Validity

Action research often suffers from criticism that the process lacks rigour and validity; thus, a range of views exist about the ways to establish validity in action research (Argyris, Putnam & Smith 1985; Fisher & Torbet 1995).

As the nature of action research relies on the observations and analysis of the researcher, it is imperative the researcher demonstrates that a system of disciplined inquiry has been followed. “A research instrument must measure what it was designed to measure” (Gray 2009 p. 155. This can be achieved through the use of a critical colleague, a mentor or a person external to the research setting who can provide an independent perspective (Koshy 2010).

The most important issue in the design of a qualitative study is the analysis of the results and the judgement of the quality of research (Creswell 2009). The research instruments and the data must allow for conclusions to be drawn and generalisations made. The issue of validity is complex and multifaceted as it encompasses internal and external validity, construct content and predictive and statistical validity (Gray 2009).

An action research is often focused on a personal problem related to one's workplace, and as such it relies on observations made by participants in relation to their actions and their interpretation and analysis of the situation. In addition, it often involves small samples; thus another important reason to consider and address validation concerns. With internal validity, the personal opinions and interpretations of the participants make it difficult to prove that the opinions are objective. In this situation, the knowledge of the researcher can establish a thorough understanding of the context and the organisation to establish that these represent a true reflection of events. External validity in action research is often impacted by the individual nature of the research and the small sample size, which makes it difficult to make generalisations applicable to other situations (Gray 2009).

To establish the trustworthiness of this research, the research process and the data collection methods were explained in detail in order to inform other researchers of the procedures used. The instruments relied upon were interview transcripts, meeting records and participant and researcher journals. A suitably qualified colleague with experience in action research was enlisted to act as a 'critical colleague' throughout the action research stage, attending the meetings, ensuring research processes were adhered to and reviewing the researcher's observations.

Both the interview stages and the action research meetings were recorded using a voice recorder and then were transcribed into text documents. For the interview stage conducted at the research school, an interviewer external to the school conducted all the teacher interviews. This strategy was utilised to provide consistency and to allow the teachers to speak openly, as the researcher held a position of authority at the school and it was felt the teachers may not want to share their experiences. The validity of both interview stages was further strengthened by ensuring sufficient time was available to conduct each interview and by allowing each participant to elaborate on their experiences. Each participant interviewed was asked to review the transcript of their interview for accuracy and to clarify any points.

Waterman (1998) suggests the process of working through the cycles within an action research add to the validity of the research as the participants plan, act, observe and reflect as they work through each cycle. The participants kept a journal to reflect on their participation as they worked through the two cycles of action research and record their actions and decision making process. The researcher maintained a journal throughout the research. Participant reflections were used to stimulate discussion during the meetings and to assist with the recall of actions to support claims made.

3.4.6 Triangulation

Triangulation is a strategy used within qualitative research to gain additional knowledge to justify and underpin the data (Denzin & Lincoln 2000). Two or more independent measurement processes reduce the uncertainty in interpreting the data. The research process is strengthened by the use of two or more independent measures, as this increases the reliability of the interpretation of the data. The involvement of the Associate Supervisor in the action research process and the return of transcripts and findings to each participant added to the quality of the findings. The use of interviews from both leading teachers and teachers within the research setting provided two independent measures to increase the reliability of the identification of barriers.

3.4.7 Credibility of the research

The credibility of qualitative research is achieved through creating confidence in the accuracy of the interpretations (Lincoln & Guba 1994). The use of quotes within the data analysis stage supports the verification of the findings. The findings could be further substantiated through more research to test the generalisations formed; or the claims could be compared with findings from research conducted in other settings (Koshy 2010).

3.5 Conclusion

This chapter outlined the methodological approach for this research. It provides an outline of the research design, and a description of the data collection tools and approach adopted for data analysis. The challenges associated with qualitative research were discussed, along with the limitations of the application of the action research findings. Reflexivity was discussed in light of the researcher holding a position of responsibility within the research setting and the implications for the construction of knowledge. The personal values and beliefs of the researcher may influence the shape of the research due to their interest in education and their role within the research setting.

Chapter 4: Phase One – Quality interviews

4.1 Introduction

This chapter discusses the leading teacher interview data. This interview phase provided an insight into the issues faced at four schools known for their ICT program. A number of themes emerged as factors that impact teacher adoption of ICT. A range of strategies each leading teacher employed to support teachers with the integration of ICT were also identified.

4.2 Data analysis process

A thematic analysis approach was adopted as described in Chapter 3. Transcripts were read numerous times and then imported into NVivo, where barriers and strategies were identified and grouped The number of times an issue was mentioned led to the creation of themes. Fifty pages of interview transcripts were analysed in the process.

4.3 Results

Early research in this area has focused on student access to ICT (Larkin 2010; Moyle 2006; Lee & Gaffney 2008); however, in each of the quality phase schools it was apparent that access was not an issue. Each school had created a culture where students brought their device to school each day. From the interview transcripts it was clear that each leading teacher had a good overview of the level of ICT expertise of their staff. They were able to group their teachers according to each teacher's level of enthusiasm and expertise: those that were quite confident and competent users of ICT; those who were happy to learn; and those who experienced difficulty in seeing how they could use ICT in their teaching area or were reluctant to change.

The data gathered from the interviews conducted at each school revealed a range of factors that impacted teachers as they endeavoured to utilise ICT to underpin student learning. In working through the transcripts, those factors were formulated according to the responses provided by the leading teachers. The number of times an issue was mentioned contributed to it being identified as a barrier. As the intention of this study was to develop a model to support teachers to integrate ICT to improve student learning outcomes, it was important to identify the barriers that impacted teachers' ability to utilise ICT. The themes identified were teacher confidence, teacher mindset, infrastructure and technical support, pedagogy, time, professional development, and curriculum limitations. Another category, observations, was added to capture interesting points made by the leading teachers.

Table 2: Themes identified from the interviews

Theme	Comments derived from interview transcripts
Teacher confidence	– A lack of confidence by teachers in relation to using ICT – A perception that the students are far more advanced in their use of ICT so not wanting to appear inferior, perhaps a challenge to their authority or role within the classroom, maybe feel undermined (x 2) – Teacher fear (x 2) – Teacher lack of confidence (x 3)
Teacher mindset	– Teacher mindset; some teachers questioned why they would need an iPad and how was it going to improve their teaching – Teacher view that by sharing their strength (teacher knowledge and expertise) this will no longer make them unique – A teacher perception that their weaknesses are the focus – Teacher attitude – Motivation – Knowledge of what is available and lack of experience with ICT; e.g. blogging and making websites – You have to be a problem-solver and if you are going to work in a school with technology things are going to go wrong
Infrastructure and technical support	– In using iPads it was difficult for students to submit their work for assessment – The infrastructure sometimes a barrier – Waste of class time when ICT does not work – Initial focus was on infrastructure and provision of ICT – You have to have access to high quality machines – Make sure every student here can access the type of technology and they actually need the internet at home – Our staff work across an enormous number of different systems. Everything from purchase orders to Gmail to Edumail or wikis – we

Theme	Comments derived from interview transcripts
	have a wiki for everything … it can be quite challenging to stay on top of all those – We always want more resources … to ensure that we continue to push what our kids can do and expect high quality productions from them
Pedagogy	– Concern from teachers that ICT is used for the sake of it – How information is processed; is this just another change? (ICT changes what we do but it doesn't change what powerful teaching and learning is) – Problematic in some subject areas to have ICT underpin the learning (perception of teachers that it is too hard to incorporate) – Adjustment from one approach to learning to another – Providing opportunities to show staff where it can be of value – Defining what makes for effective practice; ICT is part of the bigger teaching and learning agenda – Schools are conflicted, want consistency in delivery and practice and a level of commonality but still want personal and individual learning – Lack of clarity (about what is expected and around what an ICT-rich classroom looks like) – When we talk about pedagogy here we talk about using the most appropriate tool and many of those are online
Time	– Time to develop new tasks and activities – Time to learn the programs – Time to adapt to new approaches – Every teacher is busy; we have an enormous workload
Professional Development	– A lot of it is providing opportunities to show staff where it can be of value – Provide one-on-one help – Faculty leaders worked with their teams to identify areas for appropriate use – Developing a professional development plan – Having staff share good practice – Provide opportunities for teachers to demonstrate material developed – Provide time for faculties to model new practice – Create resources for staff that they can view anywhere, anytime – Provide techie brekkies – Short sharp presentations at staff meetings – Encourage staff to visit other schools to observe practice – Learning walks and professional learning
Curriculum limitations	– The curriculum framework, especially VCE as the exams are still a pen and paper exam, conflicts with students using ICT for notes etc. – The curriculum framework of AusVELS and the VCE as teachers felt pressure to ensure they got through the course – The curriculum framework (VELS/AusVELS) requires the teaching of so much content and that limits the opportunities to explore areas of interest for students – VELS/AusVELS limits opportunity to explore and delve into deeper learning

Theme	Comments derived from interview transcripts
	– Curriculum framework – Pressure to get through the course identified in the AusVELS – Our students come out of here creative meaning makers of their own learning and that's simply not valued through our current exam system at the end of Year 12
Observations	– Teacher training; there is little evidence of including ICT in the teacher training – Initial focus has been on infrastructure – The ICT was regarded as a tool, an enhancement for the learning – Lack of training and understanding – We use ICT in every class and the structure that the classes are based on enables it to be absolutely embedded but not be the focus – Technology, the iPads and netbooks, provided by the DEECD were not up to standard (older versions of Apple computers that were no longer available to the pubic were distributed to teachers) – Cost of quality ICT, buying apps and programs to support your teaching – It's completely unrealistic to think you can educate and work today without using technology – One of the most productive (strategies) is to create resources for staff that they can view anywhere, anytime – Doing the audit of how we're actually using it so we can use that as a baseline to see where we need to improve – Putting together a plan – again identifying all the ICT skills, both from a curriculum and school perspective of what our students need … to be successful – There is certainly an expectation from leadership that it (ICT) is an embedded part of the learning here – It is about building positive relationships first

4.3.1 Discussion of identified themes

Teacher confidence

Three of the five leading teachers noted a concern amongst their staff in relation to a lack of confidence. Teacher confidence covered things such as a fear of technology, not knowing how to use ICT in their teaching area and not knowing what ICT was available or appropriate. Two leading teachers noted some teachers were concerned that the students were far more advanced in their use of ICT, and the teachers did not want to appear inferior or feel undermined. Nick felt fear and a lack of confidence were the main reasons why teachers were reluctant to embrace ICT. He commented that there was a perception by some teachers that their weaknesses were the focus. He also

noted that teachers feared a loss of identity; they had a perception that by using ICT they would teach the same as their colleagues, which would no longer make their teaching unique.

Teacher confidence was identified by Paul, along with a lack of clarity about the use of ICT and submission of work online as barriers that impacted teachers' use of ICT. He suggested resistance from teachers was due in part to them not knowing how to use iPads to enhance their teaching or improve student learning. At School A, some teachers had expressed a concern to Paul that many students were better skilled than them with ICT and they did not want to appear inferior or feel undermined by the students.

Paul felt the issue for some teachers stemmed from fear, a lack of confidence and not knowing how to use the iPad. He noted there was a perception by some teachers at his school that the students were far more advanced in their use of ICT, which created a situation where the teachers "maybe feel undermined and they did not want to appear inferior, perhaps they see it as a challenge to their authority". He noticed change was at times "being driven by the students; the students will tend to come with an app and talk to their teachers about it".

Kevin noted that many teachers often want to have confidence in their understanding of the software tool before they make use of it. Whereas Paul observed that, along with a lack of confidence, some of his teachers demonstrated a resistance to using ICT and had difficulty "keeping up with" the technology that students were looking at and using. He also noted the age of teachers as a factor that impeded the increased use of ICT. A small number of teachers had requested a transfer or moved from his school due to the increasing use of ICT.

Teacher mindset

Teacher mindset encompasses teacher attitude towards the use of ICT and a willingness to use it to support teaching and learning. A number of concerns influenced teacher mindset. Two leading teachers mentioned unreliable technology. Teachers often shared their frustration when technology was not

reliable, as it wasted class time and the effort they had put into planning the lesson. Thus, the motivation to change was diminished when things went wrong. Another concern stemmed from the ICT and how to use it; for example, at School A, a few teachers questioned why they would need an iPad and how it was going to improve their teaching. All leading teachers acknowledged that students at times were more skilled with ICT than the teachers, and teachers shared their concerns about not wanting to appear inferior or feel undermined by the students.

In School D, Meg suggested teachers would not apply to work in that school if they did not enjoy working in a technology-rich environment, as the technology is integral to the teaching and learning. On the other hand, Paul and Nick identified staff in their schools who felt their identity as a teacher would change if they used ICT. The teachers expressed concern that their weaknesses as a teacher would become the focus. Nick noted one teacher in his school was concerned that they would no longer be unique; that by using ICT what they do as a teacher and how they deliver the learning would change their perception of themselves as a teacher.

Infrastructure and technical support

Each of the schools were selected due to the recognised success of their ICT program, so all schools were well equipped, with a good ICT infrastructure and the capacity to meet the needs of multiple online users. However, all leading teachers could identify a time when the technology did not work effectively or there was a lack of available technical support, which created a level of frustration for teachers. When the ICT did not work, the teachers regarded it as a waste of class time and questioned the effort put into planning a unit they could not deliver. In School A, it was difficult for students to submit their work for assessment using iPads, which was a frustration for both teachers and students. Kate noted that connecting the iPad was a little troublesome at times. At her school, teachers were willing to use the ICT but connection issues added to teacher frustration. In School A, Paul commented it was the senior students who were reluctant to use the netbooks provided through NSSCF, as they found them inferior to the ICT devices they owned and brought to school. Paul

and his principal were happy to allow teachers to use iPads predominantly for administration tasks to begin with and to gradually expand their use in the classroom as they became more familiar and confident.

In School B, Nick mentioned that the infrastructure was a barrier at times; for example, the internet drops out, and teachers get frustrated. As a strategy, Nick suggested all teachers should have the mindset that something will go wrong with the technology at some point; he encouraged teachers to accept this and always have an alternate activity that does not rely on technology. This was a viewpoint reinforced by Meg, who promoted the need to always have a backup activity with her teachers.

The BYOD programs (at School A and School D) and the increased use of mobile phones (School B) placed the responsibility for having a device to participate in learning onto students. At times, a student's device was left at home or was with the technician for repair. Two schools had addressed the issue of students not having access to ICT in class through making a device available through the library. To address concerns about technical issues, Nick set up 'communities of learners' and focused on collective efficacy, where small groups of teachers worked together and supported each other.

Pedagogy

All leading teachers identified issues related to pedagogy as a reason why teachers were slow to embrace ICT. All held the view that ICT was a tool that should be used to enhance teaching and student learning. Kevin suggested "teachers need to have a level of commonality, know what is on the device and build curriculum applications". He felt some teachers used ICT as "a 'filler' and to create 'busy work' … but it is not resulting in transformational learning". Kevin noted that "teachers wanted to know that ICT was effective for student learning and not just used for the sake of it". He says a lot of effort in the past five years at his school has been on consistency in pedagogy and practice and clarifying what this means for consistency with ICT. The move towards ICT must be "part of the bigger teaching and learning agenda about what makes for effective practice".

At Paul's school, some teachers questioned why they needed an iPad and how it was going to improve their teaching. In his view, ICT sits alongside pedagogy. From observation within his school Paul noted, "I can't see in the short term … changes to pedagogy. I've seen it work alongside it, and I have seen it be a useful tool … I think we're still at that stage … the administration and curriculum delivery for the majority of the teachers." Paul regards ICT as a useful tool to enhance teaching; however, he feels it is the students who will drive the change in teacher practice. For Meg, discussion about pedagogy within her school revolved around using "the most appropriate tool and many of those are online because that is what students enjoy".

Kevin believed that schools and the system lacked clarity in terms of what they expected from ICT compared to when he was involved with the Navigator Schools Project (1995), where the focus was clearly on ICT for learning. However, he felt there was, within his school, a tension amongst teachers "because you need a level of commonality and schools want a level of consistency but still want individualised practice and passion from each teacher". He questioned whether it is possible to do both. He felt a level of commonality in regard to the applications available to teachers so that they can effectively plan and build curriculum. Paul also mentioned a lack of clarity as a concern expressed by his teachers in relation to how ICT was going to make their teaching better; he felt teachers across each faculty needed to know and articulate what good, and educationally sound, ICT practice was. Kevin was also of the opinion that teachers with a clear view of good ICT practice would assist with the adoption of ICT. He noted it was important for teachers to be constantly thinking of how to construct curriculum while examining ways to incorporate ICT.

Another barrier Kate identified was that some experienced teachers do not have "the knowledge of what's available, what kind of things can be done with a device to enhance the curriculum", and lacked experience with the new technologies. Kate used the example of social media, blogging and making websites, and observed that if teachers have not been exposed to these tools they may not understand how easy it is to incorporate them. To assist teacher

development, Meg created resources such as podcasts, videos and screencasts for staff so they could view them anywhere, anytime. She felt this was the most effective strategy to support her staff.

Strategies employed by Kate to assist the teachers included conducting professional development sessions to show them how they could add value to their classrooms and their own teaching experience by using the devices, and developing a professional development plan for staff. She established “a little club on Tuesday afternoons where everyone gets together and can ask lots of questions about technology and the learning management system” and a “pop in kind of help desk situation” where she could help staff one-on-one with their individual needs. Kate also decided to compile a list of all the skills teachers may need to work effectively with the available ICT when they first start at the school.

Nick, Paul and Kevin all commented that teachers often use ICT as a substitute, rather than for transformational learning (SAMR model). The ultimate aim with ICT would be to have teachers incorporate it into the classroom in a way that transforms learning, to allow students to create, collaborate, communicate and problem-solve. Meg felt teachers at her school were able to select the most appropriate ICT “to help our students learn and empower them”. Nick noted that having teachers work in teams was an effective strategy to assist teachers in changing their pedagogy, as it provides a supportive environment to learn applications, share information and plan for effective use.

Time

All five leading teachers identified time as a factor that impacted teachers. Kate felt that teachers individually would probably see time as the main factor that impacted their use of ICT; that is, time to develop new tasks and activities. Each leading teacher could identify teachers who wanted more time to “establish how ICT will fit into practice and the ramifications” (Kevin) and “when so much else is going on in a busy school, teachers want time to develop new things and try out new things, this all takes time” (Kate). At School A, Paul noted “some teachers were reluctant to use ICT as they were not familiar with the technology and felt

they did not have the time to learn". Time was also mentioned in relation to the pressure teachers felt to complete the AusVELS or VCE curriculum, as this was a greater priority when time was scarce.

At School A, Paul explained that the principal's expectations of staff in relation to the introduction of the iPad program were very low. Teachers were not, in the first instance, required to use them in class or to produce units of work that demonstrated their use. The only requirement was that teachers mark the roll online. It was hoped they would 'play' with the iPad and experiment with how they might use it within their classes but there were no firm expectations. Paul suggested benefit was gained from the teachers within each learning area having the opportunity to sit and share with each other what they were doing and discuss what had "made a difference".

Each leading teacher outlined numerous strategies they had implemented to make time for teachers. As part of their leadership role, each leading teacher was prepared to provide time to support teachers to learn more about ICT and its application in the classroom, whether before school with 'techie brekkies' or during meetings or online. Each leading teacher frequently worked with teachers one to one to provide individual support. Kevin endeavoured to make time for teachers by setting up meetings and requesting time within faculty meetings be allocated to ICT.

Professional development

Professional development was a key aspect of each leading teacher's role description. Each leading teacher mentioned a range of professional learning strategies they had employed and sessions they had delivered. Kate felt strongly about the need for professional development for teachers as a way to show staff how they could add value to their classrooms and their own teaching experience. Kate took a very strategic approach to staff professional development; she conducted a staff skills audit to inform a professional development plan. She felt a professional development plan was needed to illustrate to teachers where ICT could be of value to them. In her plan she worked with a trial group of teachers then utilised subject learning area domains

to deliver subject-based professional learning. Her thinking was to provide "opportunities to see where ICT can be of value, make their lives easier and improve student learning". She coordinated the school's professional development and utilised those teachers with expertise to train others and share their knowledge and expertise.

Meg and Kate created a variety of professional development opportunities that were pitched at individual teachers' needs. Meg provided a diverse range of activities to support teachers, including "techie brekkies, a help line, group sessions and demonstrations". She created podcasts, videos and screencasts and made them available to staff. Meg commented that one of her most effective professional development strategies was to create resources that teachers could view "anywhere, anytime". Meg also encouraged all teachers to view colleagues' curriculum resources on the school's 'shared space'. She was also a strong advocate of having teachers participate in learning walks and visit other schools.

Both Paul and Nick tended to use the knowledge gained from their overview of ICT within their respective schools to inform the professional learning program. They both regularly showcased programs and applications they thought would be appropriate in the classroom that teachers could readily use. They reported working individually with staff as an effective strategy. In addition, Paul included whole-day professional learning, short workshops, ICT experts and 'one on one' professional learning for staff who requested individual assistance. In particular, he noted that older staff preferred one-on-one assistance as many were reluctant to work within large staff groups. He observed one-on-one support for teachers who had '20-plus' years of experience, he thought this was particularly effective for these teachers as, in his opinion, they were really struggling with ICT.

Another strategy Paul used was to have teachers from the iPad class explain the ICT applications they had used and share the activities they had developed and used with students with their colleagues. Paul commented, "the teachers are the hardest part of the change process". He also noted that some teachers

were open to the students showing them how to do things and students were sharing their ICT work with them. Paul was able to create a culture where the teachers were sharing within their learning area and students were sharing interesting applications they discovered with teachers.

Nick felt it was important to have the teachers “on board” so he designed and delivered professional development around their specific needs. Kevin used modelling as a strategy and implemented professional learning teams where knowledgeable teachers shared their expertise and modelled applications with colleagues. Professional learning teams provided opportunities for other teachers to demonstrate effective models to their colleagues. He felt it was important to “build a narrative around what is involved, detailed planning required, a lot of this school’s effort has been about consistent pedagogy and practice”.

Curriculum limitations

This category refers to the demands placed on teachers to ensure students meet the aspects outlined in the state curriculum, be it AusVELS or the VCE. Paul and Kate commented that teachers often feel they are bound by the curriculum framework of AusVELS and the VCE. In their opinion, teachers felt pressure to ensure they completed the course; “there is a lot of pressure to get through this and to prepare students for exams” (Kate). This point was also made by Kevin when he commented that some teachers feel constrained by the curriculum, with pressure to get through the course identified in the AusVELS. “The curriculum framework (VELS/AusVELS) requires the teaching of so much content and that limits the opportunities to explore areas of interest for students” (Kevin). On the other hand, Meg felt the 7–10 curriculum framework allowed teachers a lot of flexibility, but it was the senior VCE curriculum that tended to limit teachers use of ICT, as there was pressure to complete the course and prepare students for exams.

Observations

During each interview the leading teachers made a number of interesting comments that were not necessarily barriers but were observations in relation to

teachers and their attitudes towards ICT and the need for change. In particular, they all agreed students do learn differently with the addition of ICT and teachers need to accept that ICT is a necessary shift. The leading teachers all viewed ICT as a tool to support teaching and they commented that classroom teachers may need to release some of classroom control to students.

Kate noted the initial strategy for the DEECD was to place ICT into schools through the provision of netbooks and infrastructure; however, the focus has moved onto the curriculum and enhancing teacher practice and pedagogy. Kate suggests there is a need to develop an overview of the skills students need to work effectively with ICT devices and then plan to equip them with those skills; for example, to research properly on the internet, to create and produce work and to communicate and collaborate with people. She observed that the inclusion of ICT required an adjustment by teachers in their approach to student learning and how information is processed. Kate believes it is not a matter of the teachers not being willing to change; they acknowledge that students do learn differently and this is a necessary shift. Her next level of work is to examine how teachers use ICT to see if it is used effectively.

Paul observed some teachers at School A had difficulty finding ways in which ICT could benefit student learning within their curriculum area. Teachers with poor ICT skills often do not know what is available and may experience difficulty finding appropriate ICT programs or applications to integrate into their teaching program. In his opinion, some teachers need support to change the way they deliver the curriculum in class. Paul noted, “we have tried to get the teachers on board and I think that is the hardest thing to try and change”. He also mentioned that his school regularly hosted teachers from other schools who came to view the ICT infrastructure and discuss how the school managed the number of users, but he noted very few were looking at the curriculum.

Both Kate and Meg expected more resistance from teachers and less willingness to try new things; however, they felt teachers were keen to “get on board”. An effective strategy Kate found was conducting an audit of how ICT was actually used to establish a baseline to identify where improvement was

needed. She also observed that ICT worked better with the junior levels in terms of curriculum, with a noted move away from “just word processing”.

Kevin identified motivation as an important aspect: “what is motivating teachers to change, they need to think ICT is making a difference to want to engage (teachers are bombarded with lots of competing interests)”. He also noted that teachers are often conflicted, as schools want consistency in delivery and practice and a level of commonality but still also want personal and individual learning. He believes it is difficult for teachers to sustain a focus on one thing when there are lots of competing demands on schools and teachers.

Underpinning these observations is change; the need for teachers to change the way they have been doing things in their classroom. However, Kevin felt there was a level of ‘change fatigue’, as schools often expect teachers to embrace the latest department priority. He felt teachers were confronted with too many changes, and teachers who feel there is constant change become reluctant to be involved. Kevin observed that, in his school, it depends on the learning area as to how quickly ICT is taken up. He noted some areas are quicker to utilise ICT but other curriculum areas are more set in their ways. For example, in maths “a lot of our teachers are still fairly traditional in terms of book-based learning” but if the environment changed to one of problem-solving it might open up the opportunity for more ICT. He also commented that “it’s about an attitude of whether you’re stimulated by new ideas or whether it’s something that you don’t think is valuable or a bit of a distraction”.

Other observations included the age of some teachers impacted whether they adopted ICT, some teachers transferred out of School A when ICT use and expectations were outlined, and examples such as this may impact teachers’ use of ICT. Meg mentioned that laptops provided by the education department were not up to standard; they were inferior to what was available commercially and this made it difficult for teachers to produce high quality learning units. The cost of buying applications and software programs impacted on what some teachers wanted to do. Teacher training was also touched on, as Kevin mentioned there is little evidence of including ICT in teacher training.

4.4 Discussion

It was apparent each leading teacher played a key role in their respective schools in how ICT was implemented and in supporting teachers to develop and increase their use of ICT. They provided a good overview of how ICT was being used by teachers and the factors that impacted teacher use. The leading teachers acknowledged a key part of their role was to support teachers in expanding their use of ICT, which required gaining an understanding of the issues facing the teachers and providing solutions to support them.

A number of researchers have investigated ICT barriers for teachers (Balanskat, Blamire & Kefala 2006; Bingimlas 2009; Ertmer 1999) and used different approaches and criteria for categorising the barriers. Ertmer (1999) classified barriers into intrinsic and extrinsic categories, whereas Balanskat, Blamire and Kefala (2006) viewed them from a micro, miso, and macro level. Others sorted them according to school-based issues and teacher-based issues. The focus for this research is on teacher and school level issues. The categories that emerged are similar to those discussed by Bingimlas (2009): teacher confidence, a lack of teacher competence, resistance to change and negative attitudes, lack of time, lack of effective training and lack of technical support.

Four of the five leading teachers could identify teachers on their staff who felt a need to have knowledge and experience of programs and different types of ICT prior to using it. Other researchers identified teachers' own beliefs and attitudes about the relevance of ICT to student learning as having the biggest impact on the successful implementation of ICT in the classroom (Ertmer et al. 2012). Hew and Brush (2007) also found teacher attitudes, beliefs, knowledge and skills to be key areas impacting ICT implementation.

All leading teachers acknowledged skill level and confidence impacted teacher use of ICT. When there is a fear of ICT, fear of things going wrong, fear of losing one's uniqueness and a fear that the students know more than you, it is difficult for teachers to embrace the use of ICT. Various researchers have further investigated the lack of teacher confidence. Beggs (2000) suggested a

fear of failure was cause for a lack of confidence whereas Balanskat, Blamire and Kefala (2006) found the lack of confidence was due to a lack of ICT knowledge and expertise. Cox, Preston and Cox (1999) concluded a lack of confidence and experience in using ICT impacted teacher motivation to explore and trial ICT use in the classroom.

For teachers, having technology fail when they had ventured to use it was often a source of frustration and a deterrent for using ICT. Meg mentioned that in her school, “all teachers had a ‘backup plan’ as invariably technology will not work on occasion”. As the curriculum delivery was highly reliant on ICT within her school, there was an implicit understanding that teachers would need alternate work on hand and strategies to deal with the situation if it arose. She advised her teachers to always come to class with other work that was not reliant on ICT, as you never know when technology will let you down. Technical faults along with a lack of technical support and a fear that technology will let them down are factors that reduce teacher confidence (Russell & Bradley 1997; Cuban 1993; Preston 1999). This fear, coupled with a lack of time and technology letting them down, creates a level of frustration and resistance. Bingimlas (2009) suggests confidence, training, time and technical support are all interrelated. If teachers are provided training and time to plan curriculum and develop their ICT skills, this may increase teacher confidence and motivation.

All leading teachers felt teachers should accept that ICT is a tool, acknowledge that students do learn differently and that a necessary shift is required. “At times teachers should accept that change is required and they may need to release some of the classroom control to the students” (Kevin). According to Watson, (2001) teachers are threatened by change and do not see any value in change that appears to focus on what technology can do rather than how ICT can support learning.

According to Kate, there are a lot of different layers associated with the implementation of ICT. In her role she created opportunities to show staff how ICT could be of value in increasing student learning, delivered ICT sessions where staff could use the technology and provided one-on-one help to

individual teachers. She summed up the main barriers for teachers as a lack of clarity, time to develop new tasks and activities, and a lack of knowledge of what is available coupled with a lack of experience with ICT; for example, blogging and making websites. Kate felt that knowledge and clarity were required in defining what an ICT-rich classroom looks like; teachers need assistance with knowing what is available and what can be done with ICT. She also observed that some teachers were trying to interweave ICT into current units of work in an attempt to use it. The use of ICT requires teachers to do things differently and develop new practices (Somekh 2007).

Each leading teacher was aware of the potential for ICT to transform pedagogy but all acknowledged they had not achieved a learning environment where all teachers used ICT to transform learning, and that a number of factors contributed to his situation. Changing pedagogy was an anticipated outcome of the NSSCF that resulted in significant access to ICT for students. Weston and Bain (2010) concluded that schools continued to provide student access to ICT without a clear picture of how teachers could use ICT to create genuine educational advantage. At School D, Meg noted that the teachers regard ICT as a tool to support learning and, as such, they look for the most appropriate tool.

The identification of barriers highlighted the various factors that impacted teachers and their efforts to utilise ICT; however, it is difficult to examine each barrier in isolation as they are interrelated in many ways. There are interconnected aspects; for example, time to learn a program is often associated with confidence with ICT (Ertmer 1999). Teacher confidence may be impacted by a fear of ICT, not knowing what was available and a lack of exposure to the various programs available. Teacher confidence and teacher mindset were closely aligned.

All leading teachers acknowledged that many teachers do use ICT as a substitute to make learning tasks easier or faster. They recognised that some of their teachers were unsure of what was required and agreed there was an evident lack of clarity around the definition of educationally sound ICT practice. Kevin identified the challenge for teachers as, “What does this mean for what

sort of teacher I am? Which leads to the question – how do I need to change?" Paul observed change was at times "being driven by the students", which was a supportive strategy to help teachers embrace ICT.

There are conflicting views about whether a new approach to pedagogy is required with the introduction of ICT. Beetham and Sharpe (2007) suggest that "far from trying to create pedagogy anew – we should be in the business of locating the new technologies within proven practices" (p. 3). On the other hand, Mishra and Koehler (2006) point out knowledge about technology should be considered with knowledge about teaching and the topic when designing curriculum. They argue that good course design requires an understanding of how technology is used to produce and share knowledge within the discipline. This view is encapsulated in the TPACK model, where consideration of content knowledge, pedagogical knowledge and technical knowledge is required. The use of ICT does change a learning activity, but the extent to which it alters the learning depends on the knowledge and expertise of the teacher and the way in which they choose to incorporate it.

Professional development was a key strategy used by all leading teachers to further support their teachers to use ICT. Creating a supportive ICT learning environment enabled teachers to learn how to use programs and understand how they could be applied in their classrooms. In her school, Kate was able to concentrate on assisting teachers with using ICT to improve learning, as the school was well equipped with ICT devices and her leadership role was to work on improving pedagogy and student outcomes through ICT. It was interesting to compare Meg's experience to the other leading teachers, as the teachers she worked with came to the school with a level of ICT expertise. In her opinion, "you would not apply to come to this school if you were not competent with ICT". Despite this, the teachers she worked with continued to require professional learning support – a point made by Phelps and Graham (2013), who acknowledge that even those teachers who are using current ICT will need to adapt and change. They suggest a key strategy for change is the development of teacher attitudes, values and beliefs to foster confidence and openness to ongoing learning, along with an acceptance of the need for change.

The information gained from this series of interviews provided an overview of the factors that impacted teachers' use of ICT. The view of the role of technology has changed; it is much broader, as illustrated by Meg's comment that "it's completely unrealistic to think you can educate and work today without technology". The data also provided a picture of ICT use within each school setting, which reinforced the notion that ICT is a tool that can enrich the teaching and learning process and is an ongoing process as technology continues to change. Bitner and Bitner (2002) suggest it is the attitude and skill set of teachers that impact the success of ICT integration in the classroom. They suggest that when teachers have a skill set, they then look for ways to utilise ICT within their classes. An important consideration is creating an environment for change with a focus on pedagogy. It is not simply a matter of providing more time or more professional development.

As each school was recognised for their ICT program, they had already worked through the process of introducing ICT and it became apparent that a clear sense of purpose and clarity on this process is required to support staff in the change (Bain & Weston 2012; Moersch 2014). Whitehead, Jenson and Boschee (2013) suggest teachers need to understand modern technological pedagogies that are consistent with the educational technological classroom. The need to develop an increased understanding of ICT as part of the bigger teaching and learning agenda and expose teachers to effective ICT classroom practice appear to be key elements for success, along with a support process for teachers. Moersch (2014) suggests the promotion of digital age best practices as a strategy, whereas Bain and Weston (2012) believe a new shared vision is essential. In turn, Phelps and Graham (2013) propose a whole-school metacognitive approach. To address the barriers identified, support for teachers should include a range of targeted professional learning to address teacher needs, the provision of time and ensuring that ICT works.

This quality phase was used to affirm and identify the existence of issues that impact the use of ICT in the secondary school setting and to assist in the development of questions for the next stage of the research. While it is apparent from this interview data that a number of barriers impact teachers, it is

also apparent that teachers are the key to bringing about change. The ability to identify and understand the obstacles that impact teachers is a necessary step in providing a foundation for change (Moersch 2014). It is also necessary to address potential problems before they become obstacles and impact the change process. Moersch believes teacher capacity can be developed through building upon teachers' current skills and knowledge. He also suggests the change process often fails because the change is on the innovation (in this case, ICT) not the individual. To realise the potential of ICT in schools, a focus is required not on the technology as such, but more on how school leaders and teachers adopt and apply ICT (Hess & Saxberg 2014). The role of ICT has to be part of the teaching and learning agenda and not dealt with in isolation.

4.5 Conclusion

This chapter examined the data collected from a series of interviews conducted at four schools recognised for their use of ICT. The leading teachers provided an overview of the extent to which teachers within their school utilised ICT to support student learning and the effective strategies they used to assist teachers in increasing the use of ICT to underpin student learning. The interviews provided an insight into the issues that impacted the teachers.

The leading teachers identified similar barriers that impacted teachers' efforts to embed ICT. In addition, the leading teachers supported classroom teachers in a variey of ways, for example, professional learning, making time available in meetings for ICT learning, and working with individual teachers. Teachers not having a clear picture of an ICT-rich classroom, adapting to change and understanding ICT pedagogy were impeding factors. The identification of barriers is a strategy schools could use to then minimise or eliminate them

The information gained was used to inform the next stage of the research which involved interviewing classroom teachers within one secondary school to explore their attitude to and use of ICT to underpin student learning. The work with classroom teachers aimed to further identify and clarify the barriers that

impacted their use of ICT, which in turn would inform the development of a model to support the integration of ICT to underpin student learning.

Chapter 5: Phase Two – Teacher interviews

5.1 Introduction

Phase Two of this research consisted of two parts: interviews involving teachers from the research setting and an action research component. This chapter is limited to the first part. It describes the research setting, provides an overview of the teacher participants, outlines the interview process and discusses the interview data. The interview stage was conducted to establish the extent to which teachers at this school could identify perceived barriers to their use of ICT to underpin student learning.

Research was used to find what the various factors affecting the problem were and whether these factors are interrelated. Explanatory and analytic research strategies were used to attempt to identify the cause of the problem and to 'delve deeper' into the issues.

5.2 Description of the research setting

The interviews and action research were conducted at an inner western metropolitan Melbourne suburban school. The school is a small multicultural single gender secondary college with approximately 250 students across years 7–12. It is regarded as a low socioeconomic school. The level of social disadvantage is measured through the Student Family Occupation and Education (SFOE) index, which is a combination of the occupation and level of education of the parents (DET 2017). The teaching staff comprises 23 teachers, some of whom work part-time. The staff profile for the research setting was predominantly experienced female educators. The nine teachers interviewed included seven females and two males. The years of teaching experience within the group ranged from seven years to 38 years in the classroom, with eight of the nine teachers interviewed being quite experienced, with 20-plus years of teaching.

5.3 Interview participants

Each participant was provided with a pseudonym to maintain confidentiality. Table 3 provides background information about each participant in relation to their years of teaching, area of teaching and how they regard themselves in relation to their use of ICT. During the interview, each participant was asked to rate themselves in terms of their proficiency with ICT. The request for each participant to provide their opinion about how they perceived their level of expertise was not based on any scale and was there to provide a rich picture of each participant. It also provided an overview for the interviewer of how each participant perceived themselves and their level of ICT expertise. It may have assisted in shaping questions as the need for follow-up questions arose during interviews. The teachers are listed according to their self-rated level of expertise.

Table 3: Background information about each participant

Name	Years of experience	Teaching method	Expertise self-rating
Sue	20	Mathematics, Science	Basic
Olivia	25	English, Music, Textiles Humanities, Italian	Fair
Carmel	25+	English, English as an Additional Language, Italian	Average
Sally	25	English, Humanities	Average
Janet	25+	English, Psychology, English as an Additional Language	Developing
Pam	30+	Visual Arts	Developing
Joanne	25+	English, Humanities	Reasonably competent
Joe	25+	Mathematics, Science	Competent
Guy	7	Mathematics, Science	Proficient

5.4 Summary findings from each interview

5.4.1 Sue

To support her role as a teacher, Sue uses ICT as an organisational tool; she uses Schoology for her curriculum units and accesses ‘warm up’ activities from online sites along with interactive programs and simulations. Students in her class use ICT to access their work on Schoology, to work on Mathletics, to record notes and conduct research. Sue finds ICT allows her to provide a range of experiences for students and it is a way to reinforce learning. “I think it really opens up the classroom and it is certainly a way of giving them experiences that they wouldn’t otherwise have as well as trying to get them more interested in what we’re doing.”

Sue identifies the lack of technology support as a barrier to the implementation of ICT; not having programs installed, or having problems with the program working effectively and not having a staff member available to fix the problem. Time is also a factor; time to find appropriate material, work through it, and decide how it will support the learning in the classroom. Sue says she often finds material by accident “then having the time to have a play with it so that you’re then confident to take it into the classroom or … to have a think about what it is and how you can then bring it into the structure of the lesson”. She also commented on time for professional development, “where there is an opportunity to share ideas would be a benefit”.

Student access to ICT is a concern for Sue, as not all students have a netbook 24/7, some students are on a ‘day program’ which does not allow them to take their netbook home and, as a result, the students cannot access homework. Sue also mentioned problems with student netbooks from time to time mean that not all students have their netbook in class each lesson. Another concern is the lack of funding to purchase more resources and for membership to access other sites; this would further enhance her ICT use and her teaching.

Sue commented that she has to plan her lessons differently, as ICT changes the way you teach; she feels she is more a facilitator rather than standing up

the front of the class and directing the learning. “I think it, it sort of changes the way you teach. I suppose … it’s relying on you more as a facilitator, than standing up the front and imparting the education. Which means you do have to plan your lessons in a different way because it’s … you know you’ve got your list of skills that they need to come away with”. She also noted that the students have to learn differently in this environment, but she finds this learning environment quite exciting.

5.4.2 Olivia

A range of ICT was used by Olivia to support student learning in her language classes. She used ICT for interactive language programs, online tests, YouTube videos and design applications. Students used ICT to participate in a range of interactive programs, complete online tests, undertake research and create PowerPoint presentations. She regarded ICT as an essential inclusion to the classroom and rated herself as a ‘fair’ user of ICT.

For Olivia the barriers were a lack of time – time to learn the programs and increase her self-confidence before introducing programs to students. She would like more time and more knowledge. Olivia also mentioned the speed of the internet and connectivity issues as factors that had affected classroom learning. In addition, each student not having a working computer every lesson added to her frustration, as students had to share or she had to provide alternative arrangements. Another frustration was when students lost their work, usually because of a technical problem.

5.4.3 Carmel

In Carmel’s classes, the students used a range of ICT, including the program Language Online, online dictionaries, PowerPoint and Movie Maker. Carmel felt “ICT in the classroom is really good as it is engaging, very visual and provides an element of fun and the students enjoy it. It allows students to produce work that looks very professional and in terms of learning a language, the programs have the capacity to equate with one-to-one tutoring”. However, there are aspects that she does not like; for example, she thinks looking up a word in the

dictionary provides more thinking and learning as opposed to looking it up on the computer. She does not like it when students use Google Translate, as the translations are not always accurate, and when students use the program they do not always have an understanding of what they have accessed and used.

Carmel would like to do more training and have more knowledge so that she is more confident and competent. The frustrations she noted were when the technology was not working and when students had not brought their netbook or USB (data storage device). She also mentioned time as a barrier, namely time to learn new ways of doing things.

Carmel expressed a range of concerns in relation to student use of ICT in a more general sense. For instance, she feels there is an element of time wasting when students are involved in research activities, and she would not like to see students work on the computer all day as she has concerns about the impact on their eyesight and their social development. She also feels there is not sufficient variation in learning styles if students use computers the whole time. Also, in her opinion, students are losing the art of handwriting.

5.4.4 Sally

As a teacher, Sally uses ICT in a range of ways; for example, to send emails, to make tables, a class Facebook communication page, for student reports and for planning ‘flipped classes’. The students in her classes use ICT for research, to download class materials, to create their own notes and projects, to prepare PowerPoints, to view online videos and YouTube, to listen to TED Talk clips, to produce videos, for interactive workshops and to email their work. Problems identified by Sally in relation to using ICT in her classes included technical issues such as not all students having their netbook due to technical problems, the internet not working, or sites she wants to use being blocked by the school.

Factors that impact on Sally’s ability to utilise ICT more are time (time to look for materials, time to prepare videos of her teaching); and a fear factor (fear of ICT and feeling that she does not have enough knowledge). She also mentioned a need to use and re-use a program to become familiar with it and confident to

use it in class. She would like one-to-one professional development, as it would be more targeted to her needs and this would allow her to work through ICT programs with support. Sally would also like to do class visits to expand her knowledge and see how other teachers utilise ICT.

Sally believes that ICT is something she needs to embrace: "as teachers of 21st Century we need to create ICT-savvy learners … it should be incorporated into the good delivery of a lesson" and "it's valuable because it makes our students holistic learners and global learners". Sally also made very pertinent points about her role as a teacher: "I should be the facilitator rather than just the instructor". However, she believes "ICT should enhance classroom teaching, it shouldn't be the dominator". Sally feels she needs to change "the way we teach to engage students … it's more about engagement … students have to be able to use ICT and different forms of ICT too, to live and exist". She used PayPass as an example of how she had adapted and embraced ICT. Sally acknowledged she has room to improve her use of ICT but felt she was always in "catch up" mode.

5.4.5 Janet

From her interview transcript it was evident Janet used ICT for presentations and YouTube videos, while students in her class used ICT for note taking, conducting surveys, Polycom conferencing, tests, quizzes and research. The barriers she identified were time – time to plan, time to learn new programs and time to set up the technology. She also identified a lack of technical support to assist with set up and the unreliability of the technology at times as issues that affected her.

In reference to her use of ICT, Janet felt she was in the Technology Revolution, in a similar manner to the Industrial Revolution, but she is yet to come to terms with it. She prefers books, as she trusts that people have taken time to write a book, it has been edited and it is in hard copy, whereas she has doubts about the authenticity of information online. In addition, Janet felt there was not enough synthesising of information from a range of sources when students used ICT. Janet also finds the constant curriculum change a frustration, along

with the demands of the curriculum framework. Janet highlighted the need to be vigilant in class and monitor what students were doing on their devices, as the students were often distracted. To improve her use of ICT, Janet would like to see demonstrations of how applications and programs are used in subject areas and have access to guided support in using programs and applications.

5.4.6 Pam

The students in Pam's classes used ICT for research, for producing mind maps, word processing, submitting work, digital cameras for photography, making films and video presentations. She felt ICT should be used to enhance or enrich what you are doing in the classroom. Pam accepted that ICT has to come into the classroom: "it is ignoring reality if we don't have it integrated in the classroom". However, Pam voiced her concern that students' experiences in life are not authentic; they watch things onscreen and think they have experienced it. Another concern expressed by Pam was the constant need to monitor students to ensure they are on task. They look at so much material that is not relevant to the task set and often look at unrelated sites.

The issues for Pam include the need for students to learn critical analysis, as she regarded this as an essential skill to enable them to distinguish between meaningful, worthwhile information and irrelevant material. Pam would like technical support and more exposure to what is available to enhance learning in her subject area: "you can't teach what you don't know. So, exposure …". In addition, she would like more support when learning programs, and technical assistance in the classroom when implementing new learning, so that technicians can attend to problems when they arise. For Pam, not knowing what is available and insufficient time to find out what is available is an issue.

5.4.7 Joanne

Joanne regards herself as a reasonably competent user of ICT and uses a range of ICT to support her role as a teacher. She has a positive attitude towards ICT, as demonstrated by her comment, "I think it's a necessary progression in education and I think it has fantastic applications. It can be

absolutely great. But it's a tool that's there to be used … and it's a tool that we've got to use because it's a current world reality". She uses the learning platform Schoology for her students to access the curriculum, Notebook to prepare class materials and to record student achievement, and Accelerus for student reporting. In her classes, the students use ICT for research, accessing classwork, preparing PowerPoints, submitting their work, viewing video clips, and online journal and record-keeping. Joanne regards ICT as a necessary progression in education; it is a tool to support education and the challenge is how we use ICT.

Joanne would like to use different programs like eduCanon (an application available to teachers to enhance 'flipped' classroom lessons) and Google Docs but this takes time and it would be good to be shown how to do it, and to have someone with expertise support her in learning new programs. She wanted time to learn programs and ongoing support so that the learning is embedded and she has the confidence to use each program. Another factor that affected her classes was students not bringing their netbooks to class. Joanne made an interesting observation in relation to her senior students; she mentioned some students at the senior end of the school expressed a desire to work on assignment sheets or copy notes from the board.

> Year 11, they remember a time when there were no netbooks, and some of them ask, 'Why do we have these? Why don't we just get a textbook? Why don't we have a textbook? Why do we have to have …?' Some of them, a few of them actually have consciously resisted having to type everything up or to using the netbook. They like them (netbooks) to do their, do their own searches and stuff but they don't want to do any school work on them.

Joanne explained that in her subject area there is a need to research current issues, which sometimes requires a bit of effort, as students need to glean information from different sources; however, she does not think the students are very skilled in this area.

In going forward, Joanne would like to see all teachers use the same learning platform and have the platform open to parents. This would require a change to school policy. The challenge is to use ICT to promote thinking and a higher level of learning and to create realistic learning experiences. She was adamant that we cannot use ICT in the same ways we have used written materials.

5.4.8 Joe

Joe was positive about the use of ICT in the classroom; he thinks it is motivating and allows for multiple approaches to a topic. He recognises that he takes a lot of time to learn new skills on the computer, as he is not as intuitive as some others are. He uses a wide variety of programs with students such as Mathletics, Type with Me, GeoGebra and Stellarium, and chemical simulation programs. Joe utilises FUSE, the suite of programs provided by the Department of Education and Training to support his science classes. In addition, his students use ICT for word processing, sketching graphs and recording data (Excel) and for research.

One of the barriers for Joe was time. Even though he utilised the units from the Department's FUSE site he felt he still required time to preview the modules and develop them into a unit that he was confident with and that met all the learning outcomes. In addition, he would like more time to become familiar with the functions of each program so that he can provide clear instructions to students and manage each lesson better. He expressed the need for time as, "I actually need more time to myself to actually be familiar with the programs. I'd like to be trained about them too, yeah definitely, what works in other schools and what works here for other teachers. Like to see what they're using it for". Other factors affecting Joe included the difficulty in accessing technical support; it was frustrating when projectors were broken or needed maintenance and the time required to have them serviced.

Joe finds the changes within ICT frustrating. Upgrades of programs present problems when the teacher has a different version of the program than the students. Also, he feels things become redundant quickly and he questions whether the time spent learning a program was worthwhile. Moving within the

school from one system to another, for example, from Endnote to Schoology, required new learning and was time-consuming.

Joe mentioned a number of problems he encountered when he incorporated ICT. Students had technical issues with their netbooks and experienced delays in getting repairs done, thus they often did not have their netbook in class. When he used electronic textbooks, they were not working effectively on all netbooks and they were not available offline. At times he found the teacher version of the electronic textbook was difficult to navigate and the display settings presented problems. In his opinion, technical support was required to ensure these problems were fixed in a timely manner.

5.4.9 Guy

As elearning coordinator, Guy was quite confident and skilled in using ICT. In this role he regularly delivered professional development to colleagues and assisted with training for the learning management systems used for electronic roll marking and reporting. He also supported teachers with the use of learning platforms such as Schoology and Edmodo. Guy is very clear that there has to be a purpose behind the use of ICT and it needs to enhance student learning. He believes all of his units have some element of ICT. In planning his units of work, he tends to ask how ICT can enhance learning. He feels his use of ICT is not a conscious thing but rather just a way of doing things. His interview transcript revealed his students use ICT to research, collaborate, create, communicate and present.

Technical issues impacted Guy's ability to further utilise ICT. He mentioned that having a system that is "locked down" so that no one could add new programs presented a problem, as "you become reliant on the technical support and if they are too busy it impacts on what you want to do. If you get a program onto the student netbooks but an upgrade wipes off the program … that can hold up your teaching". Guy also mentioned the program that allows teachers to see what is on each student's screen and the frustration of it not always working due to problems as a result of technical upgrades. Teachers need to trust students are doing the correct thing. In addition, he noted that hardware could

be a problem; for example, the battery life of a three-year-old netbook does not always last through the school day.

Students not bringing their netbooks to class, for a range of reasons, was a frustration for Guy. In his classes, if the students do not have their netbook they cannot engage in the learning. He also mentioned he would like to move towards electronic workbooks but there have been problems. Another factor Guy mentioned was time. He feels a lack of time limits his ability to increase his use of ICT; he felt he could do more in terms of collaboration across schools, including internationally, if he had more time. For him, time is the biggest issue – time to research and time to visit other schools and attend professional development activities. As a teacher with a higher level of ICT experience, Guy mentioned that not having administration rights to install programs was another barrier he had to contend with. He also identified issues such as the length of time it takes for students to have their netbooks returned after reporting problems.

Through his ICT support role, Guy was able to provide a view about other teachers' approaches to ICT and the problems they encounter. Guy commented that the relationship that teachers have with students is something that can influence the effectiveness of ICT in the classroom. In his opinion, teachers who have a more authoritarian approach tend to be "knowledge keepers" and he believes this is not appropriate or manageable as there is so much information out there. He sees confidence as an issue for many people. He enjoys working things out when he is confronted with a difficulty but, in his opinion, some teachers rely on other staff members to solve the problem for them.

5.5 Results

5.5.1 Development of themes

The interview transcripts were imported into NVivo to commence the identification of factors that impact teacher use of ICT. In addition, each interview was read a number of times to further analyse the data and confirm the teacher concerns. Themes were developed using the comments teachers reported as factors that affected their use of ICT and the number of times each factor was mentioned influenced the development of each theme. The themes that emerged were teacher confidence, professional development, technical issues, student issues and time. Another category was created to capture interesting points the teachers made; this was listed as observations.

Table 4: Emergent themes

Theme	Teacher comments related to perceived barriers
Teacher confidence	– Lack of confidence (x 5)
Professional development	– More training to increase confidence and competence – Insufficient guided support in using programs and applications – Limited awareness of how applications and programs are used in subject areas – Insufficient demonstrations and one-to-one support – Require more exposure to ICT for my learning area – Need to be shown how to use ICT – Lack of support to learn new programs (x 2) – Need to be knowledgeable about the skill rather than the knowledge – Want more training and more knowledge
Technical issues	– Technology is often not working – System locked down so cannot add programs (x 2) – Netbook upgrades often delete programs on student netbooks and staff not aware (x 2) – Limited availability of technical support (x 2) – Need to rely on technical staff to do things – Battery life of staff and student netbooks is a problem – Programs often not working – Hardware and software issues – Teachers do not have administration rights – Technology often unreliable – Lack of support to assist with set up of technology (x 2) – Technical issues with ebooks – Insufficient technician time to repair, service and maintain equipment

Theme	Teacher comments related to perceived barriers
	– Internet speed and connectivity
Student issues	– Students not bringing netbook to class (x 6) – Students often distracted by social media (x 2) – Senior students reluctant to transition to ICT – Students losing their work usually due to technical problems – Concern that not all students have access to ICT after school hours – There are some students who really don't like ICT
Time	– Students waste time when doing research – Time to learn new ways of doing things (x 4) – Insufficient time to increase use of ICT (x 2) – Need time to research, visit other schools (x 2) and attend professional development (x 3) – Length of time it takes for student repairs (x 2) – Time to set up the technology for use in class – Time to plan (x 2) – Time to learn new programs (x 3) – Feeling that time learning a system is wasted when a new system is adopted; e.g. changing from Endnote to Schoology – Need time to see what is available to support learning in subject area
Observations	– Teachers' approach to teaching the class, the authoritarian approach reflects the keeper of the knowledge, which is not suited to ICT learning – The students really enjoy it and that engages them – Excellent for movie making and presentations – It opens up the classroom and provides experiences the students may not have access to otherwise – Constant curriculum change and demands of curriculum framework – Staff using different platforms – Teachers do not have a 'figure it out' mindset and rely on others to fix their problem – Changes you to be a facilitator rather than standing up the front and imparting the education (x 2) – Issues with authenticity; e.g. students watch things on screen and think they have experienced it – Lack of clarity around ICT – Lack of funds to purchase more ICT and subscriptions to sites (x 2)

Teacher confidence

Five of the nine teachers interviewed listed confidence as a factor that affected their use of ICT in the classroom. Carmel, Olivia and Sally all mentioned the need to have time to learn new programs, as they felt that would increase their knowledge and self-confidence. Confidence was mentioned in conjunction with the time and professional development categories; teachers commented that if

they had more time to attend professional learning sessions and time to learn programs and receive more training, their confidence would increase. Sally also mentioned an increase in confidence would minimise her level of fear when using ICT.

Professional development

The majority of teachers wanted more training to increase their confidence, knowledge and competency. Teachers reported there was insufficient support to learn new programs and various applications. Two teachers felt there was insufficient exposure to ICT for specific subject areas and a lack of explanations in relation to how applications and programs could be used in each subject area. Other teachers wanted to be shown how to use ICT, have time to learn the program and then have ongoing support in the classroom while using it to make sure the lesson ran smoothly. Olivia expressed her concerns about not knowing what was available in her curriculum area, and experiencing insufficient exposure to available ICT to support the learning in her classes. Likewise, Pam wanted exposure to what was available for her to use. A lack of time to research along with a lack of support when learning and implementing new programs affected her use of ICT. Sally noted insufficient one-to-one support.

The teachers would like professional development to learn new programs, see more demonstrations and have one-to-one or guided support to learn how to use ICT programs and applications. One teacher expressed a need to be shown how to use ICT, as this was the way she learnt. Two teachers suggested visits to colleagues' classes or to other schools as an appropriate form of professional development. Sally would like visits to other teachers' classes while Guy would like to visit other schools.

Technical issues

Technical issues proved a frustration for all of the teachers interviewed, as the most concerns were registered in this category. School infrastructure issues, technical support issues and student netbook issues were grouped as technical issues. School infrastructure issues included a slow internet, the internet

connection not working, the system being locked down so teachers could not add or access certain programs, through to program upgrades which resulted in students and teachers having different versions of a program on their netbooks. Technical issues covered a lack of technician support, the ICT not working when the teacher wanted to use it, through to teacher inability to install programs as the 'locked' network system prevented them from adding programs to the network.

Hardware issues included the limited battery life of netbooks for both staff and students, maintenance schedules impacting use of equipment and broken data projectors. The students are issued with a school netbook as part of a three year replacement cycle. Each problem with a netbook is reviewed by the technician to determine if it is a warranty issue or student damage. Software concerns included technical issues with ebooks, internet speed and connectivity and unreliable technology.

All nine teachers reported hardware and software issues. Five teachers mentioned a lack of technical support. Technical support within the school was provided by ICT technicians and teachers with responsibility for ICT learning. It was evident that teachers were reliant on the technicians to fix many of their problems, and they indicated there was limited technical support available to support them. Two teachers felt there was a lack of support to assist with the setting up of technology in the classroom. They also mentioned insufficient time available to technicians for repair, service and maintenance of equipment. At this school the ICT technician worked part-time and responded to student and staff concerns as they were reported. The majority of the time was spent on repairs, however classroom ICT support could be requested.

The teachers mentioned their frustration when hardware problems were not fixed in a timely manner as this impacted the delivery of their lessons. For example, data projectors (Joe) and the time students were without a netbook when it went in for repair (Olivia, Carmel, Joe). Joe also mentioned the time spent learning new programs that were superseded or became redundant within a short time frame. Two teachers mentioned that netbook upgrades often

deleted programs on the student netbooks and, as teachers were not aware of this, the program was not available to deliver their planned lessons. It was apparent all teachers felt more technician time would allow their problems to be solved quicker.

All teachers expressed their frustration when the time put into planning the lesson was wasted if the ICT did not work. When a technical problem arose in class that the teachers were unable to solve, it often prevented the delivery of the lesson and a revised strategy was required. Two teachers wanted technical support in the classroom when first implementing a program, to eliminate any initial problems and ensure the lesson could proceed with all students accessing the ICT. In acknowledging teacher frustration, Whitehead, Jenson and Boschee (2013) put forward the view that "educators need to embrace the opportunities and try to be creative in working through the frustrations because the educational reality is that 21st century learning is really not a choice" (p.118).

Student issues

Some of the student issues included in this section could also be regarded as technical issues, but it remains a separate category, as the students hold some responsibility for the creation of these perceived barriers. Seven of the nine teachers mentioned students not having their netbook in class was a barrier. When planning lessons that required the use of ICT, teachers anticipated that all students would have their netbook with them in class; however, this was not always the case. The reasons why students did not bring their netbook varied from left at home, left in their locker, netbook was not working, or they forgot to charge it overnight. At times students had a technical problem so the netbook was with the technician for repair. Other issues related to students included students losing their work, usually due to technical problems or not saving it properly, or they did not bring their USB with their work on it.

Sue expressed her concern that not all students had full access to ICT, as they were on a 'day program' or did not have their netbook as they had not paid for damage. This impacted student learning in her classes. Students could not access the learning if they did not have their netbook or, alternatively, she

would have to plan another task. The use of ICT in classes often extended to homework activities that required the use of the netbook or the internet, and some students were not permitted to take the netbook home.

Three teachers expressed concern about the inappropriate ways some students used ICT during classes. Two teachers commented that ICT was a distraction in class as some students were emailing each other or viewing sites unrelated to the classwork rather than completing the classwork. Carmel commented there was a lot of time wasting occurring when students were asked to engage in a research activity.

Time

All teachers listed time as a factor that affected their use of ICT in the classroom; however, the reasons they felt they needed more time varied. Teachers wanted time to plan, to learn new programs and to attend professional development. They also wanted time to set up the technology (e.g. the Polycom for conferencing), time to visit other schools and time to learn new ways of doing things. Janet felt having “time to play around” and “time to plan” was essential. All the teachers commented that if they had more time to learn new programs or attend professional development they would be able to increase their use of ICT to support student learning.

Joe wanted time to meet with the technician, time to design modules and time to set up the ICT and the equipment for class. Olivia commented that a program needs to be useful within her subject and she needs time to gauge its usefulness and to become familiar with its functionality. Thus, time to research programs and see how ICT might be used in class was an important consideration for her. This view is reinforced by Sally, who commented that using ICT has to be both effective and time efficient. However, there was a feeling that time learning a system is wasted when an upgrade occurs or a new system is adopted; for example, changing from Endnote to Schoology. Likewise, Joe experienced problems when upgrades deleted programs or provided a different version on his netbook to the one students were using.

Students wasting time was also included in this category. Pam noted students often wasted time in class when asked to do tasks on the computer; they were not doing the research asked of them, as they were found to be distracted on unrelated sites or were emailing each other. Carmel also mentioned students often wasted time when doing research. The time for technical repairs to student netbooks was mentioned. This impacted classes and student learning as the students did not have access to ICT while their netbook was in for repair.

Observations

During each interview, the teachers made a number of interesting comments related to the use of ICT. These comments were captured within this category. The comments cover a range of concerns, some student focused and some teacher focused. For example, Guy was of the opinion that teachers "with a more authoritarian approach tend to be the knowledge keepers and this is not appropriate or manageable as there is so much information out there". In his opinion, this approach is not appropriate in a knowledge-rich environment.

While Carmel commented on the specific barriers she experienced, she was able to see ICT in a broader sense, as demonstrated by her comments regarding the length of time students would be required to use ICT in a day and a lack of variation in student learning styles. Also, in her opinion, the use of Google Translate did not further student learning. However, despite these reservations, Carmel acknowledged that the students "know more because they're on the computer, they grew up with computers … which is good, because sometimes I get them to teach me things and teach each other things". This demonstrates Carmel's willingness to learn from the students.

Student use of computers was a concern for some teachers, as some students were distracted online while others did not bring their netbooks to class. Joanne felt she did not have the expertise to ensure the learning tasks delivered with ICT allowed for higher order thinking. Pam felt there was not enough synthesising of information from a range of sources. Sally made an interesting comment about her senior students transitioning to ICT learning; she observed that her students tended to copy notes from the board rather than photograph

them and they often requested paper assignment sheets rather than access them online. Likewise, Sally noted her senior students were reluctant to transition to ICT, with some students wanting to handwrite their notes.

Sue noted that students have to learn differently in this environment, but she finds this learning environment quite exciting. She says she has to plan her lessons differently as ICT changes the way you teach; she feels she is more a facilitator, rather than standing up the front and controlling the learning. Sally commented that as a 21st Century teacher, it was her responsibility to create "ICT savvy leaners, as a teacher she has a responsibility to create 21st Century learners, students have to be able to use different forms of ICT to live and exist". As a result, she wants to "make learning in the classroom relevant and to have a set purpose" and she feels she can achieve this with ICT, so that students are engaged and active learners. Joe felt there was a lack of clear vision about what a fully integrated ICT classroom looks like. He would like a better view of where education is going with the addition of ICT.

Janet uses ICT in her classes in a number of ways and regards it as a fundamental tool; she accepts that it is inevitable. However, she expressed a preference for books, as she has doubts about the authenticity of information online and trusts that people have taken time to write a book, it has been edited, and it is in hard copy. This personal preference does not detract from her use of ICT but it does illustrates the different mindset between this teacher and other teachers and students.

In summary, the teachers acknowledged that ICT is the way forward and they need to adapt their teaching to incorporate ICT. Each teacher reported using ICT within their classes, and the range of ICT and the ways it was used varied considerably. However, each teacher could clearly identify factors that affected their use of ICT and a level of frustration was evident when their attempts to incorporate ICT were not successful. In addition, it was evident that some teachers did not have a clear picture of the ICT available in their learning area and how it would improve their teaching and student learning.

5.6 Discussion

From this interview phase it was evident that each teacher was willing to use ICT and could provide examples of the variety of ways they had used ICT in their classes. The level of ICT experience and teacher competence differed, with two teachers rating themselves as basic and fair users, two as average, two as developing and three as competent. However, the examples of ICT use described by each teacher indicated a greater level of competence and understanding of the role of ICT to underpin student learning, For example, Sue commented that ICT engages students and broadens their learning experiences, and it allows her to provide for differentiated learning within her classroom. Each teacher also appeared to understand that the focus should not be on the ICT as such but on how it can be used to support and improve student learning.

It was clear that a range of factors impacted their efforts to utilise ICT and this created a level of frustration. Teacher confidence, technical issues and professional learning were themes consistent with the results from Phase One. All teachers believed that with the provision of more time, with professional development and the elimination of technical issues, they could increase their use of ICT. More exposure to the use of various programs within each curriculum area could increase their use of ICT.

The nine teachers all had varying levels of ICT experience and expertise; however, they all agreed time was a factor that impacted them furthering their use of ICT. They mentioned the need for additional time to attend professional development, receive individual support, to see what was available and to learn how to use new programs would be beneficial. In their opinion, there was a direct correlation between additional time and an increase in their skill level, knowledge and confidence, which they felt could be achieved through professional development. The links between confidence, fear, professional learning and time all indicate issues emanating from each teacher's personal concerns. The teachers indicated if they had more planning time and more time

for professional learning, their level of fear would decrease and their confidence would increase.

All nine teachers mentioned incidences when their efforts to use ICT were thwarted by technical issues or students not bringing their netbook to class. The teachers were frustrated when ICT did not work or they were unable to solve technical problems. In their opinion, class time was wasted and they experienced feelings of inadequacy as they could not deliver the ICT lesson they had spent time planning. Likewise, when students did not bring their netbook to class, those students could not participate in the planned learning and the teacher needed to make alternate arrangements for them. This view conflicts with the perception that ICT is the way students engage – “they are on it all the time” (Carmel) and we need to “create ICT savvy learners” (Sally).

Janet recognised that ICT was inevitable and is a fundamental tool; however, she felt students were not able to synthesise information from a range of sources. She mentioned the need for students to learn critical analysis so they can distinguish between meaningful, worthwhile information and irrelevant material. Janet also noted that there has to be a purpose behind the use of ICT, with the priority being to enhance student learning. Sue alluded to the change in pedagogy when she commented that “her role as a teacher should be one of a facilitator not just an instructor”. She noted that the use of ICT required students to learn differently and this has changed the way she plans. Sally also commented on her changing role as a teacher to that of facilitator.

There was minimal reference to the link between ICT and pedagogy. Three teachers mentioned the role of ICT in the classroom should be on pedagogy to enhance or enrich what you are doing in the classroom. This highlights a need for teachers to gain more knowledge about pedagogy and ICT and the impact it may have on their perception of their role as a teacher. A clear view of what a 21st Century ICT-rich classroom looks like and how to achieve this could further the use of ICT for most of the teachers interviewed.

It was apparent from the interview transcripts that the teachers were aware of the need to incorporate ICT and realised change is necessary to achieve this.

Eight of the nine teachers indicated they did not know how to bring about the change. It became evident that some guidance in how to achieve the change was necessary. The needs of the teachers varied, so it became evident that not everyone needs the same thing or the same level of support. Bitner and Bitner (2002) suggest teachers in schools with a strong ICT culture are more likely to use ICT to underpin student learning. This is supported by Vrasidas and Glass (2005), who suggested careful collaboration between teachers and expert users within a community that provides continual support along with successful teaching experiences leads to improved ICT integration.

This interview phase provided an overview of the ways in which the teachers used ICT in their classrooms and clearly identified the concerns that teachers felt impacted their efforts when incorporating ICT. A range of appropriate uses that extended beyond substitution was evident as teachers provided various examples of how they had incorporated ICT. There was little evidence of a whole-school approach with consideration of pedagogy and ICT. It appeared that teachers, for the most part, scanned for appropriate ICT as they planned their units.

5.7 Conclusion

A deeper understanding of the factors that affected the teachers' efforts to use ICT was gained from the interviews. All teachers interviewed identified a lack of time to plan and learn programs as the key factor that affected their use of ICT. Additional perceived barriers were identified as confidence, professional development, technical issues and student issues. The interviews also provided an overview of the teachers' attitude towards ICT and the ways in which they had used ICT in their particular subject areas. The teachers also provided interesting comments that enriched the picture of their experiences with ICT in the secondary classroom.

The teachers who participated in the interview phase had varied years of experience and expertise and all had endeavoured to use ICT to enrich learning. However, it was evident that some teachers did not have a clear

picture of how ICT could further enhance their teaching and improve student learning. The challenge is to use ICT to create realistic learning experiences, promote thinking and a higher level of learning. Providing teachers with a greater understanding of 21st Century ICT skills, along with support to develop their skill and expertise with ICT, could further their ability to integrate ICT to support the teaching and learning process.

Chapter 6: Phase Two – Action research

6.1 Introduction

This chapter outlines the action research component of the study. It reports on the findings as the participants worked through two cycles of the action research process. This final stage of investigation involved working closely with a small team of teachers to examine their ICT curriculum planning and classroom practice. The action research allowed an insight into each teacher's approach to incorporating ICT. Participants' reflections of their current practice and the decision-making processes they worked through as they developed and implemented ICT-rich units of work provided further understanding of teacher thinking in relation to ICT. The findings were used to articulate ways in which teachers can be supported to expand their use of ICT and to inform the development of a model to support both schools and teachers in the use of ICT in the digital classroom.

6.1.1 Aims and context

The aim of this component of the research was to improve teacher practice in relation to their use of ICT to engage students and improve learning outcomes. The primary aim of any action research is to improve practice, or to correct something that is not working effectively (Fraenkal & Wallen 2012). This action research allowed for the close examination of the teacher planning process related to the incorporation of ICT. Qualitative data was collected by the participants and the researcher and this was reported in narrative form to capture the human behaviour (Mertler 2014). Data analysis was ongoing throughout the process as the information gained informed the next stage within each cycle of the action research.

All participants in the teacher interview phase of the research were invited to participate in the action research phase, however, only two teachers volunteered, Sally and Joanne. While this was a small number it was

considered worthwhile to proceed, as specific data in relation to the process teachers work through when incorporating ICT could be collected. At the conclusion of the first cycle of research each participant invited a colleague to join the cohort to broaden the research base. The Associate Supervisor attended all meetings to verify the research process, given the researcher was in a position of power at the research setting.

Action research allowed the teacher participants to understand a particular issue within an educational context and to learn more about the issues through action (Koshy 2010). This increased understanding then allowed the participants to make informed decisions in relation to improving their practice. The action research required the participants to direct their attention to ICT and the way they planned for the use of ICT within their classes. Furthermore, it allowed all participants to gain a better understanding of the situations that occurred within their classroom when ICT was used. As they progressed through each cycle, participants were able to collaborate with each other and other stakeholders as knowledge emerged (O'Leary 2004). They were able to implement change to improve their professional practice as they developed their situational understanding, based on their action and critical reflection.

Regular meetings were held during two cycles of action research and discussion provided a rich picture of the participants' decision-making and findings. Journal notes, meeting transcripts and researcher journal reflections were analysed throughout each stage. As reflection is a crucial aspect of the action research process (Mertler 2014), it was an ongoing aspect throughout the action research. Reflection occurred during each stage and throughout each cycle. The opportunity to work closely with participants during meetings and to learn from their journal notes and professional discussion provided an insight into how they approached the use of ICT. In Cycle One, the participants reviewed how they used ICT in their classes and in the process learnt about action research. They observed who was using the ICT and how it was used, and then they designed and implemented an ICT-rich unit of work.

6.2 Cycle One

6.2.1 Plan

The first meeting began with introductions, followed by an outline of the action research process to ensure the participants fully understood action research and what was required of them. A visual representation of the metacognitive approach to technology learning used by Phelps and Graham (2013) was provided to the participants to ensure they were clear about the cyclic nature of action research and the three dimensions that influence technology learning. Discussion of the research question and the findings from the previous interview phase informed this stage of the action research. This reinforced a need to examine how teachers could be further supported to utilise ICT.

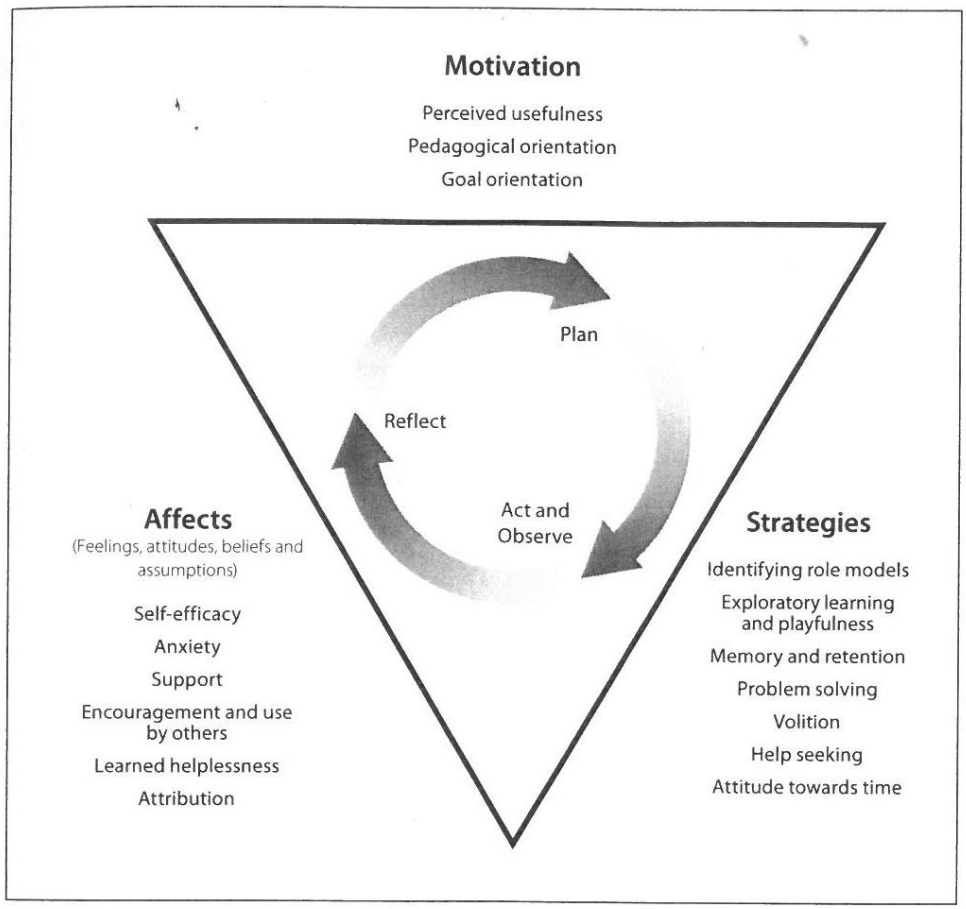

Figure 10: Metacognitive approach to technology learning

(Phelps & Graham 2013)

It was evident from the interview data (Chapter 5) that all teachers felt there were a range of barriers that impacted teachers' ability to use ICT to underpin student learning. In discussing the findings, both Sally and Joanne again expressed a frustration that their efforts to integrate ICT were often not successful because of the problems identified. They wanted support when they encountered problems with ICT and when things did not go to plan. While the participants tended to dwell on the barriers, the intent of the action research was to find how best to support teachers to integrate ICT to underpin student learning.

Sally could articulate the ways in which students used ICT in her class; for example, to capture her board notes, to research and to present their work. For Sally, time was the biggest barrier to her use of ICT; time to see what ICT was available and time to work out how, when and where to use it. She felt there were many demands on her time throughout the school day and that made it difficult to devote time to ICT. Sally also acknowledged her lack of confidence and fear as factors that had impacted her ability to embed ICT in her classes. Other frustrations she mentioned included the technical infrastructure being unreliable and some ICT sites being blocked.

Joanne was an experienced teacher who also held the responsibility for managing the college curriculum in addition to her teaching load. From her interview transcript it was clear she held a positive view about the place of ICT in the classroom. Joanne believes "it's a necessary progression in education and I think it has fantastic applications. It can be absolutely great. But it's a tool that's there to be used … and it's a tool that we've got to use because it's a current world reality". She followed on with, "I think we have a responsibility then, to use that and to look at the research that is currently taking place and to adapt our classrooms to do the best we can". For her, the barriers are time and the frustration with technical issues when learning a new program. Joanne expressed a need for one-to-one support during unit planning.

The participants were asked to record the thinking behind their decisions to use ICT, and actions throughout the action research to share with the researcher.

Options for data collection were considered and clarification provided on what to record in relation to their experiences and observations. The data collection methods discussed included audio recording their observations, writing a reflective journal and participation in a range of agreed actions such as unit planning, implementation and reflection. Participants opted to keep a journal. Sally and Joanne were asked to closely examine what occurred in their classroom in relation to the use of ICT and to record what ICT was used and who was using it – the teacher or the student. They were also asked to note any problems. A template was provided to prompt the generation of journal entry comments. Sally and Joanne agreed the task was a clear and achievable action and was something concrete they could undertake.

This first meeting had a positive tone, with the participants keen to be involved and to further their use of ICT. Throughout the meeting the barriers identified in the teacher interview phase were discussed and became the central point for discussion. Upon reflection, there was too much emphasis placed on the barriers, as there was a need to allow the action research process to unfold and have the participants view what was actually happening in their classes and share what was working for them and how that could be used to inform the development of a model.

6.2.2 Act and observe

The first meetings in this stage commenced with both teachers asking for clarification on the way they recorded their journal notes and affirmation the comments recorded were of use. In reflecting on their current ICT practice, both teachers again mentioned their frustrations in relation to their efforts to incorporate ICT; for example, some students did not have their netbooks. Joanne in particular expressed her annoyance as, in her opinion, the students always seemed to have an excuse for not having their netbooks with them. The ensuing discussion compared this to past experiences where students did not bring the correct books and equipment to class and teachers always needed strategies to deal with that. The problem of students not having their netbook was not as pronounced for Sally, as the senior students tended to use their

phones instead. Both teachers continued to emphasise the barriers that impacted their ability to incorporate ICT.

A number of meetings were held during this stage, and readings were provided to the participants prior to each meeting to stimulate discussion on the use of ICT within education and to direct a focus onto pedagogy and curriculum development. The aim of the readings was to broaden participants' knowledge about ICT in the classroom, challenge their thinking and contribute to their ongoing professional development. The visual model of the metacognitive approach to technology learning (Phelps & Graham 2013) was provided to participants to generate discussion on how learning with ICT occurs. The diagram describes the three influences on teachers' technology learning: motivation, affects and strategies, as identified by Phelps and Graham. The authors suggest the use of this metacognitive approach assists teachers in actively engaging in reflection as a stimulus to change perspectives and behaviours. This model utilises a cyclical learning process that is similar to the action research cycle; however, reflection is regarded as an ongoing action conducted within each stage.

The metacognitive approach included many of the barriers identified in the interview phase of this research; for example, time, anxiety and support. In addition, it provided clarity on motivating factors such as perceived usefulness of ICT and pedagogical orientation. It also identified many of the feelings and attitudes teachers experience such as learned helplessness, anxiety and self-efficacy (Phelps & Graham 2013). In relation to barriers, Sally reiterated she needed time: time to find the appropriate ICT and then time to become familiar and confident in using it. Sally was keen to participate in this project as she wanted to improve her professional practices in relation to ICT and often mentioned, "this is making me learn, making me do it properly".

The ensuing discussion about ICT, curriculum and pedagogy prompted Joanne to suggest having a whole-school approach to the ICT skills students needed at each year level. She thought this would benefit teachers as they could plan units knowing students had skills and expertise with various ICT. If teachers

collaborated to identify the ICT skills needed at each year level and the students were taught the skills it would ensure all students had basic competencies in specific programs and applications. The teachers would then plan to use the ICT they knew the students were familiar with and be confident the students would know how to use it. This approach might reduce teacher fear and encourage ICT use. Joanne believes teachers would be better positioned to articulate the purpose of the ICT within their unit; for example, students use ICT to think, or to process information or to collaborate.

In the following meeting the discussion centred on the role of ICT in the classroom and the attitude of students towards ICT. Joanne felt many of the students regard ICT as entertainment; it is an important aspect of their social engagement, and thus part of the challenge for teachers is to convince students to view ICT as a tool for learning. For Joanne, it was essential that ICT be used to promote higher order thinking and create real-life learning experiences as opposed to using it for "busy work". She also suggested teachers have students use ICT to process information, collaborate and receive feedback. Joanne was of the belief that students "don't necessarily have the skills … to look up factual information or to be able to put that information into a format that other people can make sense of". In her opinion, "we need to decide what we want students to do with ICT and make them adaptable". There was general acceptance from Joanne and Sally of a need for change. They compared the changes in banking due to ICT and the changed nature of how students learn at university and recognised the need to bring change into education.

After Joanne and Sally had reviewed and reflected on the ways in which they currently used ICT in their classes, the next stage was for them to plan and deliver an ICT-rich unit of work. They both chose to modify a current unit of work that addressed the learning identified in the state-wide curriculum framework. Joanne redesigned a Year 8 unit of work to make it completely online; all the learning activities were placed online for students, including the submission of the assessment task. This was a change in practice for Joanne. She was quite involved and very enthusiastic about placing the unit onto

Schoology (a learning management platform). However, the introduction of this unit did not go according to plan due to technical problems.

Joanne reported everything was in place for the delivery of the first class but the students were unable to view the classwork, as teacher access was different to student access, and whilst she could see the work on Schoology, the students could not access it. This meant she had to revert to an alternate activity until the problem was resolved. Joanne was able to discuss the problem with the technician to make sure it was resolved prior to the next lesson.

Sally revised a unit of work for her Year 11 Business Management class. This unit required the students to conduct research and collect information to inform the learning task; she observed students were using their netbooks and phones to find information. Previously, when she had taught this unit, Sally had provided all of the information. She noted the lesson ran smoothly, and students were engaged in the activity and able to find the information she had anticipated to complete the set task. Sally was surprised when one student found a definition that she was not aware of.

On completion of this first unit, Sally was really pleased with both the modified unit and the reaction of the students. She commented that every student was involved in the learning activities during the classes. She observed students who did not have their netbook use their phones to complete the task. She felt the unit was well received by the students and they were able to work in groups to complete the task; two of the student groups actually exceeded her expectations. She acknowledged they were able to work independently and find valuable information to support the task. Sally said she encountered problems during the delivery of her unit; however, she worked through each issue to a find a solution. What she perceived as a barrier was overcome either prior to the lesson or during the lesson. In her opinion, the students used ICT really well to complete the task and achieve the outcomes set. The students performed beyond her expectations in sharing the information electronically. She was pleased with what was achieved but questioned her role or, more so, the lack of a role for herself.

6.2.3 Reflect

This stage of an action research allows for reflective dialogue and learning conversations, where the participants learn from and with each other, which in turn allows for the generation of new ideas and debate about what is important (Scott & Jaffe 1989). In reflecting on her unit, Joanne felt the students were engaged and able to work at their own pace, something she had not achieved when she taught the unit previously. She commented that her teaching was more focused on collaborative learning when using ICT and predominantly involved students working online. She liked the way she had organised the unit and how she used the ICT; however, she was not sure that the students liked this change. This observation prompted discussion about how the teaching needed to change when ICT was introduced.

Upon completion of the delivery of their units, Sally and Joanne reflected on the overall success of the way the students responded to the ICT. Individually, they recorded their observations and thoughts in relation to student attitude, quality of work, problems and successes, and reflected on the general teaching and learning throughout each lesson of the unit. In particular they noted the way in which they taught the unit, the students' responses to the task and their experience with ICT during each lesson. Both teachers noted that their modified units appeared successful, as the students were engaged in the learning and could easily use the ICT to complete the work.

A reading on the TPACK model (Koehler & Mishra 2009) was distributed to generate discussion on the specific areas of planning with ICT. This model specifically addresses curriculum planning and clearly illustrates the interconnections between content knowledge, technical knowledge and pedagogical knowledge, bringing all aspects into consideration when planning curriculum. The participants could see the interrelated aspects of the model but showed little interest in working with it as a guide. Both Joanne and Sally commenced their planning using state-wide curriculum framework documents which identified the curriculum content. They then looked for appropriate ICT to support the delivery and enhance the learning they planned around the content.

Sally worked on the development of two units during this cycle; she commented that “finding ways to incorporate ICT was a way of challenging herself to use ICT to enhance her units”. She was pleased with the way students were engaged in the first unit she developed and delivered, but found it difficult to incorporate ICT into the second unit. While she explored a range of options, she felt the learning task did not lend itself to ICT and she did not want to use it just for the sake of it.

Throughout this cycle the participants were enthusiastic and appeared to enjoy the opportunity to discuss their experiences and classroom practice. However, Sally demonstrated a conflicted view about her role as the teacher; she made an interesting comment about “not being the teacher”. She felt she was not teaching but, rather, facilitating, and she seemed to intimate that somehow she was not doing her job. She gave the impression that being a facilitator was a lesser role. This view reflected her discomfort with the changing nature of teaching with the addition of ICT. Sally’s reflection on her practice was enlightening in relation to the thinking and decision-making that impacts teacher use of ICT. Her view is consistent with comments made by the leading teachers in the quality phase, where they noted that some teachers feel their role is diminished and they lose their ‘uniqueness’ as a teacher.

6.2.4 Discussion

From the transcripts of each meeting, participant journal notes and researcher observations, there was an evident willingness from participants to be involved in expanding their use of ICT. Both teachers commented on the way their teaching had changed and their increased awareness of the ways students use the ICT, and this subsequently became the focus for the next cycle. The Phelps and Graham (2013) metacognitive model was a good guide for teachers, as it identified the experiences, strategies, feelings and attitudes that were likely to be experienced by teachers as they integrated ICT. In examining this model, the participants could see the range of factors that affected teachers throughout the change process. Considering this model helped guide the participants to reflect on their values, attitudes and beliefs in relation to the pedagogical

potential of ICT, and to consider how ICT could transform their teaching (Phelps & Graham 2013). It appears the mindset of the teacher impacts the way teachers approach the use of ICT in the classroom.

It became apparent from the discussion throughout this cycle that the focus had started to move away from problems and barriers onto effective strategies. The participants appeared to enjoy being part of the research group, having the opportunity to discuss their teaching and learning. Their thinking was challenged through the readings, the interpretation of ICT for learning and the discussion around what an effective ICT learning environment looks like. The meetings provided an opportunity for the participants to share their views, to provide feedback to each other and to further explore how they might use ICT. The ongoing discussion challenged the participants' views of ICT, curriculum and pedagogy.

Sally's comment on the changing role for her as a teacher with increased use of ICT generated discussion at the following meeting around the role of a teacher in an ICT-rich classroom. Joanne noted, "this generation is different and the skills they will require are different". This view is consistent with Prensky (2012) when he argues a more effective approach is to change what and how we teach in ways that reflect current and future realities. Changing the 'how' and 'what' means creating a pedagogy that is relevant, and a curriculum that is future oriented and engaging for today's students (Prensky 2012). Further work on pedagogy and curriculum, with consideration of teacher mindset, became an emerging focus to explore in the second cycle of the action research. Change was another consideration, as the participants adapt to the changing role for teachers as they increasingly use ICT to engage and support student learning.

On completion of the first cycle, it was suggested that Sally and Joanne invite a colleague to participate in the second cycle of the action research to broaden the research base. The second cycle of the action research would further expand on the use of ICT to support student learning and the changing role of the teacher.

6.3 Cycle Two

The participants appeared to enjoy the regular meetings to discuss their work and challenge their thinking and use of ICT as occurred in Cycle One. They were keen to continue to work together to explore ways to increase their use of ICT. Cycle Two built on the focused analysis of teacher ICT practice, with a specific focus on the use of ICT to improve pedagogy.

Both Sally and Joanne were successful in recruiting another colleague to participate in the action research, which allowed for the expansion of their ICT knowledge through the sharing of experiences. The new participants, Pam and Sue, retained the same pseudonyms allocated during the teacher interview stage. To commence this cycle, an explanation of the action research cycle process was provided for the benefit of Pam and Sue. Joanne and Sally shared their experiences from Cycle One and reflected on what they had learnt. The expectations for data collection were discussed and clarified for all.

6.3.1 Plan

Pam and Sue shared their view of ICT and their experiences with it in the classroom. Pam commented that ICT was not a consideration when she commenced teaching and she had not embraced having information at her fingertips. She does not use ICT in her private life; she does not own a mobile phone and nor does she have a strong relationship with ICT. Pam did express her concern in relation to inappropriate use of ICT in her classroom, when students used ICT to record her. This contributed to her somewhat negative view of ICT.

Apart from school-based professional learning sessions, Pam has not completed any ICT training. She feels she learns better in small groups and likes to limit her learning to one specific function. She feels she is always “learning on the hop” and she was reluctant to ask for help. Pam commented that she “feels responsible for everything and it is difficult to hand over responsibility”, and now that students have netbooks in her class she is more conscious of how students learn. She watches the students to see what they

are doing on their netbooks and checks how it relates to the classroom learning. In reflecting on her practice, she observed that she now puts the onus for finding information onto the students.

Sue also mentioned ICT did not exist 20 years ago and she had always used a textbook. She said, “the reliability on a textbook has gone and a whole world opens up”, which brings a greater level of excitement to both her teaching and student learning. In her opinion, ICT has allowed students to learn in different ways and the use of ICT is “just how you do your job now; 20 years ago the focus was on books, you worked with colleagues and conducted research”. Sue feels ICT enables students to learn in different ways. She says she now does everything on her laptop; she communicates to colleagues, establishes her datasets, has access to resources from around the world and can access online sharing. Using ICT has changed the way she teaches and she now regards her role as more that of a facilitator and a problem-solver. Sue feels she has made the most advances with ICT when learning in a group setting.

The task set for Pam and Sue was to record what was happening in their classes in relation to how ICT was used and to observe both how they used it and how the students used it. In the process they were asked to consider how they might expand the use of ICT. Sally and Joanne were to continue with their development of ICT-based units of work with increased opportunity for student-generated learning. They were asked to explore ICT pedagogy and how this influences student learning.

6.3.2 Act and observe

The TPACK model (Koehler & Mishra 2009) was distributed again for all participants to consider to what extent they addressed curriculum content knowledge, pedagogical content knowledge and technical content knowledge. From the discussion it was evident that the curriculum content knowledge guided their unit planning. Again the participants showed little interest in exploring this model in relation to their practice. However, an article on the SAMR model (Puentedura 2006) generated discussion on how ICT was used to transform learning. This model clarified the differences between each stage in

relation to how ICT is used. The participants were able to demonstrate their understanding with examples of ICT use within each stage. When asked to identify where they felt they were placed within the model, three of the four participants readily identified the stage they felt reflected their ICT practice. Joanne selected the augmentation phase and Sally chose modification. Sue demonstrated a clear understanding of all the stages of the model and placed herself in the early stages of redefinition. She felt most students liked her use of ICT so “she will continue to do more”. However, she did note that it had taken almost 25 years to get to this stage. Pam did not make a judgement on her ICT capabilities.

In reflecting on her use of ICT in the classroom, Sally noted that she uses ICT a lot more and she feels it has helped reenergise her teaching. To move forward she is redesigning her tasks, exploring ICT applications and asking students to explain and show her things when she sees them using ICT that she is not familiar with. She acknowledged that she needed to overcome her fears. Sally feels she has to be more open to what ICT is available and can offer; she is committed to finding relevant ICT activities and wants to “look for exciting things”. At this point she feels she is not utilising mobile phones as much as she could.

In referencing her practice in the augmentation stage of the SAMR model (Puentedura 2006) Joanne outlined a variety of ICT tasks and programs she has included in her units of work to support her judgement. She increasingly uses online activities as a strategy to introduce a unit; she uses Kahootz, YouTube and Schoology for this. She commented that she has a few students who are reluctant users of ICT. Joanne also noted that time remained a key factor impacting her ability to expand her use of ICT; time to work things out coupled with not knowing what is possible with ICT to support her teaching.

In this stage of the action research, Joanne and Sally continued to research ways to incorporate ICT into their existing units of work and to explore options for new units. Previously, Joanne had devised a unit of work which incorporated ICT that the students engaged in and thought was a “fun” activity. However,

despite student engagement and enjoyment, Joanne felt the task did not allow for “deep learning”. She continued to explore different ICT options to resolve this issue and ensure the ICT would enhance student learning.

In developing new units with a colleague, Sally was looking for ICT tasks that had flexibility and provided guidance for students. She explored ways in which she could get students to be less reliant on teachers as, in her classes, she tries to have students take increased responsibility for their learning. She wanted to create a learning environment where students instinctively use ICT to complete the learning tasks. Sally was offered more time to assist with her planning, as time was a barrier she identified in both the quality phase and the interview phase. However, she declined the offer as she felt that planning was a normal part of the unit design process.

As a result of observing student use of ICT in her classes, Pam noticed a change in her approach to teaching. She now starts her lessons by posing a question; she sees this as a strategy for placing the responsibility for learning onto the students. Pam feels this shift in her teaching is a result of her embracing what is available and she feels she has increased her expectations. She acknowledged the benefit of ICT to gain inspiration for artworks and to access historical information about art. She observed her senior students using ICT to view YouTube tutorials and other online demonstrations when they needed to learn a technique. Pam expressed a conflicted view about ICT, as she feels there is too much information available to her students and feels she needs to teach them to be discerning. Pam continues to prepare a paper instruction sheet so that students have a visual record of the task to place in their visual diary. She is yet to have students produce artwork on the computer as, in her opinion, the quality of art produced using ICT is poor. Pam also noted that looking for resources could be a full-time job and she often finds learning support materials and programs by accident.

The participants were asked what differences were evident in the classroom with the addition of ICT. Sue responded that ICT allows the students to learn in different ways and she had become more of a facilitator. Joanne noted there

was more collaborative work and students increasingly worked within an online environment. Sally mentioned she was enjoying her classes as much as the students. Pam stated that she values online galleries and museums and is trying to use more ICT. She also mentioned the international links that this school has and noted that experiences such as these are redefining student learning.

6.3.3 Reflect

The opportunity for discussion and sharing about learning with ICT was a valuable aspect of the action research. In this reflection stage it was interesting to note the discussion on pedagogy. There was little mention of barriers and more reflection on ICT and student learning experiences, with some reference to teacher mindset. Each participant felt that it was their responsibility to find what ICT was available and suitable to incorporate. Pam acknowledged that using ICT makes sense and felt she needed to increase her understanding of ICT. She has come to the realisation she does not need to know everything and is happy to find out along with the students. This reflects a change in mindset by Pam, as previously she felt she had to control the learning. It appears she is now more open to students using ICT to support their learning and is comfortable allowing students to find information. She did note she feels guilty at times when she does not “feed the students, she finds it difficult to let go”. She also questioned whether enhancing her units would lead her to the transforming stages of the SAMR model (Puentedura 2006).

Sue felt pedagogy was changing due to the ICT students were using, whereas Sally thought it was more to do with her changing mindset. She commented “that the teaching had changed, the classroom has changed and students have changed, the classroom dynamic has changed”. She felt it was critical to overcome her fears and to be open to feedback, while Joanne maintained that time remained a key impediment; “time to work it out, it is not knowing what is available”. She felt more time would allow her to source suitable ICT and incorporate it into her unit planning. In relation to the SAMR model (Puentedura

2006), Sally and Joanne recognised the role of ICT in the transformational stage but were unclear on how to get to that stage.

Pam noted the issues associated with finding resources and questioned how she could maintain “best practice”, especially when technology was constantly changing. She felt she often found ICT resources by accident and noted “finding suitable resources could be a full-time job”. She said she would consider ICT training but was unsure of the availability and cost. She went on to question the purpose of education and what students should learn in this constantly changing ICT environment.

As it is the classroom teacher who has the most impact on student learning outcomes, success is more likely through support for teachers (UNESCO 2011). In order to identify factors to assist teachers, the participants were asked what support they needed to continue to grow the focus on ICT. The participants discussed the range of ICT available through the education department website that is specifically aligned to support the curriculum framework. They also discussed how to create a 21st Century learning environment where students were collaborating, problem-solving and designing. It appeared they had some difficulty knowing how to achieve a learning environment that brought these aspects together.

Sally suggested working in pairs would be a good strategy, as “we could challenge each other and share findings”. She felt working in pairs may help teachers to continue to grow professionally. Sue mentioned that she is about to attend professional development to learn about coding, which is the new focus within her teaching area. At this point, she has no idea about what coding is, so she is open to finding out and hopes that she is familiar with some aspects of it. Sue accepts she needs to learn about coding and realises the need to implement what she learns, as it has become part of the new Victorian curriculum framework.

The participants mentioned the large number of Google apps available to support teachers. Sue shared how the use of virtual dissections and Google Mars “puts students in the moment”. This led onto discussion about realistic

learning experiences using virtual reality goggles. In preparation for the next meeting, it was decided that the school would purchase Google Cardboard and headphones for each participant. Taking Sally's suggestion into consideration, the plan was for participants to work in pairs to learn how to use Google Cardboard and then discuss how it could be applied in their classes. The participants also agreed to visit each other's classes to observe their use of ICT. All of the participants expressed a willingness to continue to learn about ICT, to find out what is available and endeavour to integrate the new learning into their teaching. The participants were focusing on change and pedagogy through their involvement in the action research, with a targeted focus on teaching with ICT.

6.3.4 Discussion

The action research continued over a period of 18 months and during that time the participants examined their current classroom practice and their use of ICT. They made a conscious effort to incorporate ICT when planning their units of work and reflected on the tasks they set and how students both used and responded to the ICT used. They also explored ways in which they could further utilise ICT to improve their lessons and engage students in the learning. The collegiate discussion and shared learning about each participant's practice was a positive outcome of the action research. Sally expressed enthusiasm about her involvement and often commented that she was keen to do well through her participation in this project. She expressed a desire to improve her practice in relation to ICT and often mentioned, "this is making me learn, making me do it properly".

Involvement in the action research allowed the participants to examine the potential of ICT in their teaching practice and explore the ways it could be used to transform their approach to teaching and learning. It was apparent they enjoyed meeting to share their experiences and working in the group to discuss ICT and pedagogy. They appeared to like referencing their use of ICT against the SAMR model (Puentedura 2006) and exploring strategies on how they could move to the transformative level, where ICT changed the approach to learning. Sue commented that "most classes like it so I am willing to do more".

The use of the SAMR model (Puentedura 2006) allowed each participant to clarify their use of ICT in relation to which stages of the model they were in. In addition, this model allowed participants to understand the developmental stages they would transition through to achieve transformational learning with ICT. However, they did not want to use the TPACK model (Koehler & Mishra 2009), which illustrated the links between content, ICT and pedagogy.

During the second cycle of the action research, it was clear that each participant felt positive about their efforts to use ICT to support the learning happening in their classes. The action research provided a process for the participants to examine their practice in relation to ICT and student learning. Generally, each participant was pleased with the way they managed the use of ICT in their classes; they felt their use of ICT supported the learning and they had occasionally observed students taking responsibility for their learning using ICT. Pam observed a change in her teaching practice, commenting she had increasingly allowed students to take responsibility for their learning and her role in the classroom had changed to accommodate this. Joanne did note that for her unit she did not believe the activity allowed for higher order thinking, so that was an area she could develop further. The focus on barriers decreased as the participants worked through the action research cycles.

Throughout the action research the participants examined their practice and were engaged and enthusiastic; their approach to curriculum design remained a content-driven approach to teaching and learning. During unit planning, Sally and Joanne referred to the curriculum guidelines first and then explored ICT options that would enhance unit delivery and enable students to attain the required knowledge. The challenge is to use ICT to create a digital age learning environment (Moersch 2014) and that requires a change to the current approach. Sally recognised that the change required is related to teaching when she commented, “it’s about changing the way we teach to engage students … as a teacher that’s the skill you have to work out, where it’s relevant and where it’s not”. The participants are yet to embrace the 21st Century ICT skills in an intuitive sense to transform their teaching and their approach to using ICT. An

important aspect under consideration was the emphasis on the need for quality pedagogy and effective ICT learning.

A model that supports a collaborative approach would provide an environment conducive to planning, discussion, sharing of ideas and experiences, receiving support, providing feedback and reflection. Participants were asked to design a model that would assist them in incorporating ICT; however, no suggestions were provided. The action research facilitated the creation of a small, supportive collegiate group where participants were willing to share their challenges and 'bounce ideas' off each other. There was clear agreement that there was a task to be done that involved critically reflecting on their practice and designing and implementing new units of work. In this forum, the professional discussion and the commitment to the development of ICT-rich units of work appeared to be an effective strategy. It was apparent at each meeting that the participants enjoyed working together in the small group, sharing their experiences and ideas and providing feedback to each other. The opportunity for professional dialogue and the exploration of ideas related to their actual work appeared to be a successful strategy.

A supportive learning environment is created when teachers work together, whether in a professional learning team or a professional learning community (PLC), as it creates opportunity for shared experiences, feedback and the challenging of ideas and learnings. The action research methodology provided a framework for the participants to observe and reflect on their practice and to share their findings in a collaborative and supportive environment. It allowed the participants time to engage in dialogue about the professional readings, their teaching and learning and the role of ICT. The regular meetings maintained an ongoing process to support the investigation of the research problem. The continual focus on improving practice, based on their experience and with input from colleagues, was a key element as there was a level of enthusiasm evident at each meeting. Using a small group approach with focused readings and agreed tasks appeared to be an effective strategy.

The inclusion of PLCs in a proposed model would replicate a similar learning environment to that created in this action research phase. In discussing teacher quality, Rosenholz (1989) maintained that teachers who felt supported in their ongoing learning and classroom practice were more effective and committed than those who did not feel supported. This notion was further expanded by Darling-Hammond (1996), Lieberman (1995) and Little (1992) who all believed the benefits for students increased when teachers were provided with a supportive workplace environment, and a context that supported their professional endeavours and nurtured collaboration. Support was defined as working together, sharing, learning from each other and collaborating on problems.

The use of the SAMR model (Puentedura 2006) clearly articulated how ICT is used within each developmental stage. It also assisted in defining the higher order use of ICT to underpin student learning. This model was well received by participants, as they could reflect on their use of ICT and position themselves within a stage. They were then able to explore what was required of themselves, as teachers, to move into the next stage. The appeal of this model was that it is straightforward and easily understood; the teachers could use the model to identify which stage they were operating in and then explore different pedagogical approaches to move to the transformational phase. The challenge is to determine what framework is needed to support teachers to transition to the redefinition stage and design units that require students to use ICT for personal, connected and situated learning to occur.

Other researchers have explored the use of this model to change practice. Chuang and Tsao (2013) looked at the use of Short Message Service (SMS) in nursing to help students to memorise information about medications; Cornelius, Marston and Gemmell (2011) examined the use of SMS for real-time simulations in higher education; and Liu and Tsai (2013) investigated the use of videos to support learning English. The substitution and augmentation stages of the model bring little to the development of pedagogy, as for substitution it is a replacement of current practice with an ICT device that delivers the same outcome. However, Evans' (2008) study on the use of podcast lectures, whilst

limited to students' views only, did reveal that the students were more engaged in the podcast delivery of lectures. Chuang and Tsao (2013) found their research on SMS with nursing students did build on current practice as it offered another option for students to gain information, and they found that student results improved due to this use of SMS. It is in the modification and redefinition stages of the SAMR model where the transformation to learning occurs (Rommell, Kidder & Wood 2014). The learning in the redefinition stage is characterised as personalised, situated and connected (Hockley 2013; Rommell, Kidder & Wood 2014).

An outcome of this stage of the research was the positive approach to the use of ICT demonstrated by the participants, along with a willingness to continue to expand their use of ICT. The participants used reflective practice to examine how they approached the use of ICT within their classes. Their use of ICT was predominantly associated with the delivery of content. The use of 21st Century ICT skills was not discussed in detail during the meetings, nor was there a clear vision of how ICT could be integrated; the participants tended to draw upon their current knowledge. An expansion in their knowledge of available ICT may assist in embedding 21st Century ICT skills and expanding their ICT repertoire to integrate ICT to transform teaching and learning.

In this research, the process of working through the action research cycle provided a view of the current situation, allowed participants the opportunity to implement strategies, and endeavoured to identify factors to inform the development of a model to support teachers to not only increase the use of ICT in the classroom and improve their ICT pedagogy but also to transform the way students learn with the addition of ICT. An important aspect of action research according to Dick (2002) is to encourage participants to seek out 'disconfirming' evidence; that is, evidence which does not match what they expect or assume would occur. This research has reinforced the benefit that teachers gain from working in collegiate groups with an identified task, time dedicated to developing their understanding and for designing a task, along with the opportunity for feedback. The participants were able to discuss ICT and pedagogy; however, they did not progress to the natural inclusion of ICT to

address 21st Century skills. The opportunity to meet for professional dialogue with a focus on pedagogy appeared most beneficial. This approach can easily be expanded within the research setting to include all staff. This study has provided valuable information for application within the research school setting and to inform the development of a model.

Action research was a suitable mode of inquiry for this study as the iterative process of the action research provided the opportunity for participants to examine their practice and work towards improving it in relation to the use of ICT. The action research methodology allowed for the development of a supportive collegiate group, which was able to engage in professional dialogue about their actions and learning and was a successful strategy for engaging the participants in action and reflective practice. The participants were able to design and implement units of work and further increase their use of ICT to underpin student learning. In working through the two cycles, the participants transferred their focus from the perceived barriers to the pedagogy and their efforts to increase ICT. Discussion of various models introduced throughout each cycle, along with the experiences of the teachers as they participated in this cyclical process, provided an insight into the needs of teachers in relation to ICT and the change process. In addition, as the attention was on teacher practice, the participants had the opportunity to learn through their involvement. Sally often commented that, due to her participation in this action research, she felt she had to use ICT and her participation in the research was the catalyst for change.

6.4 Conclusion

The action research cycle was used as a learning cycle, for the participants and the researcher. A problem was evident, so research was used to find what the various factors affecting the problem were and whether those factors are interrelated. The central problem investigated was the inability or reluctance of teachers to use ICT to underpin their teaching to enhance student learning. Explanatory and analytic research strategies were used to attempt to identify

the cause of the problem and to ‘delve deeper’ into the issues. On completion of the two cycles of action research, the participants continued to explore ways in which they could expand the use of ICT within their classes. The participants were open to students using ICT and were actually happy to learn from students when they saw them using it. The participants were aware, from discussion on the SAMR model, that ICT can be used in a transformational manner but they were not sure how to reach that level of ICT use. A clear view of the desired end result may assist in transitioning participants to ICT use for personal and connected transformational learning in the classroom.

The opportunity to work closely with the teachers provided an insight into each participant’s current practice and their reflections on the implementation of their ICT units. Being able to observe the ways in which they overcame their perceived barriers and approached the development of ICT-rich units of work informed the final stage of this research. The information gained was used to inform the development of a model for schools to support all teachers to utilise ICT to underpin student learning.

Chapter 7: Developing a model

7.1 Introduction

In this study, a small cohort of the secondary school teaching service was examined to inform the development of a model to support schools to effectively utilise ICT to transform student learning. The incorporation of ICT is not yet a natural, intuitive process. This chapter draws together the learning from the literature review, the quality phase of the study and the action research phase. The data collected from the five leading teacher interviews and the classroom teacher interviews identified a range of challenges and barriers from the teacher perspective. The action research phase allowed an insight into the way each participant approached their use of ICT in the development of curriculum units. The action research also provided information about teacher planning and thought processes as they reflected on their practice. The findings revealed the teacher participants referred to the skills and content knowledge identified in the curriculum framework to inform the development of their units, and they then looked for ICT to assist with the delivery of the lessons.

The implementation of this type of model should endeavour to provide a process to assist schools to reduce and eliminate perceived barriers for teachers. In addition, it presents a clear whole-school approach to support the implementation of ICT. The consideration of the models discussed in Chapter 2, along with findings from the action research, informed the development of the proposed model. The model outlines a process to support teachers to use ICT to transform pedagogy so that students utilise 21st Century ICT strategies: a transformation in pedagogy that assists students to become “confident, creative and productive users of new technologies, particularly information and communications technologies, and understand the impact of those technologies on society” (MCEETYA 2008, p.7).

7.2 Factors to inform the model

A whole school approach demonstrates a commitment to the implementation of ICT and provides clarity, motivation and direction. A model that incorporates an approach to ongoing learning in regard to pedagogy and the use of ICT with a focus on the 21st Century ICT skills is more likely to engage teachers and students (Lytle 2012; Neyland 2011; Toy 2008). Phelps and Graham (2013) regard schools as social organisations that can effect change and believe a school's culture, context and structure can significantly influence the extent to which teachers are motivated, supported and encouraged to learn. A whole-school approach with involvement and support from the leadership is regarded as a strategy for success (Cox, Preston & Cox 1999; Fullan & Hargreaves 1991).

The constant change in schools, as noted by Kevin in the quality phase, indicates a lack of direction and, in his opinion, a reluctance from teachers to become involved in change initiatives. A whole-school approach would indicate a commitment to the implementation of ICT and provide clarity, motivation and direction. This approach could generate 'collective efficacy' (Goddard, LoGerfo & Hoy 2004) as suggested by Nick as a strategy for success. Kate believed teachers need clarity in what an ICT-rich classroom looks like, which again can be achieved through a whole-school approach with an agreed vision. The findings from this phase of the research demonstrated that each leading teacher held the responsibility for the integration of ICT, and they each devised strategies to work with teachers either individually or in small groups to expand the use of ICT.

An effective model should outline the process for change and explain the roles for the participants involved. In relation to the integration of ICT, Trinidad, Newhouse and Clarkson (2005) described a successful model as outlining a process where ICT is embedded and supports quality pedagogy and effective learning. In their book *Seven steps to ICT integration* (2007), Robertson, Webb and Fluck promoted the need to create a picture of the ICT landscape for teachers and to embed ICT practice through professional learning. Allowing

teachers to actually see the ICT in practice is a strategy to provide direction for teachers. The ‘Learning Edge’ approach suggested by Bain and Weston (2012) promoted reconceptualising the use of ICT to extend, connect and develop the capacity of leaders, teachers and students to promote the use of ICT tools for differentiating classroom practice. A model that assists teachers to reconceptualise teaching and learning with ICT is more likely to effect change.

Pedagogy proved to be a barrier for teachers, as they appeared to have difficulty defining effective ICT practice. Kate noted teachers were conflicted, as the school wants consistency in delivery and practice and a level of commonality but also wants personal and individual learning. In addition, there was a perceived pressure to complete the course, and the structure of VCE conflicted with the ability for students to become “creative meaning makers of their own learning” (Meg). Sue and Sally commented that the use of ICT required students to learn differently and their roles as teachers changed to one of facilitators. Janet commented on the need for students to be more discerning with information and learn critical analysis and how to synthesise worthwhile and relevant information. There was a lack of clarity from teachers about what an effective ICT-rich classroom looks like.

Prensky (2012) advocates change through pedagogy with a reassignment of roles within the classroom; a classroom where teachers scaffold learning and ensure quality and rigour, and where students use ICT and other resources to find information and to create. This is further supported by Moersch (2014), who sees improved pedagogical practice as one that allows students to use ICT to research, collaborate, think and analyse, design, problem-solve, create and communicate, as this approach has been shown to increase student engagement.

Professional development was highlighted by the teacher participants interviewed as an area where they needed more support. They mentioned wanting more exposure to ICT for their subject area and more guided support in using programs and applications, as this would lead to increased confidence and competence. The teacher participants commented there was insufficient

guided support and they had limited awareness of how applications and programs were used in their subject area. The leading teachers suggested the need for a professional development plan. Kate suggested faculty leaders work with their teams to share ICT practice and identify areas for use.

School leaders hold the responsibility for guiding the change process within their school to address the needs of students in the constantly changing ICT environment (Lytle 2012; Neyland 2011; Toy 2008; Whitehead, Jenson & Boschee, 2013). Hayes and Harriman (2001) examined the integration of computer-based technology in six diverse schools in New South Wales and concluded the active involvement of the principal was the most important factor influencing the integration of ICT, along with a need for a coherent vision. The notion of a whole-school focus coupled with a supportive principal is consistent with research conducted by Coughlin and Lemke (1999), who examined the professional skills required for the digital age classroom, and Lochner, Conrad and Graham (2015) when examining the adoption of learning management systems in secondary schools. Their research examined the use of CBAM to address teacher concerns in relation to the introduction of a learning management system.

Emerging technologies have the capacity to make a significant impact on changing how learning happens, so it is essential that school leaders have a clear vision of how technology can help transform teaching and learning at all levels (Whitehead, Boschee & Decker, 2013). In addition, leaders need a clear picture of what actions actually work, to facilitate a culture for change and a rethinking of how teaching and learning occurs with ICT. This was further supported by Neyland (2011), who highlighted the school leadership as being more influential than the external requirements of the New South Wales education department in her study on the integration of online learning in secondary schools. She also found there was a high level of understanding about the transformative effect of ICT being an impetus for pedagogical change in leading and accomplished schools.

To assist with the creation of a culture to support 21st Century ICT learning, Toy (2008) compiled a list of 10 strategies that principals could follow. The list included the expectation that the principal not only models the use of ICT but uses the same ICT that the teachers are expected to use. In addition, Toy felt it was important for principals to recognise and acknowledge the climate teachers operate within when they are expected to combine the development of their own expertise and knowledge about using ICT with the expectations of the school leadership. Fransson (2016) further supported this view. Teacher participants commented that technical issues were a barrier to their efforts to integrate ICT. They listed factors such as the technology was often not working, internet speed and connectivity, limited availability of technical support, insufficient technician time to repair and maintain equipment, and staff using different ICT platforms.

The outcome of the principal and leadership team taking an active role in the integration of ICT to transform learning is to communicate to teachers the commitment and level of support invested in assisting them in adapting their pedagogical practice to incorporate ICT. Whitehead, Jenson and Boschee (2013) argue that school leaders must be able to anticipate change and adapt the various roles and responsibilities within a school to support teachers and students. The adoption of a whole-school approach enables the creation of a culture of collective responsibility. The development of a vision, clear expectations and an implementation plan are essential to provide guidance and support throughout the change process. In addition, Whitehead, Jenson and Boschee believe school leaders should have a high level of ICT knowledge and expertise to not only facilitate this, but to model best practice.

The implementation plan must provide teachers ongoing time for discussion, planning, implementation and feedback. It is important to create a climate where teachers value ICT as an instructional tool that is infused into the teaching and learning process. Teachers need to understand modern technological pedagogies suited to the educational ICT classroom as they actively align to the students' experiences with ICT (Whitehead, Jenson & Boschee 2013). "Technological change in schools is both constant and inevitable as there will

always be new technology to challenge the way teachers think about ICT and classroom pedagogy" (Phelps & Graham 2013, p. 9).

In the proposed model the principal, in conjunction with the school leadership team, direct the learning development and continuous improvement through their roles as leaders of each PLC. Each leader develops a clear and agreed view of the change agenda and implementation plan, and to guide the work of the PLC. According to Leithwood and Montgomery (1982), teacher involvement in a collective implementation planning process is more likely to facilitate the acquisition of new skills and changed teacher practice.

To further add to the complexity of changing pedagogy to facilitate student learning with ICT, teachers need to be aware of the relationship students have with emerging technology, as this will influence the use of ICT in schools. The relevance of Prensky's (2001) view that today's students think and process information fundamentally differently from their predecessors, as they are the first generation to grow up with this new technology, remains. The expectation that students are able to utilise ICT to develop skills in order to learn, think critically, solve problems and use information to communicate, collaborate and innovate (Partnership for 21st Century Skills cited in Whitehead, Jenson & Boschee 2013) requires teachers to incorporate a pedagogical approach that reflects 21st Century ICT learning. To facilitate this, teachers need to provide authentic learning contexts that allow students to use ICT in ways that foster collaboration and real-world problem-solving (Moersch 2014).

7.2.1 Impact of the teachers

According to Routman (2012), an effective teacher is the most vital factor in a student's success. This view is supported by Papa (2011), who believes it is the quality of teaching that is critical to the success of utilising ICT to improve student outcomes. Teaching is complex, and teacher knowledge, beliefs and understanding of how students learn shapes the decisions that teachers make about content and process (Timperley et al. 2007). A teacher's attitude toward ICT, in conjunction with their pedagogical beliefs, is a key determinant of whether a teacher will use ICT in their classroom (Ertmer & Ottenbreit-Leftwich

2010; Phelps & Graham 2013). It is both the 'what' and 'how' of teaching that strongly influence student learning. Teachers need to value ICT as an instructional tool for change to take place and recreate or restructure their knowledge about teaching and learning. However, this takes considerable effort (Desforges 1995). The teacher interview data indicating a lack of clarity about ICT, the request for more exposure to ICT and time to learn new ways of doing things, demonstrate a need for a process to support teachers. The observations that students really enjoy ICT, that it engages them, that it opens up the classroom and provides experiences the students may not otherwise have access, acknowledge that teachers recognise the value of ICT in the classroom.

A successful model needs to meet the needs of the school and the teachers in order to benefit the students. The skill and attitude of the teacher is a key determinant in the success of ICT integration (Bitner & Bitner 2002). However, Hess and Saxberg (2014) suggest that education technologies have not been used effectively to rethink teaching and learning or to question when, where and how learning takes place. They believe that ICT can extend the impact of good teachers, as it adds to each teacher's repertoire. Teachers can use ICT in a variety of ways to support student learning through their activities in relation to instruction, coaching and tutoring. This view is further supported by Prensky (2012), who believes the problem lies with educators not having defined what learning is, and the need to differentiate between the various types of learning. Trinidad, Newhouse and Clarkson (2005) proposed a framework that identified the various layers associated with the development of teachers' ICT capabilities and suggested it as a process that would more likely result in changes to pedagogy and school reform. This framework adopts a holistic structured approach to measure and support ICT change in the education system, schools and for teachers. It describes teacher capabilities and provides a process for feedback on teacher progress to inform their professional growth. Technological change in schools is both constant and inevitable, as there will always be new technology to challenge the way teachers think about ICT and classroom pedagogy (Phelps & Graham 2013).

In designing a model, consideration needs to be given to how teachers can adapt to the pedagogical challenges and opportunities presented with continually evolving ICT (Phelps & Graham 2013). Bain and Weston (2012) proposed that teachers reconceptualise their view of ICT. They need to change their focus from how they access various ICT applications and learning support materials to the purposeful use of ICT to enhance student learning; for example, to differentiate curriculum and to provide timely feedback. They believe ICT is integral to the shaping of pedagogy and curriculum to meet the different needs of individual learners. This was affirmed by Sue during the action research, when she referred to the simulated science experiments, which she acknowledged were not only a preference for some students but allowed for experiments that schools often did not have the equipment to conduct.

A key consideration for success is developing the skill set of teachers so they are confident users of ICT and can incorporate it to allow for creativity, communication and collaboration in learning. Both the leading teacher and teacher interview data supported the need for professional learning; teachers wanted to know what was available for their learning area and wanted to be shown how to use the ICT. Teachers also wanted time to learn new programs, develop new tasks and activities and adapt to new teaching approaches. The teachers suggested that if they had time and professional development, their skills and knowledge would improve, which would lead to increased confidence.

An environment that supports collective learning with ICT, with supportive conditions and shared personal practice, is more conducive to teachers' abilities and inclination to change, as it is the teachers who ultimately connect ICT to learning for students (Phelps & Graham 2013). PLCs are considered to be an effective strategy for professional development (Routman 2012; Phelps & Graham 2013). A model that allows for a culture of collaboration where teachers can discuss ICT and pedagogy, plan for the use of ICT and be supportive of each other is more likely to succeed.

The use of PLCs brings small groups of teachers together to improve their professional practice in a supportive environment where they can learn with and

from each other. The acquisition of new skills and changed teacher practice is more likely to occur when teachers are involved in a collective implementation planning process (Leithwood & Montgomery 1982). Darling-Hammond and McLaughlin (1995) believe PLCs take teachers beyond the acquisition of skills and knowledge, and involve them in a collaborative process of reflection with a view to rethinking teaching practice and student learning. Whitehead, Boschee and Decker (2013) recommend educational leaders use the more contemporary PLCs and professional development programs to guide school reform.

7.3 Proposed model for ICT implementation

This model is based on the school leadership team taking an active and sustained role in the development of an ICT learning culture. The priority is to create a 21st Century classroom in which students use ICT to “become literate, responsive, innovative and adaptable in a constantly changing digital world” (Whitehead, Jenson & Boschee 2013, p. 117). The principal and the leadership group are ultimately responsible for leading the development of a vision and an implementation plan, and for maintaining ICT learning as an ongoing priority. In creating a shared vision it is important all stakeholders have input into the vison, understand it and know how the ICT will enable the school to achieve the vison.

An additional consideration for the leadership team is to ‘future proof’ the school to ensure the ICT infrastructure allows capacity to cater for the changing teaching and learning approaches required for accessing and processing information. The infrastructure and technical support barriers identified by both the leading teachers and the teachers would be addressed through a whole-school approach. The ICT infrastructure, purchase of resources, technician time and support processes would form part of the implementation plan. The principal and the leadership team create a whole-school approach to drive the transformational change process in the use of ICT.

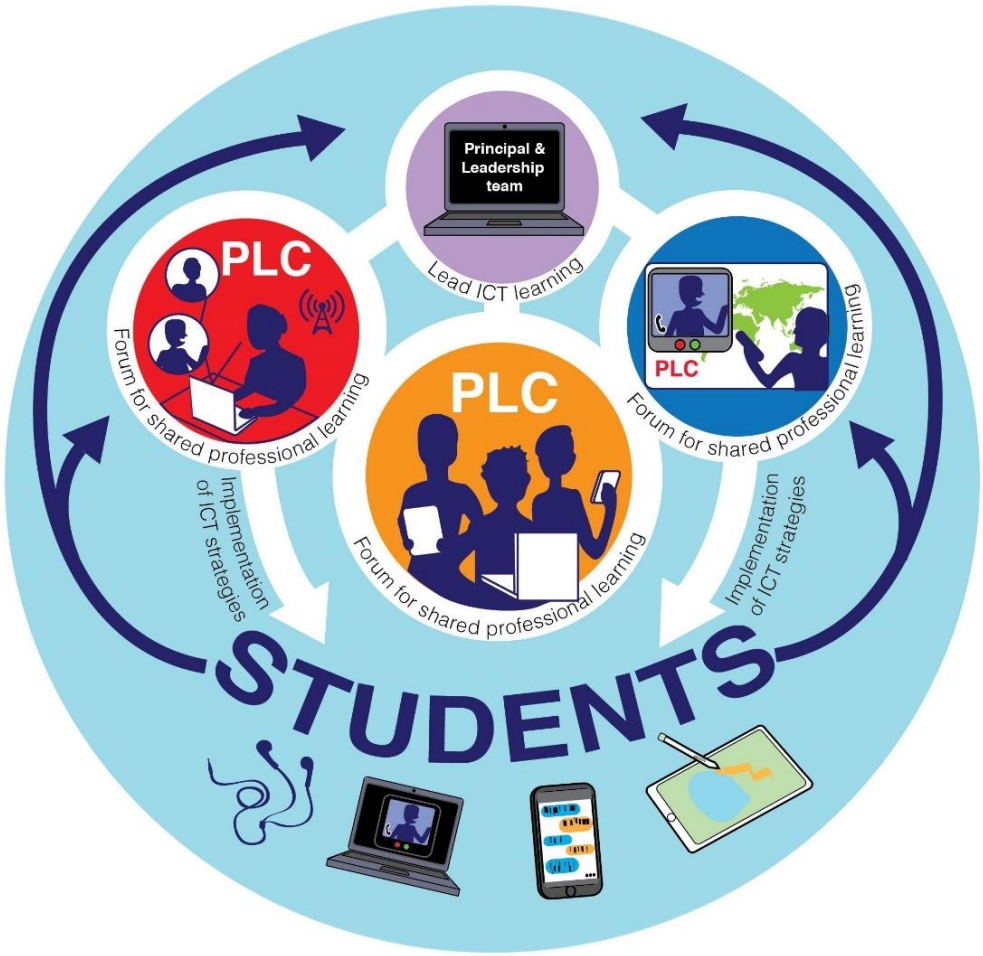

Figure 11: A Whole School ICT Implementation Model

This model is based on PLCs, premised on the understanding that student learning will be improved through improved teacher practice (DuFour & Fullan 2013; Hord & Sommers 2008). The model requires all members of the school community to work collaboratively to progress the use of ICT to transform teaching and learning. Ultimately, the principal, with support from the leadership team, holds the responsibility to create a culture for change. Within each PLC, all teachers demonstrate a willingness to learn, to assist colleagues to learn, to mentor and to be open to feedback and reflection. Teachers are required to be active participants in both the PLC and the change process required to achieve a 21st Century ICT classroom. Ideally, each PLC is comprised of five to six teachers to ensure a supportive collegiate environment.

It is the responsibility of the leader of each PLC to create a collaborative and supportive learning environment where they can identify the needs of each teacher and develop a process to further the ICT learning needs for all teachers within their PLC. The model requires teachers to be open to improving their ICT skills, expertise and pedagogy through active participation in the PLC. Plomp, Pelgrum and Law (2007) identified staff development as a key element in achieving educational change, as every teacher is impacted when ICT is implemented as a tool to support teaching and learning. Phelps and Graham (2013) promote the notion of teachers considering themselves as ICT learners. In the process of incorporating ICT, teachers assist each other and students in reframing how learning occurs with the addition of ICT.

Each PLC will demonstrate variability due to the differing needs of the members, thus their strategies and activities will diverge. Sharing and professional learning will occur both within the PLC, and between PLCs. A key aim is to change what and how teachers teach, to “accurately reflect current and future realities” (Prensky 2012, p. 19). A PLC comprised of small groups of teachers, guided by a leading teacher, allows for professional dialogue, problem-solving, sharing and learning from each other. All teachers will have different ICT skills, knowledge and expertise so the ‘one size fits all’ approach to professional learning is not appropriate. The needs of the teachers within each PLC can be best served with a collegiate approach to shared learning and modelling conducted within a supportive environment (Phelps & Graham 2013). The discussion within the PLC addresses the challenges of incorporating ICT. Ongoing points for discussion include pedagogy, professional development and individual teacher learning needs, and student feedback. It is essential that data is collected and used to indicate changed practices and improved student learning.

An elaboration of the responsibilities of each group within the school is outlined in the following diagram. The list of tasks informs the initial actions but the actions will vary as the PLC process is embedded and each group forms its own method of professional learning, and as ICT pedagogy develops.

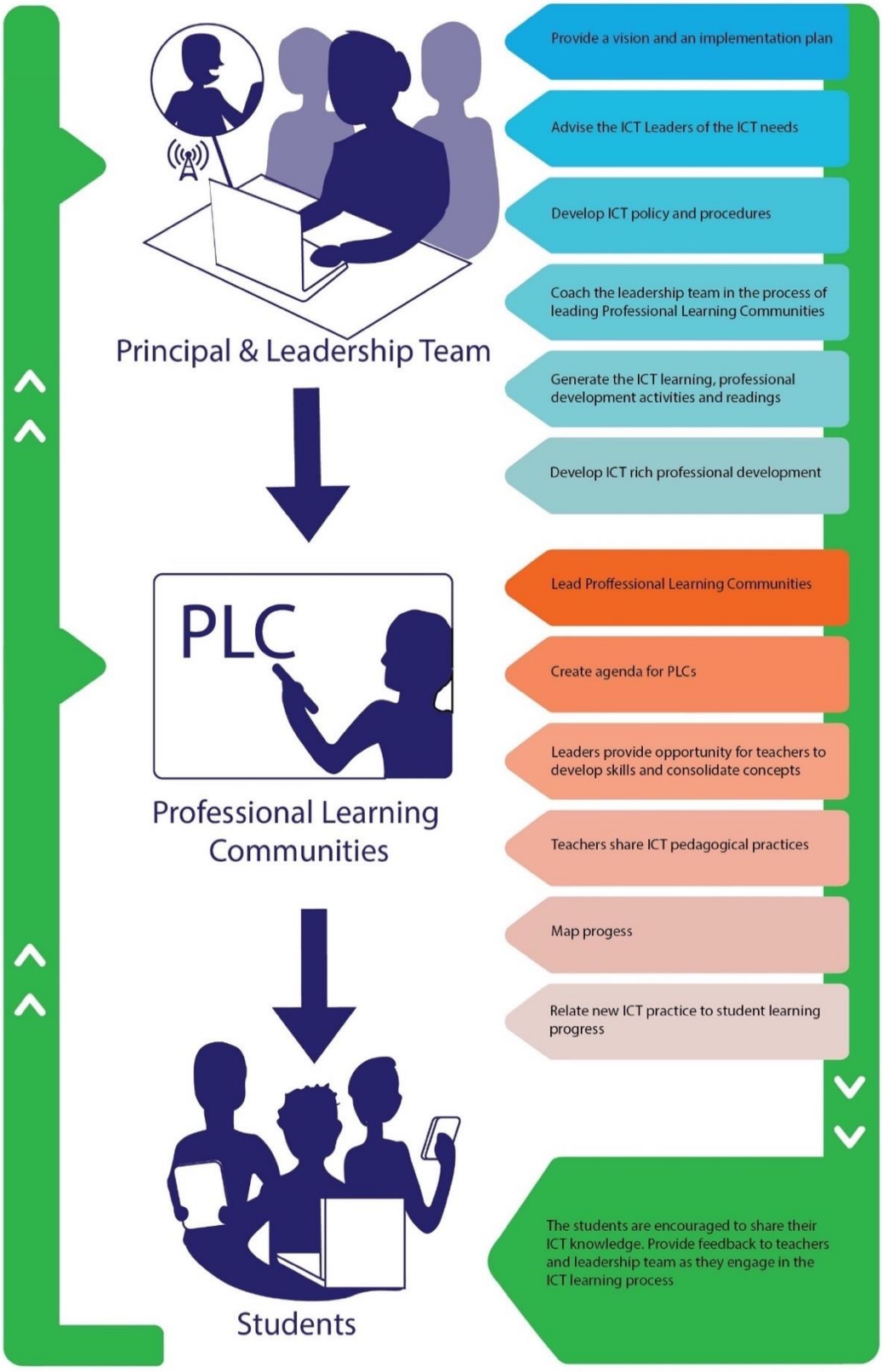

Figure 12: Roles within the Whole School ICT Implementation Model

7.3.1 Overview of the roles with the Whole School ICT Implementation Model

The principal

The key role for the principal is to lead the change process and create the culture for the integration of ICT to transform teaching and learning. The stronger the culture, the more likely it is that ICT will be used to change pedagogy (Baskin & Williams 2006; Bitner & Bitner 2002). Within this model there is an expectation that the principal demonstrates a moderate level of ICT knowledge and expertise. The principal is not required to be an ICT expert but it is important for the principal to model the use of ICT and to demonstrate a level of understanding of the role of ICT in the classroom teaching and learning process. Modelling the use of ICT demonstrates leadership in the change process (Hayes & Harriman 2001; Lochner, Conrad & Graham 2015). The principal can draw upon theoretical frameworks such as Technology Together (Phelps & Graham 2013) or The Learning Edge (Bain & Weston 2012) to support the change process. However, the critical leadership role required is a commitment to the ICT vision and implementation plan and the ongoing promotion of digital age best practices. It is also important to consider the factors influencing the implementation of a model, such as time, space and resources, be addressed so that intended outcomes can be achieved (Cho 1998).

The leadership team

Within this model, the leadership team works together with the principal to drive the change agenda. As leaders they have a responsibility to develop their own ICT knowledge and expertise to model effective use of ICT for reconceptualising pedagogy. Leading teachers must be effective leaders and demonstrate how the learning activities of their PLCs connect to the vision, implementation plan and pedagogy. A focus on pedagogy is central to the PLC work, to ensure transformation in student learning is achieved through the addition of ICT. Leading teachers manage the work of the PLC and continuously refer to the vison and implementation plan to inform the work of

their PLC. At a leadership level, the leading teachers discuss and coordinate sharing between PLCs. They coordinate the professional learning and sharing of ICT to support pedagogy to expand teacher knowledge and expertise. In addition, they ensure the collection of data to map changed practices. Leading teachers collect data to inform the success of teacher strategies and report progress against the ICT implementation plan. Leading teachers also seek information directly from the students and consider feedback from them.

The teachers

This model outlines a whole-school approach to support teachers to reconceptualise teaching and learning with ICT. The PLCs comprising multidisciplinary teams allows for the blending of discipline knowledge, pedagogy and ICT knowledge (Twining, Raffaghelli, Albion & Knezek 2013). Teachers are required to actively participate in PLCs and work collaboratively, sharing both their learning needs and their learning to expand their knowledge and skills in relation to the use of ICT to transform learning. Teachers consider the use of ICT in the classroom to allow for personalising and broadening content to include local, national and international connections. They expand their use of ICT for differentiation, promoting student-directed inquiry, collaboration and for structuring social networking (Moersch 2014).

Professional learning focused on pedagogy and ICT supports teachers to re-define the use of ICT to transform learning. This model addresses concerns expressed by the leading teachers and the classroom teachers during this research through the provision of time for professional development and working collaboratively to find resources, learn programs and design ICT units of work in a supportive environment. The Whole School ICT Implementation Model can be incorporated into the school meeting schedule, thus providing time for ICT learning.

The students

Within this model, students are encouraged to provide feedback to teachers and the leadership team as they engage in the learning process underpinned by ICT pedagogy and 21st Century skills. As students operate within the ICT world

to a greater extent than many teachers (Prensky 2012), they can share their expertise with technology and demonstrate how they learn with ICT. During the action research, Sally and Pam acknowledged how they learnt from their students. Pam said she observed how the students were using ICT in her classes to view tutorials on technique. Sally commented that students were able to find information she was unaware of, which made her more conscious of not providing all the information and to be open to allowing students to conduct research. Bain and Weston (2012) suggest a system that values input and feedback from students contributes to the development of all participants.

7.4 Discussion

This model is a vehicle for change to enable a whole-school approach to the use of ICT to transform teaching and learning. The PLCs are used to create a collaborative professional learning environment, where teacher discussion about quality pedagogy and effective ICT learning is generated. The model relies upon the active involvement of the principal in leading the change process and guiding the leadership team in their role supporting teachers. A key role of the PLC leaders is to create a supportive and collegiate environment where teachers discuss pedagogy and professional learning to improve their knowledge, skills and expertise in relation to ICT and pedagogy (Trinidad, Newhouse & Clarkson 2005). The PLC acts as a community of influence, where colleagues contribute to the development of ICT units of work, provide feedback to each other and share learning.

Many of the models discussed in Chapter 2 could be used within the PLCs to support teacher learning and unit planning. For example, teachers could use the SAMR model (Puentedura 2006) to establish their position in relation to the use of ICT to transform learning. The TPACK model (Koehler & Mishra 2009) could be used to guide discussion on pedagogy, as it clearly illustrates for teachers the three educational aspects of curriculum planning: content knowledge, technical knowledge and pedagogical knowledge, and the interconnections between each aspect. It is the technical knowledge and the

pedagogical knowledge that present the greater challenge for teachers, as they do not necessarily know what ICT is available to provide the best educational learning outcomes.

Other models such as iCARE (Hoffman & Ritchie 1998) and ASSURE (Heinrich et al. 2001) could be discussed in PLCs to illustrate different planning processes for the development of ICT units. For example, those teachers who possess a level of ICT expertise might use the iCARE model (Hoffman & Ritchie 1998) to guide their preparation of online units of work. In addition, within PLCs, teachers could engage in action research as a process of reflective practice and to evaluate the effectiveness of new practice.

The inclusion of PLCs promotes a culture of ongoing professional growth within a collaborative learning environment. All members of the leadership team hold the responsibility for leading the PLCs and generating action. They hold the responsibility for minimising barriers for teachers so that they become change agents in using ICT to transform their practices and pedagogy (Ward 2003). Teachers need to understand modern technological pedagogies that are consistent with the technology-focused classroom (Whitehead, Jenson & Boschee 2013). The leadership team also coordinates skill development, training and professional reading. The leaders ensure the actions of the PLCs align with the vison and implementation plan and they model the effective use of ICT for learning. They work together and share strategies to progress the learning needs of all teachers within their group and are tasked with creating the supportive learning environment.

Teachers are regarded as the key to change (Cox, Preston & Cox 1999; Frazier 2012; Romano 2003). This model places an emphasis on teachers and support for them in rethinking education with the addition of ICT. Supporting teachers to innovate with ICT in the classroom and move beyond sustaining current practices with ICT may lead to a transformation in the way teachers teach and students learn.

This model addresses the barriers identified in the interview phases of this research. The barriers identified by both the leading teachers and the teachers, such as time, professional development and confidence, are addressed through the provision of regular meeting time for PLCs, which allow for professional dialogue, learning and collaboration. This model allows for a sustained focus on ICT to ensure it becomes “an integral part of the curriculum philosophy, policies and practice of the school” (Baskin & Williams 2006, p. 471).

The barriers identified in the infrastructure and technical support category identified by the leading teachers should be addressed through the vision and implementation plan. The identification of one system for teachers to work on, and the purchase of hardware and resources to support teacher and student access, are whole-school decisions. Likewise, the technical issues and student issues identified by the teachers should be minimised or eliminated through a whole-school approach. The employment of technical support to ensure the ICT system works effectively, and the allocation of administration rights and technician support in the classroom, form part of an implementation plan.

The principal and the leadership team need to generate enthusiasm and ownership of the model, and demonstrate the benefits to the school, the teachers and the students. Teachers need to have a vested interest in the change process and understand the ‘bigger picture’. Success is more likely with a shared vision, a plan, and the allocation of time, professional learning and money to purchase necessary equipment. An implementation plan with clear steps and achievement markers provides a picture of the desired outcome, which supports teachers to embrace ICT to transform learning and allow change to occur. Ultimately, students will benefit from the increased ICT expertise that teachers develop through this model.

7.5 Conclusion

This model provides a framework to maintain an ongoing developmental focus on the integration of ICT to underpin student learning and promote transformational change in education where ICT is fully utilised to support student learning in the digital age. It outlines a process where ICT is embedded and supports quality pedagogy and effective learning (Trinidad, Newhouse & Clarkson 2005).

The proposed model takes into consideration research that recommends a more prominent and active role from the principal in promoting the change agenda for the integration of ICT (Lytle 2012; Neyland 2011; Toy 2008; Whitehead, Boschee, & Decker 2013). This model outlines a process where the principal and the leadership team take responsibility for the creation of an ICT learning culture to enable pedagogical change to occur in a supportive learning environment. The adoption of PLCs, led by members of the leadership team, requires leaders to take a prominent role in teacher ICT development. It requires the principal and the leadership team to devise strategies for change, develop and share a vision, create an implementation plan and model ICT use.

The PLC component of the model promotes teacher innovation and pedagogical change. The PLCs provide a forum for discussion and elimination or minimisation of any barriers as the teachers develop their ICT knowledge, skills and expertise. The creation of a supportive environment where teachers can collaborate and learn with and from colleagues and from students has the potential to generate enthusiasm and minimise resistance and fear. The leadership team work with teachers in the PLCs to promote effective use of ICT to support student learning with a focus on 21st Century skills. A model that values the contributions of all teachers is conducive to ICT pedagogical change. A framework that provides opportunity for discussion and collaboration on pedagogy and 21st Century ICT skills for teaching and learning has the potential to minimise the barriers identified in this research and create a positive learning culture.

This model requires committed leadership, a clear vision and implementation process, and the opportunity for collaboration and reflective practice. The role of the principal and the school leadership team is increasingly viewed as the key to achieving effective reform in relation to how teachers teach and students learn with ICT (Pettersson 2018; Toy 2008; Whitehead, Boschee & Decker 2013). The principal is required to model the use of ICT and lead the development of a vision and an implementation strategy to guide the change process and the work of the PLCs. As time is designated to the PLCs, it allows teachers to engage in regular professional learning. In summary, a model that encapsulates a whole-school approach and shows strong involvement from the principal and leadership team is more likely to accomplish aims outlined in the Digital Education Revolution (DEEWR 2007).

Chapter 8: Summary and implications

8.1 Overview

This research set out to explore the factors that affect teachers' efforts to utilise ICT to transform pedagogy and enable classroom learning experiences that incorporate 21st Century ICT skills. Despite significant financial investment, unprecedented access to ICT and various efforts by educators, policymakers and manufacturers of ICT (Bain & Weston 2012), the anticipated large-scale transformation to education offered through ICT is not yet evident. While there have been some advances to the use of ICT in the classroom, Bain and Weston (2012) contend that education has failed to capture the potential of ICT for transformational change. This view is supported by Moersch (2014), who noted that investment in ICT has not increased student achievement in the past two decades. The Digital Education Revolution Strategic Plan (DEEWR 2007) anticipated ICT being used to transform teaching and learning, but this has not occurred.

The identification of barriers impacting teachers gained from interviews conducted with leading teachers and a sample of secondary school teachers within the research setting confirmed a range of issues that impacted teacher efforts to increase their use of ICT. A greater understanding of the situation was gained by working directly with a group of teachers during the action research phase. The opportunity to work closely with a small group of teachers allowed for the close examination of their approach to the use of ICT in their classrooms and curriculum planning. The research findings were used to inform the design of a model to support the implementation of ICT within secondary schools.

The proposed model takes into consideration the barriers identified and provides a framework that ensures dedicated time to improve teacher knowledge, expertise and confidence through PLC meetings. As the research progressed, it became evident that the solution to transformational change was

much broader than eliminating or minimising the barriers for each teacher. The identification of the barriers was one part of a whole-school change agenda.

A review of the literature outlined in Chapter 2 found that previous researchers (Bingimlas 2009; Hew & Brush 2007; Mumtaz 2006; Romano 2003; Thomas 2015; Trinidad, Newhouse & Clarkson 2005) had identified similar barriers impacting teacher efforts to integrate ICT to underpin student learning. The main barriers encountered include time, confidence, pedagogy, curriculum limitations, hardware and software issues and professional learning. This chapter also discussed teacher mindset and change processes as factors that contribute to transformation in practice. In addition, a number of models developed to support the use of ICT in a range of educational settings were reviewed. Various models to further ICT use within primary, secondary and tertiary settings in a range of curriculum areas were examined; however, there was little evidence of these models being used in secondary school settings in a sustained and ongoing way. Of the models discussed, the TPACK model encapsulated the key elements for curriculum planning, highlighting the connections between content, ICT and pedagogy. The SAMR model was useful in assisting teachers to articulate how the use of ICT in the 'redefinition' stage results in a transformation to teaching and learning. It is in the 'modification' and 'redefinition' stages that ICT begins to dramatically impact on pedagogy.

Chapter 3 provided an outline of the structure of the research and the methodology. The research comprised a quality phase and an action research phase. The quality phase consisted of a series of interviews conducted at four schools recognised for their ICT programs. This phase was followed by an action research which identified the issues teachers faced in the research setting as they endeavoured to expand their use of ICT to transform student learning. This part of the research was located within the government secondary school sector, with a focus on one small metropolitan government school. It provided the opportunity to work closely with a small group of teachers as they expanded their use of ICT, planned curriculum and reflected on their efforts. Qualitative data was collected from semi-structured interviews, journal

notes and meeting records. A thematic approach was used in the data analysis stage to group the barriers that impacted teachers.

The data collected during the quality phase was discussed in Chapter 4. A range of programs, such as the Navigator Schools Program (1995), the NSSCF (2008) one-to-one learning programs initiative and BYOD programs, appeared to be the starting point for each school. In the first instance, the focus for the integration of ICT was on the provision of devices for teachers and students, along with the necessary technical infrastructure. Data collected from the leading teacher interviews provided an overview of the way ICT was used in these leading schools and the various strategies that leading teachers implemented to transform teacher practice to improve student learning with ICT. Data from the quality phase of the research confirmed that teacher ICT use continued to be impacted by a range of barriers. While these leading schools had adopted a whole-school approach to ICT and teacher use was relatively high, ICT was predominantly used to support practices located in the enhancement stage of the SAMR model (Puentedura 2006). The leading teachers continued to explore how to integrate ICT to transform teaching and learning and provide opportunities for students to learn in ways that were not possible prior to the introduction of ICT (Jukes, McCain & Crockett 2010; Yelland 2007).

The teacher interview phase, conducted in the research setting, was reported in Chapter 5. The main barriers identified were time, confidence, technical issues, student issues and professional development. There was an apparent overlap and interconnection between the barriers, as teachers felt that with more time to do professional learning, their confidence would increase. The barriers identified by the participants in the research setting were similar to those identified by the leading teachers. The action research component that followed allowed the opportunity to work closely with a small group of teachers as they endeavoured to expand their use of ICT to underpin student learning. The interviews also provided insight into strategies that were effective such as accessibility to one-on-one coaching and technical support.

The action research phase of this study, discussed in Chapter 6, revealed each participant was prepared to integrate ICT into their teaching and learning classroom activities and demonstrated their capacity to engage in the use of ICT. The initial two participants reported using ICT in a variety of ways and stated they were keen to expand their use of ICT. They recognised it was the way forward, but they tended to look for ICT that supported the delivery of their current units and content as opposed to using 21st Century ICT skills to transform the way in which students learnt. The participants expressed a level of frustration when their efforts to incorporate ICT were not successful, invariably due to the barriers identified. To a large extent, each teacher was working in isolation to develop their ICT expertise. A whole-school focus with a structured approach to the use of ICT was not evident.

The findings from each stage of the research informed the development of a model for use in secondary schools, presented in Chapter 7. The proposed model provides a framework for a whole-school approach, with a clear expectation that the principal and the leadership team take responsibility for the creation of a vision and an implementation plan. The model requires the principal and the leadership team to be actively involved in the creation of an ICT learning culture and to model expected ICT practices. The model is based on PLCs and requires leaders to guide the change process through working with small groups of teachers. The leaders identify the needs of the members of their PLC and determine how to best minimise perceived barriers, provide professional development and share learning. Any of the models discussed in Chapter 2 can be utilised according to the needs of group members. In line with the findings, Phelps and Graham (2013) reinforce that the opportunity to work in a PLC provides both time and a supportive collaborative learning environment.

A whole-school approach along with the active involvement of the principal and the leadership team provides teaching staff with an overview of the 21st Century ICT classroom and learning transformation process. The principal and leadership team hold the responsibility for shaping the whole-school approach to ICT and the transformation of student learning. The implementation plan provides direction and a supportive learning environment that works to minimise

barriers. The proposed model encourages the leadership team and teachers to be receptive to input from students in working towards a learning partnership between students and teachers (Prensky 2012).

Within the model the importance of student input is acknowledged, as they are often the lead users of ICT and ICT is increasingly the foundation underpinning everything they do (Prensky 2012). The creation of a culture where students are encouraged to share their ICT knowledge not only demonstrates the use of ICT for learning but also assists in the creation of a collaborative learning environment. Prensky (2012) promotes the notion of a learning partnership where students and teachers work together to achieve 21st Century learning outcomes. He envisages students using technology to find information and create products, and teachers guiding learning by creating context and ensuring quality and rigour. With students demonstrating how they use ICT, teachers may be more willing to incorporate opportunities that allow for learning with ICT. “Unless we change *how* things are taught and *what* is taught, in all of our classrooms, we won’t be able to provide an education that has our kids fighting to be in school” (Prensky 2012, p. 15).

Referring back to the intent of the Digital Education Revolution (DEEWR 2007), the four strands of change identified were leadership, infrastructure, learning resources and teacher capability. From this research, it has become apparent that the role of the principal is a driver for transforming learning through ICT to cater for 21st Century learners. This transformation requires an active and sustained role in leading a whole-school approach to ICT and the creation of a culture that ensures the vision is achieved. A model that clearly outlines the roles of those within the school, along with a vision and overview of the desired outcomes, provides a reference for the whole-school community. Staff and students can be guided into a new learning paradigm.

8.2 Outcomes of the research

8.2.1 Understanding of the problem

This research identified a range of barriers that affected secondary school teachers within the research setting when they endeavoured to expand their use of ICT in their teaching. Various researchers identified similar barriers that impacted teachers' adoption of ICT, which verified that this problem was not unique to this research setting. It was evident from the teachers interviewed that they were happy to expand their use of ICT to support student learning, despite the barriers they had encountered, a finding also confirmed by Bingimlas (2009). Each participant interviewed could demonstrate a variety of ways in which they had used ICT. However, many of the teachers appeared to be working individually in their efforts to improve their practice, and some were unsure of what an ICT-rich classroom looked like.

As the research progressed, it became apparent the research problem was part of a bigger cultural change required to bring about a transition within education. It was evident that the focus should not be limited to the identification and elimination of barriers for individual teachers. A model that supported a whole-school approach and embraced a broader perspective of pedagogy and ICT, and how teachers could be best supported to use ICT to improve student learning, was more likely to effect change.

Many researchers (Phelps & Graham 2013; Cox, Preston & Cox 1999; Trinidad, Newhouse & Clarkson 2005; Hayes & Harriman 2001) have recommended that principals take a leading role in creating a culture for change and creating the vision for ICT pedagogy to transform student learning. The literature suggests change is more likely when principals take an active role in the implementation of ICT. The integration of ICT is not simply a matter of mapping the use of new technologies into old curriculum (Yelland 2007); it requires recognition of the problem and a change process. The transition to a 21st Century ICT classroom requires new thinking, new curriculum and a new pedagogy. The use of a model by schools can assist the change process by outlining the process and the commitment to change.

This research commenced with the notion that by identifying barriers, one could eliminate them and find a solution. This was a rather narrow view of the problem. Whilst the research initially concentrated on the identification of barriers that impacted teachers and their integration of ICT, as the research progressed a fuller understanding of the situation emerged. Teachers tended to work in isolation and there was often a lack of clarity about the direction for the whole school. Teachers are part of an organisation and the problems existed for all teachers to varying degrees. All the teachers interviewed felt they could do more with ICT if the perceived barriers were addressed.

> The curriculum of the future is not 'out there', it needs to be imagined and constructed. (Williamson 2013, p. 63)

To cater to the teaching and learning needs of the current generation, the learning environment needs to transition from a content focus to a collaborative environment, where learners create the learning process, the content and the outcomes, and teachers facilitate learning in an ICT-rich environment. An understanding of learning theories and pedagogy and a vision of how new technology facilitates learning is required for the curriculum of the digital age. Prensky (2005) believes the time has come for teachers to do new things in new ways. The curriculum model may need to be redesigned to better represent the digital age.

8.2.2 The advantages of working in learning teams

The supportive nature of the action research allowed the participants to share their learning experience within the group, to plan and trial work, to engage in professional dialogue about pedagogy and ICT, and to gain feedback. The participant involvement in the action research appeared to provide the incentive for those teachers to spend time examining their practice and exploring available ICT, so they could further embed their use of ICT to underpin student learning. The participants were keen to improve on their use of ICT and, over the two cycles, one was able to increase her ability to work through ICT problems that arose. The participants were responsive to the SAMR model, as they could easily locate themselves on a stage in the model and could

understand the levels in approaching transformational learning. The action research process was similar to a PLC. A school's culture can significantly influence the extent to which teachers are motivated to change, be involved in a process of continual learning, and perceive ICT as integral to the teaching and learning process (Phelps & Graham 2013). Thus, the establishment of PLCs within a model that is supported and guided by the principal and the leadership team is likely to create a collaborative learning environment.

8.2.3 Development of a model

A direct outcome of this research is the creation of a model that places the responsibility for leading change with the principal. The proposed model promotes a whole-school approach to the use of ICT to transform the way students learn. It requires the principal to create the learning culture and take a leadership role in advocating the use of ICT to transform teaching and learning. It is important for school leaders to create and maintain a culture of learning and to model expected behaviours. Toy (2008) supports the notion that principals should become expert users of ICT to model ongoing learning. This model incorporates this expectation and further enlists all members of the leadership team to actively support teachers to expand their ICT pedagogical practice within PLCs. It is anticipated that a positive learning culture is created within each PLC. This model values input from students and allows for feedback to the principal and leadership team and to PLCs. The opportunity for input from students allows for the sharing of student knowledge and expertise, and input about their preferred learning styles and concerns.

The principal and the leadership team manage the change process, guided by an agreed vision and implementation plan. PLCs provide a format that encourages continuous learning through professional development, sharing and training. The PLCs allow the teachers to collectively take action to create a digital earning environment. The value of professional reading, dialogue, sharing and feedback became apparent during the action research phase. Thus, a key factor influencing the inclusion of PLCs in the proposed model was building regular and ongoing time for this to occur into the school schedule.

It is often the case that principals delegate the responsibility for ICT to staff members who are more knowledgeable in this field (Baskin & Williams 2006). However, this research has highlighted the need for principals, as educational leaders, to be more cognisant of the broader challenges confronting teachers and the need for cultural change. The principal needs to be directly involved in creating the culture to achieve the desired outcome. The principal, in conjunction with the leadership team, should articulate the vision, modelling the use of ICT and implementing processes to support the creation of a learning culture. The use of a model provides a clear plan for the school community, the leadership team, teachers and students.

8.3 Scholarly contributions of the study

The findings contribute to the field of research associated with ICT and pedagogy and the integration of ICT into teacher practice. These findings also support existing research on the importance of school leadership in transformational change and collaborative leadership for school improvement (Hallinger & Heck 2010). Investigation of the barriers impacting teachers and their use of ICT has highlighted that this teacher issue is a small aspect of a whole-school problem and a leadership issue that requires cultural change (Phelps & Graham 2013).

This research highlighted the importance of the principal in leading the change process with a clear vision and modelling the use of ICT in practice. This study contributes to the research examining the direct impact principals have on ICT outcomes (Anderson & Dexter 2005; Otto & Albion 2002; Wei et al. 2016). The integration of ICT into school pedagogy and practice has changed what learners know and how they learn (Papa 2011), and leaders and teachers need to respond to this changed landscape. Pedagogical support for teachers and principals has the potential to increase the capacity to use ICT to change the approach to teaching with ICT and personalise learning. In addition, this research points to the benefit of a whole-school approach to ICT for transforming education.

The creation of a whole-school approach where teachers are able to collaborate in a supportive environment encourages teacher development and is conducive to change. The development of a model that support teachers to minimise barriers provides a process whereby teachers can formulate new paradigms for student learning and redesign the spaces in which learning takes place.

The current findings portray an emphasis on increasing teacher ICT expertise by minimising or eliminating the barriers that impact their efforts to integrate ICT. Transformational change requires teachers to move away from seeing ICT as an 'add on'. A clear vision of a 21st Century ICT classroom, and how ICT can be used to allow students to create, communicate, collaborate, and problem-solve, will inform teachers on how ICT is used to transform learning.

8.3.1 Implications for theory and research

This study builds on the research into barriers that impact the integration of ICT conducted by Hew and Brush (2007), Mumtaz (2000), Romano (2003) and Thomson (2015), exploring possible solutions through action research. The current investigation examined the problem from the viewpoint of teachers and change, and considered how a model could assist in furthering the integration of ICT to support student learning. This research identified the barriers experienced by a number of teachers in a small sample of secondary schools. A unique insight into the research problem was gained by having the principal as the researcher. The model, presented as a figural representation of the current research, is yet to be evaluated for its effectiveness in engaging principals in the leadership of ICT.

The teacher participants engaged positively in the collegiality of the small group aspect of action research, as it is a methodology often used to change professional practice. Actively involving teachers in action research located the investigation at the source. Action research is suited to educational research as it allows for the investigation of real problems and for teachers to analyse and reflect on their practice (Koshy 2010). In this study, the principal could see the learning process for teachers as the participants worked on the integration of ICT. Action research not only engages participants in reflective practice, but

also creates the production of knowledge through the process (Cochran-Smyth & Lytle 2009).

Additional investigation into the theory of change practice is important to guide school leaders and teachers in the creation of a collaborative environment that enables teachers to bring together the set of ICT skills possessed by 'digital natives' (Prensky 2001), and the skills and competencies required in the knowledge economy to transform pedagogy. Furthermore, supporting each student's ability to move through virtual spaces, online environments and forums in conjunction with teachers' ICT practice will promote the 21st Century digital classroom. Hall and Hord (2010) acknowledge change is difficult in educational settings, so it is important to address each individual's concerns and ensure a clear purpose (Milne 2006).

This study contributes to the field of research on the roles of principals and leaders in advancing ICT to transform pedagogy. It provides both an insight into how teachers approach the integration of ICT, and contributes knowledge about the difficulties teachers encounter with the integration of ICT. The research identifies the benefit of teachers working collaboratively, which can be facilitated through the establishment of PLCs. The proposed framework acts as a guide for the work of leading teachers within PLCs to support teachers. Furthermore, the current research builds on research conducted by Otto and Albion (2002), who concluded that little is known about how the beliefs of principals and school leaders influence the adoption of ICT within schools.

8.3.2 Implications for practice

The impact of ICT within the banking, travel and medical industries is clearly evident, yet there remains a reluctance to integrate ICT in schools and confusion about how ICT can be used to transform learning (Romeo 2006). This study was designed to facilitate the identification of the barriers facing teachers, but also highlighted the need for such issues to be considered within the broader context of a whole-school change process. This research reconceptualised the role of principals in leading and modelling ICT practices to transform pedagogy. The most significant finding is the need for school leaders

to be proactive in supporting teachers to develop their ICT knowledge and expertise. This research prompts leaders to examine their role in regard to the meaningful integration of ICT (Anderson & Dexter 2005) and to reflect on the extent to which they can use change management processes such as PLCs to effect change. The principal, through adopting a proactive role in leading the transformation of ICT practices, demonstrates support for teachers and a commitment to ICT, which is more likely to effect change.

The active involvement of principals and leading teachers is necessary to achieve a whole-school approach. The quality phase data revealed each leading teacher held the responsibility for ICT implementation and individually responded to the ICT needs of staff. They all provided examples of how they had varied the delivery of professional learning to meet the needs of small groups and individual teachers. This model promotes a collective responsibility in the approach to the implementation of ICT, ensuring that all leaders are involved in the change process. It provides guidance on suggested actions for the principal and the leadership team, such as developing a vision and implementation plan, establishing PLCs, modelling the use of the ICT teachers are expected to use, and expanding ICT practice. The creation of a vision and an evaluation process, along with time to achieve changes in practice, are important components of the change process (Solar, Sabattin & Parada 2013).

There appears to be a gap between the intentions outlined in the Digital Education Revolution (DEEWR 2007) and the potential of ICT to transform the ways students learn. The development of teachers' understanding of the application of ICT in their teaching area contributes to the integration of ICT to further student learning. The implementation of small collaborative teams where ICT policies, practices and professional learning are discussed has the potential to inform the ICT needs of each teacher. An environment that encourages teachers to embrace the ICT skill set that students bring to the classroom will more likely engage students in the learning process.

A further consideration for practice is the area of teacher training. Trainee teachers may require assistance with understanding the integration of 21st

Century ICT skills and knowledge to facilitate student learning. Trainee teachers need to identify pedagogical approaches that enable the inclusion of ICT into meaningful learning tasks (Moyle 2006). In her research into the digital literacies of graduate teachers, Carr (2010) found the personal ICT skills that pre-service teachers possess do not automatically translate into transformative classroom practice. Pre-service teachers need exposure to the effective use of ICT and assistance to develop technology pedagogical content knowledge (Carr 2010) to engage and motivate students.

8.4 Limitations of this research

The research enabled a unique insight into issues within one small metropolitan secondary college. The study outlines the research process and presents the outcomes of an action research study, the findings of which are context specific and unique to the participants in this setting. Research and theory construction has allowed the teacher participants to reflect on the research problem and their practice; however, the action research findings may be seen as limiting, as they are specific to this setting and the research base was quite small in the action research phase.

The data gained from the interviews and action research makes it difficult to generalise the findings and implications of this study, as the data is unique to the research setting. However, the findings should stimulate interest for further inquiry in this area, in particular from school leaders. While the findings cannot be generalised to other settings, the action research process may be applicable to other schools to assist in bringing about transformational change.

As the researcher for this study held the position of Principal in the research setting, the willingness of teachers to be involved and speak freely may have been impacted. Strategies to minimise any perceived power relationships included the teacher interviews being conducted by a person external to the setting. The interviewer coded the responses so that each participant was not identified. The small participation rate for the action research component may also be a contributing limitation.

In action research, the role of the researcher is predominantly one of a facilitator and manager of the process. According to Stringer (2007), the researcher stimulates participants to review their practice and in this way is a catalyst for change. Care was taken to limit bias and maximise involvement of participants through the involvement of an academic in education serving as a critical friend during the action research meetings.

The initial research on the challenges facing educational leaders and teachers regarding the use of ICT to transform teaching and learning (Cox, Preston & Cox 1999; Mumtaz 2006; Passey & Samways 1997) moved towards a focus on models to support ICT adoption (Hall & Loucks 1997; Heinrich et al. 2001; Hoffman & Ritchie 1998; Mishra & Koehler 2006; Puentedura 2006; Wang & Wu 2007; Wang 2008). However, the number of studies dealing specifically with ICT to transform pedagogy (Pandolfini 2016; Prensky 2012; Trinidad, Newhouse & Clarkson 2005; Williamson 2013) often appear to discuss the educational benefits of the latest model or ICT device.

8.5 Future research

An examination of the proposed model within a broader spread of secondary school settings to test its effectiveness would provide data in relation to ICT transformation in teaching and learning. In particular, further research into the professional learning process that occurs within PLCs and the actual ICT practices employed by teachers would be useful. Such an approach, using either case study or action research, would gauge the efficacy of this model. In addition, it would be valuable to monitor the development of the ICT learning culture within PLCs. Both existing literature and the current findings reinforce that the effective use of ICT to transform pedagogy requires a paradigm shift, therefore further investigation into teacher development in relation to their use of ICT to create new learning perspectives would contribute to the manner in which ICT is used in schools to support student learning.

An examination of the use of this model within a broader sample of secondary settings could form the next stage of research. Schools are busy places, with a

range of demands from various stakeholders, so it would be interesting to gauge the effectiveness of this model in maintaining a sustained focus on ICT to transform pedagogical practice and underpin student learning. The role of the principal in leading and maintaining a focus on the change process is of particular interest. The next layer to this research would require the evaluation of the extent to which ICT is embedded in pedagogical practice to transform the ways students learn.

However, there is a need to go beyond the evaluation of the school context and the learning situation gained from observations and personal reflections to measure the real impact of ICT to improve student learning. The management of school-based investigations similar to the current study could be extended to connect researchers with PLCs, which in turn would help teachers to define the research questions and link research to practice (Balanskat, Blamire & Kefala 2006). As teachers progress through the action research cycles, their 'theoretical' reflections could be adapted to meet their own professional and subject-specific needs. In addition, changed educational contexts such as teamwork and collaboration could be incorporated into school improvement plans, with student performance assessed to evaluate on-the-ground progress.

Teachers need support in qualitative interpretation in order to evaluate the causes and to measure the impact of change. Balanskat, Blamire and Kefala (2006) suggest that skilling teachers in action research and the interpretation of data contributes to the quality of the data obtained which, in turn, informs the process for change. An examination of the impact of ICT, when barriers are eliminated and teacher ICT capacity has increased, would indicate the extent to which ICT is used to transform pedagogy.

A further area for investigation is the leadership role of principals in the implementation of ICT in schools. This could extend the work of Wei and colleagues (2016), who examined the integration of ICT in the Malaysian education system. They suggest principals are well placed to function as the agents for change in influencing ICT; however, relatively little empirical research has explored this issue.

8.6 Conclusion

In considering the initial development of this research proposal, there was an underlying assumption that the research problem was limited to the identification of barriers that impact teachers' use of ICT. The study enabled an investigation of the research question and the subsequent development of a model to either minimise or eliminate the barriers. It was assumed that this in turn would facilitate increased use of ICT and a move towards a 21st Century ICT classroom. However, that view was far too simplistic. It transpired that the research problem was part of a broader and more complex issue that requires change on a number of levels.

The identification of barriers that affected teachers' use of ICT was essential to provide an understanding of the research problem, what teachers had to contend with and how they were feeling when their efforts to use ICT were not successful. Working with a small team of teachers through the action research phase, combined with the knowledge about the range of barriers gained from the interview phases, informed the development of a model to provide a framework that could assist school leaders to reflect on their role in the integration of ICT to transform student learning. A need emerged to examine the identified challenges as part of a whole-school approach to the use of ICT and 21st Century learning.

Throughout the action research component, it was evident that teachers enjoyed working in a supportive collegiate learning environment. The inclusion of PLCs within the model is an attempt to replicate this collaborative learning environment. The use of a model outlines a clear process for all members of the school community. This model requires the principal to lead the change process, to model the use of ICT to ensure there is a vision and implementation plan, and to maintain leadership in the change process. The involvement of the principal is an essential part of this model, to ensure a change in culture and to develop a whole-school approach to progress the use of ICT by all teachers. An essential aspect of ICT in the classroom is to support more meaningful learning

experiences for students, and greater success is achieved with a clear process in place (Phelps & Graham 2013).

> Lifelong learning and the journey never ends, and that's part of teaching I suppose, and that's the beauty of it; reinventing what you do in some way all the time to be able to create energised classes with students that are committed to learning and ICT does provide that. (Sally)

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Appendices

Appendix 1: DEECD permission to conduct research

Appendix 2: Advertisement for participants

Appendix 3: Information for participants (quality practice phase)

Appendix 4: Participant consent form (quality practice phase)

Appendix 5: Exemplar questions (quality phase)

Appendix 6: Exemplar questions (participant interviews)

Appendix 7: Information for participants (action research phase)

Appendix 8: Participant consent form (action research phase)

Appendix 1: DEECD permission to conduct research

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BRUNSWICK 3056

Dear Ms Prange

Thank you for your application of 7 February 2014 in which you request permission to conduct research in Victorian government schools and/or early childhood settings titled *Investigating a best practice model for facilitating information and communication technology implementation in the secondary school classroom.*

I am pleased to advise that on the basis of the information you have provided your research proposal is approved in principle subject to the conditions detailed below.

1. The research is conducted in accordance with the final documentation you provided to the Department of Education and Early Childhood Development.

2. Separate approval for the research needs to be sought from school principals and/or centre directors. This is to be supported by the DEECD approved documentation and, if applicable, the letter of approval from a relevant and formally constituted Human Research Ethics Committee.

3. The project is commenced within 12 months of this approval letter and any extensions or variations to your study, including those requested by an ethics committee must be submitted to the Department of Education and Early Childhood Development for its consideration before you proceed.

4. As a matter of courtesy, you advise the relevant Regional Director of the schools or governing body of the early childhood settings that you intend to approach. An outline of your research and a copy of this letter should be provided to the Regional Director or governing body.

5. You acknowledge the support of the Department of Education and Early Childhood Development in any publications arising from the research.

6. The Research Agreement conditions, which include the reporting requirements at the conclusion of your study, are upheld. A reminder will be sent for reports not submitted by the study's indicative completion date.

7. If DEECD has commissioned you to undertake this research, the responsible Branch/Division will need to approve any material you provide for publication on the Department's Research Register.

State Government Victoria

I wish you well with your research study. Should you have further enquiries on this matter, please contact Youla Michaels, Project Support Officer, Research, Evaluation and Analytics Branch, by telephone on (03) 9637 2707 or by email at michaels.youla.y@edumail.vic.gov.au.

Yours sincerely

[redacted]

Joyce Cleary
Director
Research, Evaluation and Analytics Branch

30/04/2014

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Appendix 2: Advertisement for participants

Participants wanted …

Teacher participants wanted to participate in an action research project during terms 1, 2 and 3.

Title: Investigating a model of facilitating Information and Communication Technology implementation in the secondary school classroom.

What is involved?

- Willingness to focus on implementing ICT to underpin student learning
- To meet and participate in collegiate discussions as part of the action research
- Participate in an interview with an external reviewer
- To keep a journal
- To share thinking, processes and difficulties encountered in working through a unit that embeds ICT

Background

The strategic plan for Australian schools to transition to 21st Century learning was outlined in the Digital Education Revolution (2007). This four to five year plan that aimed to "contribute sustainable and meaningful change to teaching and learning in Australian schools to prepare students for further education, training, jobs of the future and to live and work in a digital world." (National Partnership Agreement 2009 p. 2) The *Joint Ministerial Statement on ICT in Australian education and training: 2008-2011 (2008)* outlined a commitment by Education Ministers to collaborate to share resources and expertise, leverage initiatives and to continue to focus on innovation and experimentation. "In practice, this means:

- *Students undertake challenging and stimulating learning activities supported by access to global information resources and powerful tools for information processing, communication and collaboration,*
- *Teachers devise student centric programs of learning that address agreed curriculum standards and employ contemporary learning resources and activities, and*
- *Parents support students in their learning by monitoring programs and progress and by communicating with teachers online* (DER *2007 p. 3).*"

In summary, the expectation of this statement was teachers would devise contemporary learning programs that incorporate global resources through ICT that both stimulates and challenges student learning.

Expressions of interest to be submitted to Chief Supervisor Dr Anthony Watt:

Email: Anthony.Watt@vu.edu.au

Appendix 3: Information to participants (quality practice phase)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH (Quality Practice Phase)

You are invited to participate

You are invited to participate in a research project titled: *Investigating a model of facilitating Information and Communication Technology implementation in the secondary school classroom.*

This project is being conducted by a student researcher Bette Prange as part of a Doctorate of Education at Victoria University under the supervision of Dr Anthony Watt and Dr Peter Thomas.

Project explanation

This research aims to formulate a model to support teachers in changing practice through the development of their expertise in utilising a netbook program as a component of current strategies instigated to improve student learning outcomes. The initial phase of the project will consider the ICT implementation practices of three secondary school settings where staff currently utilise netbook technology. Staff at the principal class level, the ICT curriculum and implementation coordinator, and a teacher currently utilising the Notebook technology will be recruited and interviewed at each of these settings. This will be followed by an action research phase, where participants will examine what enables teachers in using a one to one netbook program.

What will I be asked to do?

Participants in this phase will participate in a semi-structured interview regarding how ICT has been implemented at their school lasting approximately 30 to 60 minutes.

What will I gain from participating?

There is no direct benefit to participants in this phase beyond the opportunity to share information within the professional community regarding successful practices in school based ICT implementation.

How will the information I give be used?

The information will be used to inform the development of a model to assist classroom teachers to embrace the use of ICT to underpin student learning in the classroom. Collective thinking, ideas and strategies will be used to inform the development of a model. The information will also form the basis of the student researchers thesis, and may be used in future conference presentations of journal articles.

What are the potential risks of participating in this project?

The risks to participants is minimal. However, there is the possibility that discussing professional practices associated with school teaching and learning outcomes could lead to a level of anxiousness. You will also be provided with opportunity to review the interview transcript once completed if you desire by contacting the Principal Investigator, Dr Anthony Watt (9919 4119). If as an outcome of your involvement in the project you experience any continuing concerns or anxiousness, then you may contact or Counsellor, Dr Mark Andersen of Victoria University, who is available to discuss any issues that you would like to raise (9919 5413, mark.andersen@vu.edu.au).

How will this project be conducted?

School visits will be conducted at three sites where ICT has currently been implemented successfully. This phase will inform the Action Research phase conducted at one school site.

Who is conducting the study?

Chief Investigator:	Dr Anthony Watt Phone: email: Anthony.Watt@vu.edu.au
Associate Investigator:	Dr peter Thomas Phone: 9919 2023
Student Researcher:	Bette Prange Phone: 9689 4788

Any queries about your participation in this project may be directed to the Chief Investigator listed above.
If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

Appendix 4: Participant consent form (quality practice phase)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH (Quality Practice Phase)

INFORMATION TO PARTICIPANTS:

We would like to invite you to be a part of a study titled ' Investigating a model of facilitating Information and Communication Technology implementation in the secondary school classroom'. The aim of this project is develop a model to assist teachers to embed Information and Communication Technology in their teaching and learning tasks.

CERTIFICATION BY SUBJECT

I, "[Click here & type participant's name]"
of "[Click here & type participant's suburb]"

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: Investigating a model of facilitating Information and Communication Technology implementation in the secondary school classroom being conducted through Victoria University by: Bette Prange, Anthony Watt, and Peter Thomas.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Bette Prange – Student Researcher

and that I freely consent to participation involving the below mentioned procedures:

- Semi- structured Interview lasting between 30 and 60 minutes

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:

Date:

Any queries about your participation in this project may be directed to the chief researcher
Dr Anthony Watt
Ph: 9919 4119

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email Researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

[*please note: Where the participant/s are aged under 18, separate parental consent is required; where the participant/s are unable to answer for themselves due to mental illness or disability, parental or guardian consent may be required.]

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Appendix 5: Exemplar questions (quality phase)

Thank you for participating in this interview. I have a set of questions to guide this interview but may ask follow up questions to seek clarification and elaboration.

This research project endeavours to establish the barriers that impact on the use of technology in the classroom to underpin teaching and learning.

1 How many teachers are on staff here?

2. What is the student population?

3. Can you tell me about your ICT program? What devices do teachers and the students use here at your school?

4. How was ICT introduced to the college initially?

5. Can you picture the staff in terms of their ICT skill level and being in favour of the ICT initiative here with a greater focus on ICT?

6. What strategies did you use to support teachers to increase their use of ICT?

7. What are the main barriers you feel prevented some teachers from adopting ICT?

8. How did you go about minimising the barriers so that teachers came on board?

9. In what ways do teachers currently use technology in their classes?

10. Can you provide examples of how you think teachers use ICT to assist student learning?

11. Do you think it is the teacher who uses the ICT to teach or is it students who use the technology?

12. Do you have any concerns about the demands of AusVELS and VCE study designs and the need to cover the curriculum impacting teacher use of ICT?

13. Do you think your school has been successful in ensuring the focus of ICT is on enhancing student learning or are teachers using it more for administration tasks?

14. Do you think teachers allow students to construct their own meaning from their learning experiences? How do teachers set up the classroom situation/learning environment to allow this to happen?

Thank you for your time. You will receive a transcript of the interview and have an opportunity to confirm your responses and make some changes if you feel that is necessary.

Appendix 6: Exemplar questions (participant interviews)

All participants would be asked to complete the DEECD epotential survey to establish their skill level.

Have participants complete a SWOT analysis to identify their strengths, weaknesses, opportunities and threats.

Follow up interview questions:

How do you rate yourself as a user of Information Communication Technology?

In what ways do you currently use technology in your classes?

Do you think it is you who uses the Information Communication Technology to teach or is it students who use the technology?

What do the students use the netbooks for?

Do you think you could use Information Communication Technology more to support student learning? If so, how?

What concerns do you have in relation to using ICT in your classes?

Do you think the ICT used currently is used to assist you in your role as a teacher or to assist students with their learning?

Can you provide examples of how you use ICT to assist student learning?

What prevents you from broadening the way you use Information Communication Technology? For example: confidence, not sure what to do or what programs do what, feel better doing it myself and talking, I can do it better?)

When planning a unit of work do you look at how Information Communication Technology can enhance the learning? At what stage of unit planning do you consider technology/

What do you think will help you integrate Information Communication Technology to improve student learning?

Appendix 7: Information to participants (action research phase)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH (Action Research Phase)

You are invited to participate

You are invited to participate in a research project titled: Investigating a model of facilitating Information and Communication Technology implementation in the secondary school classroom.

This project is being conducted by a student researcher Bette Prange as part of a Doctorate of Education at Victoria University under the supervision of Dr Anthony Watt and Dr Peter Thomas.

Project explanation

This research aims to formulate a model to support teachers in changing practice through the development of their expertise in utilising a netbook program as a component of current strategies instigated to improve student learning outcomes. Through this action research study, participants will examine what enables teachers in using a one to one netbook program. An important goal of this research is to focus on the teacher's thinking and decision making processes to identify a model of unit planning that allows them to embrace the use of ICT in the classroom. The engagement of a collaborative protocol, will provide the opportunity for the researchers to work together with participants in identifying the efficacious skills and knowledge associated with teachers pedagogical usage of Netbooks.

What will I be asked to do?

Teacher participants will be asked to focus on implementing ICT through a unit of work to underpin student learning.
Teacher participants will be interviewed by the research team and student researcher to establish the current level of ICT use in student curriculum.
Participants will also meet and participate in collegiate group discussions with the student researcher as part of the action research process, 3 times throughout both of the action research cycles of the project. This will enable the sharing of thinking, processes successes and difficulties encountered in working through a unit that embeds notebook based ICT
Participants will also be asked to keep a reflection journal as a source of information to be utilised within the project.
A critical friend from Victoria University will attend the collegiate meetings to observe meeting procedure and protocols.

What will I gain from participating?

Collegiate support in the implementation of ICT and access to an additional professional learning opportunity

How will the information I give be used?

The information will be used to inform the development of a model to assist classroom teachers to embrace the use of ICT to underpin student learning in the classroom. Collective thinking, ideas and strategies will be used to inform the development of a model. The information will also form the basis of the student researcher's thesis, and may be used in future conference presentations of journal articles.

What are the potential risks of participating in this project?

The risks to participants are minimal. However, there is the possibility that discussing professional practices associated with student outcomes could lead to a level of anxiousness. Further to this the possibility exists that members of action research group may share information outside of the scheduled meetings. The researcher will reinforce with all members of the group the need for confidentiality and to restrict conversations regarding the project to the meeting format. You will

also be provided with opportunity to review the report once completed if you desire by contacting the Principal Investigator, Dr Anthony Watt (9919 4119). If as an outcome of your involvement in the project you experience any continuing concerns or anxiety, then you may contact or Counsellor, Dr Mark Andersen of Victoria University, who is available to discuss any issues that you would like to raise (9919 5413, mark.andersen@vu.edu.au).

How will this project be conducted?

School visits will be conducted at three sites where ICT has been implemented successfully. This phase will inform the Action Research phase conducted at one school site. Participants recruited at that site will be interviewed prior to joining a collegiate group to work through two Action research cycles. Teacher participant personal observations, reflective journal material and interviews will provide the data for the analysis.

Who is conducting the study?

Chief Investigator:	Dr Anthony Watt email: Anthony.Watt@vu.edu.au
Associate Investigator:	Dr Peter Thomas Phone: 9919 2023
Student Researcher:	Bette Prange Phone: 9689 4788

Any queries about your participation in this project may be directed to the Chief Investigator listed above.
If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

Appendix 8: Participant consent form (action research phase)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH (Action Research Phase)

INFORMATION TO PARTICIPANTS:

We would like to invite you to be a part of a study titled 'Investigating a model of facilitating Information and Communication Technology implementation in the secondary school classroom'. The aim of this project is develop a model to assist teachers to embed Information and Communication Technology in their teaching and learning tasks.

CERTIFICATION BY SUBJECT

I, "[Click here & type participant's name]"
of "[Click here & type participant's suburb]"

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: Investigating a model of facilitating Information and Communication Technology implementation in the secondary school classroom being conducted through Victoria University by: Bette Prange, Anthony Watt, and Peter Thomas.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Bette Prange – Student Researcher

and that I freely consent to participation involving the below mentioned procedures:

- Semi- structured Interview at the commencement of the research project
- Join a collegiate group for the purposes of conducting and action research and attend six review meetings during the project
- To maintain a reflective journal throughout the research as a source of shared data

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:

Date:

Any queries about your participation in this project may be directed to the chief researcher
Dr Anthony Watt
Ph: 9919 4119

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email Researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

[*please note: Where the participant/s are aged under 18, separate parental consent is required; where the participant/s are unable to answer for themselves due to mental illness or disability, parental or guardian consent may be required.]

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