Investigation of knowledge needed by teacher mentors to support pre-service teachers to use information and communication technologies (ICT) during teaching practicums

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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Declaration of the author

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and ethics procedures and guidelines have been followed. I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

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Glossary of terms

Achievement Standard

Describes the learning expected of students at each year level or band of years in the Australian Curriculum F–10 (ACARA, 2018b) or at each level or band of levels in the Victorian Curriculum F–10 (VCAA, 2018a). There are Achievement Standards for each Learning area, (see Learning area) and also for each of the Capabilities (see General Capability) in the Victorian Curriculum F–10.

AusVELS

Refers to integration of the first phase of the Australian Curriculum F–10 learning areas into the Victorian Essential Learning Standards (VELS) curriculum framework. AusVELS replaced the VELS curriculum framework and superseded the Victorian Curriculum F–10, which was implemented in both Victorian government and Catholic schools in 2017.

Australian Curriculum Assessment and Reporting Authority (ACARA)

ACARA is the independent statutory authority responsible for the Australian Curriculum from Foundation to Year 10 in specified learning areas, and also the national assessment program aligned to the national curriculum. It is also developing senior secondary Australian Curriculum subjects. http://www.acara.edu.au/ (ACARA, 2018b).

Australian Curriculum F–10

Learning areas (see Learning area) across Foundation to Year 10 have been developed and published as sets of expectations for what all young Australians should be taught, regardless of where they live in Australia or their background http://www.acara.edu.au/curriculum (ACARA, 2018b).

Australian Institute of Teaching and School Leadership (AITSL)

Government body which oversees national regulation of initial teacher education in Australia http://www.aitsl.edu.au/ (AITSL, 2018a).

Australian Council of Deans of Education (ACDE)

The peak association of Faculty Deans and Heads of Schools of Education in Australian universities and other higher education institutions https://www.acde.edu.au/ (Australian Council of Deans of Education, 2019).

Australian Professional Standards for Teachers (APST)

Set of seven standards, grouped into three domains of teaching (Professional practice, Professional knowledge and Professional engagement), which outline what teachers should know and be able to do at four career stages (Graduate, Proficient, Highly accomplished and Lead); the standards are part of national accreditation processes, developed in 2011 (formerly known as the National Standards for Graduate Teachers). https://www.aitsl.edu.au/teach/standards (AITSL, 2018b).

Capability (see also General Capability)

Term used in the Victorian Curriculum F–10 which encompasses knowledge, skills, behaviours and dispositions that will be developed, practised, deployed and demonstrated in and through student learning across the curriculum. There are four Capabilities identified in the Victorian Curriculum F–10: Critical and Creative Thinking; Ethical; Intercultural; and Social and Personal Capability. Capabilities in the Victorian Curriculum F–10 have the same status as other learning areas, with explicit content descriptions and achievement standards.

Content Description

Term used in both the Australian Curriculum F–10 and the Victorian Curriculum F–10 to describe what is to be taught and what students are expected to learn. Content descriptions include knowledge, understanding and skills. In the Australian Curriculum F–10, content descriptions are described at a year level or band of years; in the Victorian Curriculum F–10, Content descriptions are described at a level or band of levels.

Cross-curriculum Priority

Three Cross-curriculum Priorities are embedded in the Australian and Victorian curriculums: Aboriginal and Torres Strait Islander histories and cultures; Asia and Australia's engagement with Asia and Sustainability. Each of the Cross-curriculum Priorities has a strong but variable occurrence according to their applicability to each of the learning areas http://victoriancurriculum.vcaa.vic.edu.au/overview/cross-curriculum-priorities (VCAA, 2018b).

Digital Technologies

The name of a learning area or subject in the Australian Curriculum and a curriculum area in the Victorian Curriculum F–10 that "enables students to become confident and creative developers of digital solutions through the application of information systems and specific ways of thinking about problem solving" http://victoriancurriculum.vcaa.vic.edu.au/technologies/digital-technologies/curriculum/f-10 (VCAA, 2015c).

Digital technologies

Refers to electronic tools, systems, devices and resources that generate, store or process data such as social media, applications, cloud computing and mobile devices.

Education Council

Consists of members from the Australian Commonwealth, and each state and territory, with responsibility for assisting the Council of Australian Governments (COAG) to improve educational outcomes for all Australians through national collaborative action. It was formerly known as the Standing Council on School Education and Early Childhood, (SCSEEC) and before that the Ministerial Council for Education, Early Childhood Development and Youth Affairs (MCEECDYA) and before that the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) http://www.educationcouncil.edu.au/ (Education Council, 2018).

Foundation

Refers to the first year of schooling in both the Australian and Victorian curriculums and is often represented by the capital letter 'F'. It is also referred to as Prep in Victoria.

General Capability (see also Capability)

The term used in the Australian Curriculum F–10 to refer to knowledge, skills, behaviours and dispositions that will be developed, practised, deployed and demonstrated in and through student learning across the curriculum. There are seven General capabilities identified in the Australian Curriculum F–10: Literacy, Numeracy, Information and Communication Technologies (ICT) Capability, Critical and Creative Thinking, Personal and Social Capability, Ethical Understanding and Intercultural Understanding https://www.acara.edu.au/curriculum/general-capabilities (ACARA, 2018a).

Information and Communication Technologies (ICT) General Capability

Refers to the General Capability related to accessing, creating and communicating information and ideas, solving problems and working collaboratively in all learning areas at school (ACARA, 2017).

Initial teacher education (ITE)

A pre-service course/program undertaken before entering the classroom as an in-service teacher.

Learning area

The Victorian Curriculum F–10 includes eight Learning areas: The Arts; English; Health and Physical Education; The Humanities; Languages; Mathematics; Science; and Technologies.

Melbourne Declaration on Educational Goals for Young Australians

Declaration made in 2008 by all Australian Education Ministers (Ministerial Council on Education Employment Training and Youth Affairs, 2008) that describes nationally consistent future directions and aspirations for Australian schooling, setting out the national purposes and role of learning to deliver a high-quality education for every student. It superseded the 'Adelaide Declaration on National Goals for Schooling in the Twenty-first Century' (known as the Adelaide Declaration 1999), which superseded the 'Hobart Declaration on Schooling' (known as the Hobart Declaration 1989) http://www.curriculum.edu.au/verve/_resources/national_declaration_on_the_educational_goals_for_young_australians.pdf (Australian Government Teacher Education Ministerial Advisory Group, 2015).

My School

My School is a website administered by the Australian Curriculum, Assessment and Reporting Authority, which provides access to information about Australian schools such as the student profile, enrolment numbers and funding levels https://www.myschool.edu.au/ (ACARA, 2019a).

National accreditation for initial teacher education programs

A national approach to the accreditation of initial teacher education programs in Australia was introduced in 2011, which set out requirements for program standards, professional standards and the accreditation process. It is managed by AITSL. These standards were revised in 2015 and then further updated in 2018 https://www.aitsl.edu.au/deliver-ite-programs (AITSL, 2019a).

OECD (Organisation for Economic Co-operation and Development)

An intergovernmental economic organisation with 36 member countries, founded in 1961 to stimulate economic progress and world trade https://www.oecd.org (OECD, 2019).

Pre-service teacher

Student undertaking an initial teacher education program.

Teacher Education Ministerial Advisory Group (TEMAG)

Established by the Australian Government in 2014 to provide advice on the quality of teacher training in Australia and how it could be improved https://www.education.gov.au/teacher-education-ministerial-advisory-group (Australian Government Department of Education, 2019).

Teacher mentor

In-service (or practising or classroom) teacher who supervises pre-service teacher learning on site in partner schools.

Teaching practicum

In-school professional experiences where pre-service teachers work in a classroom with real students and an in-service teacher (teacher mentor) who oversees their work.

Known also by a variety of terms such as 'clinical placement', 'cooperative education', 'field experience', 'fieldwork', 'internships', 'placement', 'practicum', 'professional experience', and 'Work-Integrated Learning' (WIL).

Top of the Class

Report on the inquiry into teacher education by House of Representatives Standing Committee on Education and Vocational Training, published in 2007 (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training & Hartsuyker, 2007).

Victorian Curriculum F–10

Released in 2015, the Victorian Curriculum F–10 is the guiding framework for F–10 curriculum in Victorian government and Catholic schools; the Victorian Curriculum F–10 incorporates the Australian Curriculum F–10 and reflects Victorian priorities and standards http://victoriancurriculum.vcaa.vic.edu.au/.

Victorian Curriculum and Assessment Authority (VCAA)

VCAA is an independent statutory body responsible to the Victorian Minister for Education, serving both government and non-government schools.

Victorian Department of Education and Training (Victorian DET)

Government department responsible for government school education in Victoria. The Victoria Department of Education and Training has been referred to in this way since 2015.

During the period referred to in this paper (1994–2019) the Victorian Department of Education and Training has had numerous names. In 1994, it was named the Directorate of School Education (DSE); in 1998, it was named the Department of Education, (DOE); in 2000, it was named the Department of Education, Employment and Training (DEET); in 2001, it was named the Department of Education and Training (DET); in 2006, it was named Department of Education (DoE); in 2007, it was named Department of Education, Employment and Early Childhood Development (DEECD).

Victorian Essential Learning Standards (VELS) (See also AusVELS)

Name of the curriculum framework for Prep to Year 10 levels in Victoria which was released in 2005; VELS was superseded by AusVELS, which was then superseded by the Victorian Curriculum F–10 that refers to Foundation to Year 10.

Victorian Institute of Teaching (VIT)

An independent statutory authority for the Victorian teaching profession, whose primary function is to regulate members of the teaching profession. One of the roles of this regulatory body is to oversee initial teacher education programs in Victoria https://www.vit.vic.edu.au/.

Abstract

Using information and communication technologies (ICT) in teaching is not straightforward as it requires teachers (both in-service and pre-service) to negotiate a range of complex factors. This research study focused specifically on gaining an understanding of the complexity of knowledge needed by teacher mentors to develop ICT capacity in pre-service teachers during teaching practicums. Both initial teacher education providers and schools play a role in developing ICT capacity in pre-service teachers in Australia. Yet, it is claimed that pre-service teachers are not prepared to teach using ICT; so too, teacher mentors who support pre-service teachers to use ICT during teaching practicums. The Australian Institute for Teaching and School Leadership (AITSL) highlights that teacher mentors can play a significant role in assisting pre-service teachers to develop their capacity to teach, including how to integrate ICT into their teaching practicum. Nevertheless, specifically what knowledge is needed to integrate ICT into teaching practice is subject to much consideration.

The Technological, Pedagogical and Content Knowledge (TPACK) framework, developed by Mishra and Koehler (2006), was used to frame the research. This research study used a mixed methods approach guided by a pragmatic paradigm framework, with a sequential explanatory design. A case study methodology was added to a sequential explanatory design, which used data from a questionnaire, semi-structured interviews and analysis of artefacts, to generate cases of four teacher mentors from schools in the North Western Metropolitan region of Melbourne, Australia.

The main findings of this research study highlighted the beliefs of teacher mentors that pre-service teachers would bring technological knowledge into the teaching practicum was problematic, and needed to be addressed. In addition, it suggested that contextual knowledge was an important knowledge to consider when teacher mentors are supporting pre-service teachers to use ICT in teaching practicums. It also reinforced that the importance of mentoring knowledge of teacher mentors needs more attention. The findings suggested

that the use of ICT in the classroom was neither easy nor straightforward. Correspondingly, it suggested that the use of ICT by teacher mentors and, consequently by pre-service teachers, was limited and constrained by numerous barriers. In essence, it concluded that the domains of knowledge needed to support ICT uptake was problematic and challenging.

Based on these main findings, a number of implications have been suggested in relation to ICT policy development, training for teacher mentors, design of initial teacher education programs and ICT-related professional learning for teachers as well as for future research. In particular, my conclusions indicated implications for enabling school leadership teams to make local decisions for local school needs, as well as emphasising that supporting teachers, and subsequently teacher mentors, to experience a range of different types of professional learning to accommodate their different needs was paramount in regard to ICT uptake. The implications also reinforced the importance of the teacher in the mentoring relationship by stipulating that in addition to a teaching degree, they need to have some formal training or further qualifications to undertake mentoring in order to enhance the practicum experiences of pre-service teachers. Specifically, it accentuated that the accreditation for teacher mentors needs to be mandated to ensure standards for mentoring are aligned with theoretical underpinnings and empirical evidence.

1. Introduction

1.1. Providing the context

This research study explores the domains (or types) of knowledge needed by teacher mentors to support pre-service teachers to use ICT during teaching practicums. Since the early 1990s, Australian governments have encouraged an ICT agenda in Australian schools. Nowadays all teachers, and therefore teacher mentors, are expected to use ICT in their teaching practice and to do so safely, responsibly and ethically to support delivery of the curriculum (AITSL, 2018b). However, while the early years of ICT implementation were categorised by considerable hype (Selwyn, 2011), there has been increasing concern that teachers lack the knowledge to do so, with the recent review of teacher education (Teacher Education Ministerial Advisory Group, 2014), advocating for teacher mentors (those who supervise pre-service teachers while on teaching practicums) to take a more proactive role in supporting pre-service teachers to use ICT.

Teacher education has a critical role to perform in supporting pre-service teachers in developing knowledge to integrate ICT into their teaching practice. All initial teacher education programs in Australia require pre-service teachers to undertake teaching practicums in schools. According to AITSL, teacher mentors play an important role in supporting pre-service teachers to develop their knowledge to teach, including how to integrate ICT into their practice (AITSL, 2011). As mentioned, in recent times there has been increased acknowledgement nationally and at state level in Australia about the role of teacher education in supporting pre-service teachers to develop capabilities in using ICT in their practice. For example, the Teacher Education Ministerial Advisory Group (TEMAG), set up to advise the Australian government on how initial teacher education providers could better prepare pre-service teachers like the ‘Top of the Class report’ (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training &

Hartsuyker, 2007) beforehand, recommended more explicit attention to ICT capabilities (Australian Government Teacher Education Ministerial Advisory Group, 2015).

In Australia, as well as other countries such as the United States and the United Kingdom, there is also an increasing regulatory environment around teacher education. In 2011, national Accreditation Standards and Procedures were introduced in Australia, which stipulated particular requirements (e.g. entrance requirements, program selection and program design) (AITSL, 2017). These Australian national standards also set out the requirements for the teaching practicum. These requirements include that programs should be well-sequenced; involve formal written partnerships with schools that outline communication processes, roles and responsibilities of those involved; learning experiences in coursework, and expectations for the teaching practicum; and have a minimum number of days in schools in undergraduate and postgraduate programs. Importantly, the teaching practicum must be supervised by teacher mentors, experienced teachers who can support the development of practical skills of pre-service teachers.

These national standards also incorporate the Australian Professional Standards for Teachers at the Graduate level (AITSL, 2018b). The 37 standards are organised into three domains: Professional knowledge; Professional practice; and Professional engagement (AITSL, 2018b). All initial teacher education programs need to document where these standards are taught, practised and assessed, including those related to using ICT resources as well as for the safe, ethical and responsible use of ICT.

This national approach to initial teacher education programs is intended to enhance the quality and consistency of teaching programs across Australia. The teacher regulatory authorities for each jurisdiction implement them in the local context; the Victorian Institute of Teaching (VIT) (Victorian Institute of Teaching, 2019) is responsible for leading activities to support the nationally consistent assessment of evidence supplied in Victoria, in which this research study is conducted. Largely, this Australian national approach has been applauded by the Australian Council of Deans of Education (Australian Council of Deans of Education, 2019) as it is regarded as enabling a more universal and coherent way of delivering desired outcomes for pre-service teachers so that they can use ICT effectively in their classroom practice (Lloyd, 2014).

There has been considerable research around teacher use of ICT in the classroom (Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017; Mouza, 2011; Phillips, 2013; Selwyn, Nemorin, Bulfin, & Johnson, 2018; Wozney, Venkatesh, & Abrami, 2006). Other research has focused on the use of ICT by pre-service teachers (Cabero & Barroso, 2016; Finger, Jamieson–Proctor, & Albion, 2010; Redmond & Peled, 2019; Sweeney & Drummond, 2013; Valtonen et al., 2019). Yet precisely what knowledge is needed to do so effectively is subject to much debate. There has been greater recognition in the literature that teacher use of ICT is complicated and requires them to negotiate a complex set of factors (Balanskat, Blamire, & Kefala, 2006; Bingimlas, 2009; Ertmer, 1999; Groff & Mouza, 2008; Mumtaz, 2000; Pelgrum, 2001; Steketee, 2005). As well, there has been greater acknowledgement that teacher use of ICT is "slow and uneven" (Brown & Warschauer, 2006), despite governments spending vast amount of money to put ICT into place (Australian Government Department of Education, 2013; Victorian Department of Education and Training, 2018a, 2019a). In the past it was often assumed that teachers only needed technical know-how to use ICT in their classrooms, while the contextual and personal factors identified by Ertmer (1999); Becta (2004); Groff and Mouza (2008); and others were overlooked or downplayed. There is considerable agreement that teachers face both barriers and enablers to using ICT in the classroom (Bigum, 1998; Ertmer, 1999; Groff & Mouza, 2008; Kopcha, 2012; Zhao, Pugh, Sheldon, & Byers, 2002). The findings of these researchers and others offers a powerful insight into the complexities that teachers, and subsequently teacher mentors, can encounter when integrating ICT into their classrooms.

At the same time as increasing recognition and acknowledgement of the complexity in using ICT, teachers face a growing regulatory context and intensifying expectations to use ICT.

Pre-service teachers, in accordance with the Australian Professional Standards for Teachers (AITSL, 2018b), are required to know how to use ICT in their practice and to do so safely, responsibly and ethically. As well, pre-service teachers may need to be able to support the delivery of the Victorian Curriculum F–10: Digital Technologies (VCAA, 2015c) in the classroom. With this pressure on teachers (in-service and pre-service) to use ICT, a greater understanding of the complexities involved in its use, including the knowledge that teacher mentors need to support pre-service teachers to integrate ICT into teaching practicums, is much needed.

1.2. Purpose of the research

As highlighted, there is now considerable evidence in the research literature that teacher use of ICT is not simple, but rather is complicated, and that teachers need to negotiate a complex set of barriers and enablers in their use. Educational researchers have also shown that teacher use of ICT is highly contextual (Mishra, 2019; Muller, 2015; Rosenberg & Koehler, 2015; Selwyn et al., 2018). Thus, there has been significant shifts in the literature over the last 20 years. This research study aims to add to this growing body of research literature by investigating how teacher mentors, those who supervise pre-service teachers during the teaching practicum, support them to use ICT in their practice. As the researcher, I am particularly interested in the knowledge that is needed by teacher mentors to do so.

Koehler and Mishra (2009) suggest that teacher complexities in using ICT have not been explored enough and that challenges with using ICT in the classroom have been underestimated. There is no doubt that there has been agreement by researchers that using ICT in the classroom is not straightforward and that it is highly contextual (Divaharan & Ping, 2010; Finger et al., 2015; Mishra, 2019; Rosenberg & Koehler, 2015; Selwyn et al., 2018). According to Groff and Mouza (2008), using ICT is not predictable. Koehler and Mishra (2009) contend that "[t]eaching with technology is complicated further considering the challenges newer technologies present to teachers" (p. 60).

Initial teacher education providers have also been censured for their seeming failure to prepare pre-service teachers to be ICT-ready (Grove, 2008; Kay, 2006; Tondeur et al., 2012). This criticism suggests that initial teacher education providers have had difficulty in providing pre-service teachers with learning experiences at university to support the development of their ICT capabilities when on teaching practicums; and efforts of pre-service teachers to use ICT via teaching practicums are an ongoing issue, with opportunities not always available in schools (Ertmer, 1999; Finger et al., 2015; Groff & Mouza, 2008; Haydn, 2010). It is considered most likely that this criticism with pre-service teachers not meeting requirements of teacher standards will continue. There is also agreement that there is a range of factors to consider when ICT is used by teachers, and subsequently teacher mentors, in the classroom. Finger et al. (2015) state the following factors are the most common ones influencing ICT uptake: teachers' knowledge and skills; technical resources; curriculum; access to technology; leadership; and professional development. Other factors influencing ICT uptake in teaching practices identified in the research literature include time (Divaharan & Ping, 2010; Ekici, Demirhan, Kara, & Ekici, 2014; Mumtaz, 2000; Tallvid, 2016); teacher beliefs (Balanskat et al., 2006; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Taimalu & Luik, 2019) and teacher self-efficacy (Garvis, Twigg, & Pendergast, 2011; Lemon & Garvis, 2015; Pendergast, Garvis, & Keogh, 2011; Topkaya, 2010).

In more recent times, researchers have argued more consistently that the use of ICT in teaching practice is complex and requires a sophisticated skill set. Rather than just requiring technical know-how, researchers such as the influential Mishra and Koehler (2006) contend that a range of domains of knowledge, including content knowledge, pedagogical knowledge, and technological knowledge is needed. The resulting TPACK framework that "attempts to capture some of the essential qualities of teacher knowledge needed for technology integration in teaching, while addressing the complex, multifaceted, and situated nature of this knowledge" (Mishra & Koehler, 2006, p. 1) has been highly influential in the research literature.

All initial teacher education programs in Australia need to ensure that they provide well-structured teaching practicum experiences for pre-service teachers that are supervised by teacher mentors. The teaching practicum is highly valued by pre-service teachers and in-service teachers alike as providing opportunities for them to practise their teaching knowledge and skills. As earlier identified, the TEMAG report argues that initial teacher education providers need to ensure that pre-service teachers have "[p]rofessional experience placements [teaching practicums] … [that] provide real opportunities for pre-service teachers to integrate theory and practice" (Teacher Education Ministerial Advisory Group, 2014, p. xii). This report identifies the important roles of teacher mentors who supervise the pre-service teachers. While mentoring is encouraged by organisations such as AITSL, which provide online courses to support teachers to gain the skill set to support pre-service teachers, mentor training is not compulsory.

> The role of mentoring teachers is largely an unrecognised and untrained one, with little support provided for developing the requisite mentoring knowledge and skills. Many schools use experienced teachers who may not receive the formal training required to provide high-quality mentoring. (Teacher Education Ministerial Advisory Group, 2014, p. 61)

The need to have ICT knowledge to support pre-service teachers is also downplayed, and the support required relates to ensuring teacher mentors "have the necessary skills to supervise, provide support and feedback, and assess professional experience placements [teaching practicums]" (Teacher Education Ministerial Advisory Group, 2014, p. 53). Many educational researchers claim that pre-service teachers are not ready to teach using ICT in the classroom, notwithstanding the efforts to provide them with the knowledge at both university and on teacher practicums (Ertmer, 1999; Koh, Chai, & Tsai, 2010; Mirzajani, Mahmud, Ayub, & Luan, 2015; Niess, 2005; Steketee, 2005). Given the increasing regulatory environment and increased expectations on in-service and pre-service teachers to use ICT in their practice, a research study that explores the roles that teacher mentors play in supporting pre-service teachers to use ICT during teaching practicums is warranted.

1.3. Shaping my research

Unsurprisingly, my own story of learning how to use ICT in the classroom intertwines with this research study as I too tried to make sense of the heightened complexities of teaching when using ICT and the domains of knowledge needed. This section is the ideal place to start recalling some of my journey with using ICT in the classroom and set the context for the discussion of the purpose and significance of this research study.

I officially began my ICT journey when I commenced teaching at Bendigo Senior Secondary College in the mid-1990s. I remember during my interview for a teaching position at the school that the last question related to my use of computers, and I spoke about using my prized Apple Macintosh LC computer to write teaching notes and create student handouts, and also my recollection of sending and receiving an email from the computer in the Victorian Certificate of Education (VCE) Coordinator's office. I considered that I had demonstrated a preparedness and ability to use ICT. My response was very simple and teacher-directed, but it was considered quite bold and innovative for the time. Little did I know that my response to this and other interview questions were rated highly, and so I was successful in my application for a position as a teacher of VCE Health Education and VCE Human Development.

Bendigo Senior Secondary College was a single campus school in regional Victoria, with approximately 1800 students enrolled in their final two years of schooling and a staff of over 100 equivalent full-time teachers and nearly 50 support staff. Arriving to teach at Bendigo Senior Secondary College at the beginning of 1995 was an ideal time for me to begin expanding my understanding of ICT in teaching practice. The Smith Report (Victorian Directorate of School Education, 1993) had been released by the Department of Education in 1994. This report recommended that teachers have computer skills and training necessary to develop these skills. Also, in 1994, Bendigo Senior Secondary College had implemented a charter that included a focus on encouraging more widespread incorporation of ICT into the curriculum (EkinSmyth, 1998; Toomey, EkinSmyth, & Nicolson, 2000). The use of ICT in teaching practice was being actively encouraged by the school principal, who was eager to encourage all staff to enthusiastically embrace it.

The time was ripe for developing my ICT skills further. I arrived when expressions of interest for computers in the classrooms were being sought from learning areas within the school. I worked with learning area colleagues and took the lead to successfully apply for six computers to be installed in the dedicated Human Development classroom in C Block. The classroom was rearranged so there were six clusters of tables with a computer placed on each. We had to work with the information technology (IT) support team to ensure cords were taped appropriately to meet occupational health and safety requirements, and that all computers were networked. This configuration of tables and computers lent itself to new ways of providing instructions to the students – students were sitting in circles so often instructions were given from anywhere in the classroom (back, front, side, middle) and there was a greater emphasis on collaborative teaching and learning approaches as the configuration of tables afforded more opportunities for students to undertake activities together. At the time, this was considered quite progressive and innovative for secondary students. The greater access to digital technologies also afforded opportunities for more use of pedagogies that incorporated ICT; this meant that I committed time to learning how to use digital tools and for discussing with colleagues about ways to use these tools for teaching and learning in VCE Health Education and VCE Human Development classes. I was extremely interested in using ICT in my classroom and was somewhat optimistic about the potential of using the range of ICT that was available at the time, and perhaps in retrospect, would say that I was mesmerised by the opportunities that ICT could afford me as a teacher.

Around the same time, the Victorian Department of Education developed 'The Classrooms of the Future' suite of initiatives in response to the Smith Report (Victorian Directorate of School Education, 1993) and allocated millions of dollars to assist in meeting its aims of developing ICT capacity in all teachers in Victoria. There was increasing interest in the use of ICT in education at both national and state level in Australia (Victorian Department of Education, 1998a). From 1995 to 1998, the Navigator Schools Project was part of this initiative; it involved funding several primary and secondary schools to incubate ways to use ICT in the classroom and showcase this practice to other schools (Victorian Department of Education, 1998b). Bendigo Senior Secondary College was one of the schools selected to 'navigate' the way for other schools to follow in regard to ICT implementation (Toomey, EkinSmyth, & Nicolson, 2000).

My classroom was one that was open to teachers across Victoria to visit and observe how ICT was being implemented, requiring me to demonstrate a capacity to use ICT in my teaching practice and a willingness to share my use of ICT with teaching colleagues. Over a three year period, two teachers from every Victorian government school were funded by the Victorian Department of Education, Employment and Training to attend a three-day practicum at a 'navigator school' (Victorian Department of Education, 1998b). I felt quite special and honoured to have been selected to be one the Bendigo Senior Secondary College's practicum teachers, especially as I was a relatively new 'kid on the block' and taught in a learning area that was not typically associated with using ICT in teaching practice. I regularly attended internal professional learning run by school-based coaches as well as other external professional learning organised by the Department of Education and Training, such as how to use the internet, and how to set up online discussion groups. By this stage, I had developed greater skills in applying ICT such as using PowerPoint (Microsoft Corporation, 2016), including learning how to create interactive slides for presentations and revision sessions, as well as enhancing my skills in emailing through using listservs and my research skills through using Netscape Navigator as a web browser and using AltaVista and Excite as search engines. Also, as Assistant Head of Department, I worked closely with other staff to develop technology plans to guide our use of ICT within our teaching programs and align with specific learning intentions. The focus was mainly on identifying specific ICT tools to teach content (Compton, 2004).

The professional learning model run by Bendigo Senior Secondary College involved teachers and principals from other schools visiting our school for a series of in-service teacher practicums. They spent several days observing classes and discussing ways to use ICT with me and other staff. Participants were expected to return to their schools, reflect on their understandings and experiment with using ICT within their classes, and then later come back to Bendigo Senior Secondary College to increase their experiences with ICT. There were many assumptions made about this professional learning model. It was assumed that by modelling practice, visiting teachers would be able to adopt the practices of classrooms that they observed. At this time, little consideration was given as to how a range of other factors, such as school contexts (i.e. natural settings), including the school leadership and technical infrastructure of schools, access to resources within schools, etc., as well as beliefs about using ICT could impact on the professional learning model.

I had definitely become a passionate advocate for the use of this professional learning model. I put a lot of time and effort into learning how to use ICT, such as specific digital tools like digital cameras, discussion boards and instant messaging as well as ways of incorporating it into my teaching practice and sharing my learnings with colleagues, both within and outside the school and through my professional teachers' associations.

Little did I think about the underlying assumptions of this professional learning model – I just assumed that the teachers would be able to take my ideas back to their classrooms, even though their school contexts and beliefs were different. That is, the teachers had different cohorts of students and taught different subjects; had different timetables; had different leadership; had access to different resources, especially digital tools; and had different technical infrastructure as well as held different beliefs and values. This professional learning model assumed that teachers would be able to observe others using ICT and be able to simply and easily transfer this understanding into their teaching practices. It did not take into consideration the barriers and enablers and other complexities related to using ICT in teaching practice. There was an assumption that schools are very similar, and that, in particular, school context was not important. On reflection, it is surprising. For example, I was fortunate to have access to a range of ICT in my classroom that was considered high-tech at the time: two digital cameras, six networked desktop computers and a dedicated mounted data projector, as well as a multimedia centre (with additional networked desktop computers and printers) at my beck and call and accessible within metres of my classroom, my own school email address; and my own school-owned laptop computer. Teachers from other schools tended to be 'disadvantaged' in that they had less access to ICT because they were not 'navigator' schools and so were not provided with the same level of funding to purchase or access ICT resources. There was also the assumption that there would be transference of use of ICT, despite differences in levels of access to digital devices, knowledge and skills. The ambitious Navigator Schools Project assumed that using ICT in teaching practice was simple, and did not address the many complexities and barriers in the process. Interestingly, the account of the Navigator Schools Project was positive, reporting on general uptake of ICT and some positive case studies (EkinSmyth, 1998; Toomey, EkinSmyth, & Nicolson, 2000; Toomey, EkinSmyth, Warner, & Fraser, 2000). Selwyn (2016) also highlights (and then challenges) some of the optimistic views that presumed that ICT has an advantageous impact on education, referring to ICT in education as "overhyped" as well as "over-sold". He particularly highlights that the optimistic view of the potential of ICT uptake in the classroom "… runs counter to many of the realities of educational technology use" (Selwyn, 2011, p. 713). Selwyn et al. (2018) cautions about not "getting distracted by the chatter, noise and hype … [surrounding ICT uptake]" (p. 10). At the time, a very positive view of ICT tended to dominate with reporting providing an 'evangelical' view of the value of ICT in teaching practice, and perhaps suitably referred to by Selwyn (2002) as "techno-romance".

In hindsight, when I reflect on my time at Bendigo Senior Secondary College, I realise that I believed that the more support I gave teachers, the better they would be able to use ICT in their teaching practice. I considered the use of ICT would occur via 'osmosis' and I only had to share my understandings and ways to use ICT for other teachers to adopt these or similar ways of using ICT. At no stage did I identify or question any of the assumptions I had. My overly optimistic viewpoint of ICT was common at the time and shared by many teachers (Compton, 2004; Selwyn, 2011, 2016).

These views transferred into my later experiences when working for professional teachers' associations and in various roles in the Victorian Department of Education and Training, where I managed a range of projects in the eLearning Unit such as the development of digital curriculum materials including 'curriculum@work', and implementation of 1-to-1 learning projects including the 'National Secondary School Computer Fund (NSSCF) initiative', 'Netbook trials for primary schools' and 'iPads for learning trials'. These projects saw me working with in-service teachers to support their use of ICT in teaching practice. For example, I worked with a team to run professional learning for teachers involved in the 'iPads for learning trials'; this professional learning centred around how to use iPads; identification of applications, (or 'apps'), that linked to specific curriculum areas; ideas for ways 'apps' could be used in teaching and learning programs; and considerations for school policies around use of iPads including cybersafety. I found that I felt that I was always playing 'catch-up' with these teachers as they had already had practice in the classroom and were starting to settle into their own ways of teaching and learning, in regard to their beliefs and values about the use of ICT and had developed their teaching identities and philosophies. For example, some teachers regarded the use of iPads as 'special' and took the use of the iPad away from students to sanction them; these teachers did not want to consider the iPad as another tool to use in their repertoire of teaching and learning strategies, and therefore having the same status as other teaching tools such as pens and paper. When these teachers were questioned about their school policies to remove iPads from misbehaving students, they could not relate to comparing this to confiscating pens and paper to punish students. In addition, iPads were often used by these teachers as a reward for students who completed their classwork and so, were not explicitly used for teaching and learning but rather for entertainment or 'filling in time'.

At the time, I was offered sessional employment at RMIT University and this provided me with the opportunity to work with pre-service teachers, where I became interested in supporting them to learn to use ICT in teaching practice. From this experience, I began to understand more clearly how important the roles of teacher mentors play in supporting pre-service teachers to use ICT during teaching practicums. When I commenced my research study, I retained many of the optimistic, albeit idealist, views of the role that ICT had in education. I believed that ICT could enhance teaching and learning and that in-service teachers had a large role to play in ensuring that students in the classroom used ICT. To be honest though, my views on reflection, were often simplistic and I made lots of assumptions. I assumed for example, that all teachers could and should use ICT in their practice and I did not consider the complexity of issues with regard to using ICT, or the domains of knowledge needed and the range of barriers that exist for many teachers and subsequently teacher mentors and pre-service teachers. This was the beginning of me formalising my interest in understanding more about ICT, teacher mentors and pre-service teachers into a PhD study at RMIT University.

1.4. The research question and research direction

The broad aim of this research study was to determine the knowledge needed by teacher mentors to support pre-service teachers to develop capabilities to use ICT during teaching practicums.

The research study specifically examined the main research question: 'What knowledge do teacher mentors need to support pre-service teachers to use ICT during teaching practicums?' Furthermore, the research study investigated the following research sub-questions:

1. What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?

2. What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?

3. What are teachers' beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?

4. What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?

1.5. Significance of this research

For over twenty years, both national and state governments in Australia have encouraged an ICT agenda in Australian schools. According to Jordan (2011) "[b]eing able to use ICT in the classroom is now an expected part of a teacher's toolkit in Australia" (p. 16). But the limited use of ICT in classroom practices is still a concern today. There is increasing demand for initial teacher education providers to tackle the challenges of supporting pre-service teachers to use ICT during teaching practicums. Pre-service teachers are expected to gain practical skills in teaching, including in the use of ICT, during the teaching practicum component of their teacher education programs. There are assumptions that most pre-service teachers are confident and competent users of ICT. However, despite this, there has been limited transference of ICT skills for personal use into their teaching practice. The goal of this research study was to investigate this phenomenon, that is what knowledge is required of teacher mentors to support pre-service teachers' use of ICT in teaching practicums.

1.6. Overview of this thesis

This research study begins by describing the scope of the study in chapter 1. Chapter 2 explains the context of the research study, highlighting four major themes, each written as a separate part in this chapter. The first part is concerned with the current regulatory environment in Australia in regard to curriculum imperatives and greater calls for pre-service teachers to be able to use ICT in their practice through the release of the Victorian Curriculum F–10 (and its implementation in 2017) to meet ICT teacher standards (AITSL, 2018b). A brief discussion of the evolution of ICT in the Australian and iterations of Victorian curriculums is also provided in this part of the chapter, along with the development of teacher standards including those related to ICT. There is also a brief description about the Victorian government's investment of ICT to support curriculum delivery. The second part of chapter 2 concentrates on how pre-service teachers are expected to gain practical skills in teaching, including in the use of ICT, during the teaching practicum component of their teacher education programs. There is an exploration of the barriers and enablers to develop ICT capabilities in pre-service teachers. Discussion is concerned more broadly with research literature around the development of ICT capabilities in pre-service teachers, revealing that it is a complex, multifaceted and ongoing issue for initial teacher education providers to develop these ICT capabilities. Many educational researchers such as Ertmer (1999); Koh et al. (2010); and Niess (2011) state that pre-service teachers are not ready to teach using ICT during teaching practicums, notwithstanding the efforts to provide them with the knowledge and skills at both university and on teacher practicums. The third part of chapter 2 defines the term 'mentoring' and examines the roles of teacher mentors to support pre-service teachers in order to maximise the teaching practicum experience and assist them to be ICT-ready. Discussion of the evolution and complexity of the TPACK framework (Mishra & Koehler, 2006) follows in the fourth and final part of this chapter, which reflects on how this body of knowledge (content, pedagogical and technological) for teaching is taught in a fragmented manner and does not support teachers to develop robust understandings of the interaction between content, pedagogy and technology for effective teaching using ICT.

According to Ertmer and Ottenbreit-Leftwich (2010), “the teaching of content is undertaken separately to the teaching of general pedagogical and technological skills” (p. 255).

Chapter 3 details the methodology and research design for this study, which is based on a mixed methods approach (Creswell, 2009; Creswell & Creswell, 2018; Mertens, 2015; Teddlie & Tashakkori, 2003) framed by a pragmatic paradigm framework, with a sequential explanatory design. The research study is centred on both quantitative and qualitative data gathered using a questionnaire completed by 50 teacher mentors and interviews administered to four teacher mentors. In addition, there is a collection and examination of artefacts from the schools of each teacher mentor that were interviewed, such as ICT policies, eLearning plans, My School website data, school website data and information about technical infrastructure of schools.

Chapter 4 provides the quantitative findings of this research study. This chapter presents the findings from the questionnaire completed by 50 teacher mentors, using percentages obtained on frequencies and chi-square tests. Chapter 5 provides the qualitative findings from the semi-structured interviews and an analysis of the artefacts from these teacher mentors’ schools, and introduces the four teacher mentors that self-nominated to contribute to this research study and be interviewed. This chapter presents the findings as a series of four case studies and includes a description of the context of each of the schools where the teaching practicums occurred.

Chapter 6 presents a discussion of the quantitative and qualitative findings, providing a more realistic view of the complexities of using ICT during teaching practicums. This research was a small-scale study but provides an insight into the intricacies of the knowledge needed to use ICT for teaching. Chapter 7 draws conclusions and identifies implications of the research study for ICT policy makers such as the Victorian Department of Education and Training, for teacher mentors in schools, for the design of initial teacher education programs, for supporting ICT uptake including professional learning of teachers, and future research directions.

2. Literature review

This chapter reviews the research literature relevant to this study and is divided into four main parts. The first part provides a broad overview of the policy and regulatory environment, including the development of digital technologies/ICT curriculum in the Australian and Victorian education systems and investments by governments to support this curriculum delivery. There is also discussion about the pressure on initial teacher education providers to guarantee that pre-service teachers are ready to teach at AITSL teacher standard for graduates (AITSL, 2018b). In the second part, the review examines research literature relating to the factors that influence teachers', and subsequently teacher mentors' and pre-service teachers', uptake of ICT, identifying both barriers and enablers. The third part explores the roles that teacher mentors play in supporting pre-service teachers to develop knowledge to use ICT in their practice and meet the curriculum imperative. The fourth part investigates the TPACK framework (Mishra & Koehler, 2006) as providing a highly influential account of the complexity of the domains of knowledge needed by teachers to integrate ICT in their practice. It also reviews the role of initial teacher education providers in the development of TPACK in pre-service teachers.

2.1. Regulatory environment influencing ICT uptake

This part of the chapter provides a broad overview of the regulatory environment influencing ICT uptake for both teacher mentors and pre-service teachers. It is divided into two sections. The first section describes the development and implementation of ICT into the Australian Curriculum F–10 (ACARA, 2018b) and Victorian Curriculum F–10 (VCAA, 2018a), as a means of orientating the reader to the curriculum imperatives that underpin this research study. It also discusses the ongoing investment from the Victorian government to support the ICT uptake in schools. The second section then discusses the Australian Teacher

Professional Standards (AITSL, 2018b) and why the development of ICT knowledge and skills in pre-service teachers is becoming increasingly important for initial teacher education providers.

2.1.1. Development and implementation of the Australian and Victorian ICT curriculums

This section outlines the national curriculum, the Australian Curriculum F–10 (ACARA, 2018b), and the Victorian state curriculum, the Victorian Curriculum F–10 (VCAA, 2018a), that frame this study. Both these curriculums include ICT and are discussed in detail. There is also a discussion about the vast investments by governments to support the delivery of these curriculums.

2.1.1.1. Australian Curriculum F–10 (2007 to 2015)

Prior to 2007, Australia had been progressing towards a national curriculum for over twenty years. In 2007, the then Australian Labor government, as part of its election promises, committed to the development and introduction of a new national curriculum in four learning areas – English, Mathematics, History and Science. A National Curriculum Board was established in the following year. In 2009, the National Curriculum Board was replaced by the Australian Curriculum, Assessment and Reporting Authority (ACARA). ACARA oversaw the development of the Melbourne Declaration on Educational Goals for Young Australians (Ministerial Council on Education Employment Training and Youth Affairs, 2008), the third iteration of the national goals of schooling that were agreed by all Australian Education Ministers. The Melbourne Declaration was the blueprint for the Australian Curriculum F–10, with the following design structures – Learning Areas, General Capabilities and Cross-curriculum Priorities (Howes, 2013a). It should be noted that at the time of this research study, the Education Council Ministers are reviewing these Australian national educational goals. While there is overall agreement that much of the content is still relevant, there are areas for improvement being discussed in a draft of these updated educational goals. Further discussion of this is outside the scope of this research study.

The Australian Curriculum F–10 was developed in three phases: Phase 1 included curriculums for English, Mathematics, Science and History; Phase 2 included curriculums for Languages, Geography and the Arts; Phase 3 included curriculums for Health and Physical Education, Technologies and Humanities (ACARA, 2012).

Development of Phase 1 curriculums began in 2009 (National Curriculum Board, 2009) and was released in 2011 when the Australian state, territory and national Ministers of Education approved the content descriptions and achievement standards for the first four learning areas of the Australian Curriculum F–10. Victoria made the decision to merge the four Phase 1 curriculums, developed as part of the Australian Curriculum F–10, with its existing curriculum framework, the Victorian Essential Learning Standards (VELS), subsequently known as AusVELS. Schools had the opportunity to implement this hybrid curriculum, which was released in 2012. When the Geography curriculum was released by ACARA in 2013 (ACARA, 2013), it was later added as part of the AusVELS.

In September 2015, ACARA released the Australian Curriculum F–10 after it was endorsed by the Australian Education Council. This curriculum was developed from the curriculums of all Australian states and territories, and shaped with the best international curriculums (ACARA, 2012). The newly-endorsed and released Australian Curriculum F–10 included the following curriculum areas: English, Mathematics, Science, Humanities and Social Sciences, The Arts, Technologies, Health and Physical Education, Languages and Work Studies: Years 9–10, that is Phases 1, 2 and 3 of this curriculum. It is to be noted that Australian national curriculum at the senior secondary level, Years 11 and 12, is also being developed and ACARA continues to work with the states and territories that are responsible for determining how the curriculums are implemented.

2.1.1.2. Victorian response to the Australian Curriculum F–10 (2013 to 2015)

In Australia, the responsibility for the delivery of curriculum lies with the individual states and territories. In Victoria, the VELS curriculum framework was in place when the Australian Curriculum F–10 was being developed. The VELS was published in 2005 and used a triple-helix model to represent the curriculum, which was organised into three strands. The three strands included Subject-based disciplines; Interdisciplinary learning; and Physical, social and personal learning (VCAA, 2016). These three strands were considered “necessary to enable students to meet the demands of a modern, globalised world” (Howes, 2013a, p. 3). Many of the concepts within the VELS curriculum framework were considered revolutionary.

> It was a ground-breaking framework. No other formal statutory curriculum in the world had previously attempted in such a comprehensive fashion to not only map student progress in both traditional subjects, interdisciplinary learning and personal and social capacities but to give them equal status in the curriculum as discrete areas of learning. (Howes, 2013a, p. 3)

The VELS curriculum framework was used to shape the development of the Australian Curriculum F–10, as evidenced by the inclusion of General Capabilities and Cross-curriculum Priorities along with the traditional curriculum areas.

Planning for the transition to the Australian Curriculum F–10 in Victoria followed a two-stage process. The hybrid model construct, released in the first stage of the Australian Curriculum F–10 in Victoria, was implemented in 2013 and known as AusVELS, “an expression of both the continuity of this new structure with the previous VELS construct and the implementation in Victoria of the set of nationally-agreed content and skills defined by the Australian Curriculum [F–10]” (Howes, 2013b, p. 4).

The second stage of implementation of the Australian Curriculum F–10 in Victoria involved the release of the Victorian Curriculum F–10 in 2015 (VCAA, 2015b). However, in the

Australian Curriculum F–10, content descriptions and achievements standards were only written for the curriculum areas, and not for the General Capabilities or Cross-curriculum Priorities. In the VELS and consequently AusVELS, all three strands were treated equally and had achievement standards written for them to be assessed against (VCAA, 2016). Likewise, in the Victorian Curriculum F–10, both the curriculum areas and Capabilities are treated equally and have content descriptions and achievement standards. The implications of this, especially for developing ICT capabilities in pre-service teachers, will be discussed in more detail later in this chapter, under the heading ‘2.1.1.7. Implications of the Victorian Curriculum F–10 for pre-service teachers’.

Another key difference was that the AusVELS curriculum and subsequently the Victorian Curriculum F–10, was organised by developmental levels, rather than year levels as evident in the Australian Curriculum F–10. The Victorian Curriculum F–10 recognises the development stages that students progress through, and reflects that learning is a continuum and, although students follow similar pathways of learning, different students will develop at different rates, independent of the year of schooling or ages (VCAA, 2015b).

2.1.1.3. Victorian Curriculum F–10 (2015+)

The Victorian Labor government made a guarantee to establish Victoria as the ‘Education State’ during the 2014 state election and its foundations were laid in the 2015–2016 Victorian Budget. Its aims were to enable Victorian students to gain a world-class, dynamic set of skills and knowledge to meet the needs of the ever-changing economy. “The vision for Victoria as the Education State is about a public guarantee – the guarantee for educational excellence and opportunity in every community” (Victorian Department of Education and Training, 2015a). Transforming Victoria into the ‘Education State’ relied heavily on the quality of the teaching workforce (Victorian Auditor-General's Office, 2019), which accordingly depended on appropriately trained in-service, and subsequently pre-service, teachers.

The ‘Education State’, which set out Victoria’s priorities for education from 2015–2019, played a critical role in the release of the Victorian Curriculum F–10. The Victorian Curriculum F–10 was released in September 2015 (VCAA, 2015b). The Victorian Curriculum F–10 incorporated much of the Australian Curriculum F–10 and reflected Victorian standards and priorities.

> This new curriculum sets out what every student should learn during their first eleven years of schooling. The curriculum is the common set of knowledge and skills required by students for life-long learning, social development and active and informed citizenship … The Victorian Curriculum F–10 sets out a single, coherent and comprehensive set of content descriptions and associated achievement standards to enable teachers to plan, monitor, assess and report on the learning achievement of every student. (VCAA, 2015b, para 1–2)

2.1.1.4. ICT and Digital Technologies in the curriculums

This section explains the difference between ICT and Digital Technologies in the Australian and Victorian curriculums, and provides an understanding of why, given recent developments in both the Australian and Victorian curriculums, the issue of making ICT an integral part of initial teacher education programs becomes more critical.

2.1.1.5. ICT in the Australian and Victorian curriculums

In the Australian Curriculum F–10, ICT is included as a General Capability, that is it is a broad set of knowledge and skills ‘general’ to all students (ACARA, 2015a, 2018a). In other words, all students are expected to “develop [this] capability when they apply knowledge and skills confidently, effectively and appropriately [across curriculum areas]” (ACARA, 2015a, para 1) – ICT in the curriculum is not subject- or discipline-specific. Importantly, in the Australian Curriculum F–10, as a General Capability, ICT is not formally assessed.

The Victorian Curriculum F–10 comprises eight curriculum areas and four Capabilities, and together are referred to as Learning Areas. (VCAA, 2015b). The four Capabilities, Critical and Creative Thinking; Ethical; Intercultural; and Personal and Social, are treated like the curriculum areas in that they are written as a continuum of learning with content descriptions and achievement standards. Unlike the Australian Curriculum F–10, ICT is not explicitly stated as a Capability in the Victorian Curriculum F–10. This does not undervalue the importance of ICT as a Capability, but rather emphasises the importance of ICT across the curriculum areas.

> [I]n the Victorian Curriculum, skills associated with ICT as a capability are either specifically embedded in the content descriptions of Mathematics, Media Arts, Geography, English and Digital Technologies or schools have the flexibility to determine how these skills will be used in their teaching and learning programs for other curriculum areas. (VCAA, 2015c, para 5)

However, the Victorian Curriculum F–10 does not identify how content must be taught. It is a school-based decision about how the curriculum is implemented in classrooms. It needs to be done in accordance with the needs and resources of schools and students (i.e. the school context helps determine how content is taught). Schools have the freedom to decide how ICT will be addressed in their teaching and learning programs. Therefore, it is critical that pre-service teachers are provided with opportunities during their initial teacher education programs to develop capabilities to use ICT across a range of curriculum areas.

In summary, within the Victorian Curriculum F–10 framework, ICT is no longer represented as a General Capability (referred to as 'Capabilities' in the Victorian Curriculum F–10) (VCAA, 2015b). Instead, ICT is listed within the content descriptions and achievement standards of several curriculum areas including Victorian Curriculum F–10: Digital Technologies (VCAA, 2015c). While it is critical that students are explicitly taught ICT across the curriculum, "[i]t is, however, arguable that sufficient guidance can be provided by drawing on … [Digital] Technolog[ies] rather than writing entirely different constructs of learning" (Howes, 2013b, p. 3).

2.1.1.6. Digital Technologies in the Australian and Victorian curriculums

Digital Technologies, referring to a curriculum area, has been formally introduced into both the Australian and Victorian curriculums (ACARA, 2015b; VCAA, 2015b). The inclusion of Digital Technologies as a curriculum area is a significant change. Digital Technologies is different to ICT as a General Capability, as identified in the Australian Curriculum F–10 – Digital Technologies is a discipline-based learning area that "offers students with the opportunity to obtain and apply specific ways of thinking about problem solving to create innovative, purpose-designed digital solutions" (VCAA, 2015a). Digital Technologies is about students exploring "… the capacity of information systems to systematically and innovatively transform data into digital solutions through the application of computational, design and systems thinking" (VCAA, 2015c). According to the VCAA (2015c), approximately 50 per cent of the curriculum for Victorian Curriculum F–10: Digital Technologies can be taught without the use of ICT, referred to as "unplugged learning".

2.1.1.7. Implications of the Victorian Curriculum F–10 for pre-service teachers

Pre-service teachers are expected to be able to integrate ICT into their teaching practice, as required by the Victorian Curriculum F–10 (VCAA, 2018a). Some pre-service teachers will also be expected to teach Digital Technologies, the new subject developed as part of the Australian Curriculum F–10 (ACARA, 2018b) and Victorian Curriculum F–10 (VCAA, 2018a). This current changing curriculum environment is having, and is likely to continue to have, significant influence, by placing increasing demands on pre-service teachers to have ICT capabilities. Thus, initial teacher education providers have an important role in ensuring that pre-service teachers are equipped to meet these expectations and requirements.

2.1.1.1. System ICT support to schools

Governments have invested in ICT resources for schools over many years. As a result of the Smith Report (Victorian Directorate of School Education, 1993), published by the Victorian government on the use of ICT as an education and communication tool in schools, so began the investment in ICT by Victorian state government in the 1990s. This investment included technical infrastructure, such as the internet, network access, operating systems, and security and school administration software; provision of professional learning programs, such as training for use of the internet and laptops; and the provision of hardware, such as laptops for teachers, and software such as Microsoft Office products (Microsoft Corporation, 2020). A key implication of this investment was the 'Teacher and Principal Notebook Program' (Victorian Department of Education and Training, 2019j), which has been in place in Victorian government schools since 1999, and continues to evolve in alignment with the Department's requirements (Victorian Department of Education and Training, 2019b). The vision of the 'Teacher and Principal Notebook Program' is to afford all Victorian government schools an equitable provision of laptops or allowances to enable the digital delivery of curriculum in school.

The Victorian Department of Education and Training continues to provide a variety of resources from a system level to support the delivery of ICT in schools in 2019. This includes the provision of updated technical infrastructure, including wifi, plus a centralised internet service provider (ISP) facility to all Victorian government schools as part of the Department's School Technology Architecture and Resources (eduSTAR) program (Victorian Department of Education and Training, 2019g, 2019h), which provides desktop computers, laptops, iPads and interactive whiteboards and educational software and applications (apps) for both teacher and student use, and cost-effective arrangements with ICT suppliers. Victorian government schools are provided with an annual budget allocation for ICT resources (Victorian Department of Education and Training, 2019c), and have some autonomy in regard to how they leverage off these ICT resources to support the delivery of the curriculum. Independent and Catholic education sectors also adopted similar approaches at a system to support ICT uptake in schools to that of the Victorian Department of Education and Training.

2.1.2. Teacher ICT standards

As commented previously, all initial teacher education providers in Australia need to ensure that pre-service teachers meet the Australian Professional Teacher Standards at the Graduate career stage (AITSL, 2018b). There are seven teacher standards grouped into three domains: Professional knowledge; Professional practice; and Professional engagement (AITSL, 2018b). Three teacher standards relating to ICT are included in the first two domains (see Table 1). Thus, preservice teachers must demonstrate that they can use ICT in teaching the curriculum, as a resource to engage students, and do so in safe, responsible and ethical ways (AITSL, 2018b).

Table 1: AITSL (2018b) teacher standards related to ICT with focus areas and descriptors for Graduate career stage

Domains of teaching	Standard	Focus area	Descriptor for Graduate career stage
Professional knowledge	2. Know the content and how to teach it	2.6. Information and Communication Technology (ICT)	Implement teaching strategies for using ICT to expand curriculum learning opportunities for students
Professional practice	3. Plan for and implement effective teaching and learning	3.4. Select and use resources	Demonstrate knowledge of a range of resources, including ICT, that engage students in their learning
	4. Create and maintain supportive and safe environments	4.5. Use ICT safely, responsibly and ethically	Demonstrate an understanding of the relevant issues and the strategies available to support the safe and responsible and ethical use of ICT in learning and teaching

(AITSL, 2018b)

The use of ICT cannot be considered as an 'optional extra' to pre-service teacher training because ICT integration is extremely relevant to initial teacher education. The use of ICT needs to be regarded as critical for all teachers and so is seen as an indispensable component of initial teacher education programs (Albion & Redmond, 2008; Gill & Dalgarno, 2017; Jamieson-Proctor, Finger, & Albion, 2010; Jordan & Compton, 2015; Ottenbreit-Leftwich, Millard, & van Leusen, 2012; Sime & Priestley, 2005).

2.1.2.1. Criticisms of initial teacher education providers

Initial teacher education providers have been criticised in the past for their apparent failure to prepare ICT-savvy pre-service teachers (Henderson, Bellis, Cerovac, & Lancaster, 2013). This criticism is due to the prevalence of discrete, skill-based courses (Albion & Redmond, 2008). While this approach has been equipping pre-service teachers with knowledge to use ICT, it has questionable impact on their capacity to use ICT in practical settings in schools. The lack of development of ICT capabilities in pre-service teachers during their initial teacher training programs is "one of the greatest roadblocks to integrating technology [ICT]" (Brand, 1997, p. 10).

2.2. Factors influencing ICT uptake in teaching practice

There is increasing recognition that implementing ICT in teaching practice is complex and that there are numerous factors that impact on the decision-making of teachers to use ICT (Balanskat et al., 2006; Bingimlas, 2009; Groff & Mouza, 2008; Hew & Brush, 2007; Mumtaz, 2000; Phillips, 2017; Zhao et al., 2002) as well as pre-service teachers (Albion, Jamieson-Proctor, & Finger, 2011; Finger et al., 2010; Gill & Dalgarno, 2017; Jamieson-Proctor et al., 2010; Steketee, 2005). In this second part of the chapter, written in two sections, some of the barriers and enablers to uptake of ICT by teachers, and subsequently teacher mentors, are explored as a means of understanding particular challenges that they face, given the expectations of Australian and state curriculum frameworks to embed ICT into their teaching practices, as discussed previously in the first part of this chapter. Influences that initial teacher education providers have on uptake of ICT by pre-service teachers are considered in the second section.

2.2.1. Demographics of teachers that influence ICT uptake

Educational researchers in ICT have suggested that a teacher's sex, age and years of teaching experience impacts on the use of ICT in the classroom (Alazam, Bakar, Hamzah, & Asmiran, 2012; Bhati, Mercer, Rankin, & Thomas, 2009; Krumsvik, Jones, Øfstegaard, & Eikeland, 2016; Russell, Bebell, O'Dwyer, & O'Connor, 2003). This is explored further in the following discussion.

2.2.1.1. Use of ICT and sex

The research literature is not clear whether a teacher's sex impacts on use of ICT. Top, Yukselturk, and Cakir (2011) in their study of sex and web 2.0 technologies found no significant differences. Likewise Verma and Dahiya (2016) in their study of ICT awareness between male and female Indian university staff found no noteworthy differences. However, other researchers report that there are differences. Topkaya (2010) suggests that male pre-service teachers tended to display greater self-confidence in using computers than females. This was also a finding by Jamieson-Proctor et al. (2010) and Jordan (2011). Teo, Fan, and Du (2015) and van Braak, Tondeur, and Valcke (2004) suggest that male pre-service teachers displayed higher competence than their female counterparts. Mahdi and Al-Dera (2013) indicate that male language teachers have greater access to, and use of, ICT than females. Overall, the literature is unclear around the relationship between sex and ICT use, and perhaps Jordan (2011) best sums up this relationship by asserting that the role of sex "… in relation to perceived TPACK knowledge is unclear and under researched" (p. 23).

2.2.1.2. Use of ICT and age of teacher

When it comes to the relationship between teacher use of ICT and age, there are also no conclusive findings in the research literature. For example, Bhati et al. (2009), while suggesting that some teachers may be less resistant to using familiar ICT tools, such as mobile phones for learning, were not able to conclude whether it was related to the age group of teachers or the learning activities. Other researchers have drawn similar conclusions such as Alazam et al. (2012); Alkahtani (2017); Ekici et al. (2014); and Gil-Flores et al. (2017). Albion et al. (2011) in their study suggests that influence of age on ICT use was small. However, to the contrary, others such as Mahdi and Al-Dera (2013), suggest that competence in using ICT decreases with age.

Despite the unconvincing findings regarding ICT use and teacher age, there are still some views that younger teachers are more adept. Often this view is associated with the “digital native” concept made popular by writers such as Prensky (2001) to refer to individuals born or raised during the age of information technology, who should be familiar with using ICT. Accordingly, pre-service teachers are considered to be more confident in their use of ICT because they have grown up with ICT. This is in contrast to the ‘digital immigrants’ concept, which refers to older teachers who have been introduced to ICT much later in their teaching careers.

However, Prensky’s (2001) arguments require closer examination and many researchers have debunked the “digital native” phenomena (Bennett, Maton, & Kervin, 2008; Brown & Czerniewicz, 2010; Kennedy, Judd, Churchward, Gray, & Krause, 2008; Koutropoulos, 2011; Selwyn, 2009), especially in regard to its simplistic view, which considers age as an important factor in using ICT and ignores issues related to complexity and diversity in the use of ICT. Orlando and Attard (2016) caution against expecting young early career teachers to be confident and capable in their use of ICT for teaching because they use it in their personal lives as there are unsubstantiated "high expectations of these teachers to teach well with technology [ICT]" (p. 109).

2.2.1.3. Use of ICT and teaching experience

In terms of teaching experience and teachers' use of ICT, the research literature is also somewhat unconvincing and somewhat conflicting. Researchers such as Gil-Flores et al. (2017); Mahdi and Al-Dera (2013); and Alazam et al. (2012) conclude that there are no significant differences in ICT use in relation to teaching experience. Prieto-Rodriguez (2016) found that "[t]here were very few differences in teachers' use of ICT resources or how they incorporate relevance into their practice based on by *(sic)* age or experience of the teachers" (p. 23). Yet, Krumsvik et al. (2016) found that the level of competence with using ICT is lowest in teachers with over 15 years of teaching experience. Interestingly, Baek, Jung, and Kim (2008) assert that while most "teachers intend to use technology [ICT] to support teaching and leaning (*sic*), experienced teachers generally decide to use technology [ICT] involuntarily in response to external forces while teachers with little experience are more likely to use it on their own will" (p. 233). Baek et al. (2008) suggest that this implies the more experienced teachers "do not pay much attention to raising the quality of learning" (p. 233) when deciding to use ICT in the classroom. Conversely, Russell et al. (2003) claim that less experienced teachers report higher levels of comfort with ICT and use it more for lesson preparation outside the classroom, while more experienced teachers report higher levels of use of ICT in the classroom to deliver instruction or provide learning opportunities for students.

This discussion about the demographics of teachers, and subsequently teacher mentors, influencing ICT uptake in the classroom highlights that the research surrounding sex, age and years of teaching experience is not consistent, and in some cases contradictory. I will now discuss the barriers and enablers to ICT uptake that have been identified by researchers, and the complexity of the relationships between them.

2.2.2. Barriers and enablers to ICT uptake

Education researchers have endeavoured to categorise factors influencing the uptake of ICT in teaching practice as barriers and/or enablers. Ertmer (1999) classifies the barriers to teacher uptake of ICT into "first-order" and "second-order" (p. 54) and studied the relationship between them. According to Ertmer (1999), "first-order barriers" as those that are "extrinsic to teachers and include a lack of access to computers and software, insufficient time to plan instruction, and inadequate technical and administrative support" (p. 54) and so relate to contextual factors. In contrast, "second-order barriers" are defined as those "intrinsic to teachers and include beliefs about teaching, beliefs about computers, established classroom practice, and unwillingness to change" (Ertmer, 1999, p. 54), and so relate to personal or human factors. Ertmer (1999) suggests that while "first-order barriers", such as a lack of resources and a lack of time, may impact teaching practice, what comes into play are teachers' beliefs, which are the "second-order barriers". Thus, Ertmer (1999) suggests that there is a complex relationship between both the "first-order" and "second-order barriers".

Balanskat et al. (2006) classifies barriers to using ICT, and identifies three categories: micro-level, meso-level and macro-level (or system-level) barriers. Like the "second-order barriers" identified by Ertmer (1999), micro-level barriers are those that relate to individual (or teacher) attitudes and personal approaches to ICT. The meso-level barriers are those that relate to the school or institutional context, such as technical infrastructure and leadership and are similar Ertmer's (1999) "first-order barriers". Macro-level barriers, as identified by Balanskat et al. (2006), relates to the wider educational system or framework, and includes government funding and policies.

"Second-order" (Ertmer, 1999) or "micro-level" (Balanskat et al., 2006) barriers have been discussed by other educational researchers, such as teacher beliefs about ICT uptake (Hsu, 2016; Prestridge, 2012; Taimalu & Luik, 2019) and teacher confidence with using ICT

(Jamieson-Proctor & Finger, 2008; Jamieson-Proctor, Burnett, Finger, & Watson, 2006; Phelps & Graham, 2013). The influence of “first-order” (Ertmer, 1999), or the “meso-level” (Balanskat et al., 2006) barriers, in relation to ICT uptake, have also been discussed in the research literature by other authors. Technical infrastructure such as availability of hardware and software (McKnight et al., 2016; Pelgrum, 2001; Salehi & Salehi, 2012; Shiue, 2007), ease-of-access to the internet including wireless internet (or wifi) (Salehi & Salehi, 2012), and technical support (Bingimlas, 2009; McKnight et al., 2016; Moses, Bakar, Mahmud, & Wong, 2012; Salehi & Salehi, 2012; Unal & Ozturk, 2012) is considered to be vital for ICT uptake in school. Leadership has also been identified as important for ICT uptake (Divaharan & Ping, 2010; Hayes, 2007; Hew & Brush, 2007; McKnight et al., 2016; Mumtaz, 2000; Newhouse, 2012; Selwyn et al., 2018). Hew and Brush (2007) specifically argue that use of ICT could not be incorporated at a school level if it is not well-planned and endorsed by school leaders, and Hayes (2007) maintains the integration of ICT in the classroom is more successful when the principal connects it to the school’s vision for learning. Educational researchers also suggest that school leadership support for ICT integration needs to be technical as well as pedagogical (Mumtaz, 2000; Petersen, 2014). Selwyn et al. (2018) assert that ICT leadership is “not a wholly in-school matter” (p. 49) as schools are influenced by the policies and funding from governments, which is a “macro-level” influence, according to Balanskat et al. (2006). While Divaharan and Ping (2010) claim that the use of ICT may be influenced by different types of leadership styles, further discussion of this is outside the scope of this research study. Thus, while different researchers use different categories to identify barriers and enablers to use ICT in the classroom, there are similarities and intricacies between these barriers and enablers, and all highlight the complexity with using ICT in teaching practice.

2.2.2.1. Complex relationship between barriers

While published some time ago, the British Educational Communications and Technology Agency – Becta (2004), likewise, argues that there are complex relationships between barriers when using ICT in the classroom, and that a number of barriers can be broken down into different "sub-barriers". The researchers suggest that "a lack of access to resources" (Becta, 2004, p. 12) should be further broken into sub-barriers such as "a lack of hardware, poor organization of resources, poor quality hardware, inappropriate software and lack of personal access to teachers" (p. 14). Becta (2004) also argues barriers perceived by teachers are actually the "symptoms of other barriers" (p. 17). For example, barriers such as teachers' perceived resistance to change is the reflection of other barriers, namely the type of equipment and training that teachers had access to. Becta (2004) also classifies factors into different levels such as "institution-level" and "teacher-level" and identifies the interconnections between them. For example, "a lack of teacher confidence" was the consequence of a combination of "a lack of personal access [at school and at home]", "technical problems (lack of technical support)" and "fear of things going wrong", and also that "a lack of teacher competence" might be affected by "a lack of skill training, self-training and pedagogical training" (Becta, 2004, p. 21). Becta (2004) contends that the barriers pertaining to teachers are more difficult to address than those related to the school (or institution). Becta (2004), therefore, stresses the importance of giving teachers, and subsequently teacher mentors, enough support and guidance, so they can overcome the teacher-related barriers, thus ensuring that they keep up with changes in implementing ICT in teaching practice.

Hew and Brush (2007) categorises the barriers to ICT uptake into six groups: "resources, institution, subject culture, attitudes and beliefs, knowledge and skills and assessment" (p. 223). Hew and Brush (2007) also argue that use of ICT cannot be disseminated extensively at the school level if it is not supported and well-planned by school leaders. They assert that teacher use of ICT is largely contingent on whether they believe ICT can assist them to achieve the goals of their school. Thus, Hew and Brush (2007) also emphasise the role of teachers' beliefs on influencing their ICT uptake in teaching practice.

In comparison, Groff and Mouza (2008) represent barriers to ICT uptake in four broad categories: “the Context [School], the Innovator [Teacher], the Innovation [Project], and the Operator [Student]” (p. 35). They argue that the “Context” includes a lack of administrative, advocacy and professional training that may impede teacher, and subsequently teacher mentor, ICT use. With regard to the “Innovator”, the lack of technical knowledge and skills, and of “support resources” (Groff & Mouza, 2008, p. 31), as well as negative attitudes and beliefs toward ICT, appear to be major barriers to teachers’ implementation of ICT-based projects. In terms of the “Innovation” itself, it is considered that the more alien the innovation is to the existing culture of the school, and the more largely it depends on factors that are beyond teachers’ control, the less likely that ICT would be successfully implemented. Finally, in relation to the “Operator”, the barriers facing the student were similar to those facing the teacher and subsequently teacher mentor. These include students’ lack of experience and skills with working with ICT, and negative attitudes and beliefs toward ICT.

2.2.2.2. Complexity of factors

Zhao et al. (2002) focus on the conditions for successful use of ICT in the classroom and claim that uptake is dependent on a number of factors. Similarly to Groff and Mouza (2008), Zhao et al. (2002) identified the “Innovator” – the teacher; the “Innovation” – the project; and the “Context” – the school, which interacted with one another in various ways, thus suggesting that these factors were “complex and messy” (p. 482). Zhao et al. (2002) emphasises that the “Innovator – the Teacher” had the most important role, a view also held by Groff and Mouza (2008). In order to do this, the teacher should possess what Zhao et al. (2002) called “technology [ICT] proficiency, pedagogical compatibility, and social awareness” (p. 489). The writers argue that it is essential that teachers first have both the capacity to use technical equipment and the knowledge of the conditions that facilitate the use of certain ICT tools in teaching. Furthermore, teachers who were more “reflective about their own teaching practice and goals [in using certain ICT tools] … in the sense that they consciously use technology [ICT] in a manner consistent with their pedagogical beliefs” (p. 492) would most likely become successful when using ICT in their teaching practice. Finally, they argue that teachers who knew how to interact and negotiate with administrators, technicians and other teachers about ICT resources would be able to fully utilise ICT in their own practice. This is what Zhao et al. (2002) terms “social awareness”, which is teachers’ knowledge about the “social dynamics of the school, where to go for what type of support, and [being] attentive to their peers” (p. 494). Yet, the research of Divaharan and Ping (2010) focuses on context when identifying factors that influence the intent of teachers to use ICT in teaching practice. “The factors identified are availability of time, access, shared vision, relevant professional development, multi-faceted leadership, and functioning as a learning organization” (Divaharan & Ping, 2010, p. 743).

2.2.2.3. Relationships between factors

Like other researchers, Mumtaz (2000) categorises factors as barriers and enablers but, she also explores the relationship between factors. For example, Mumtaz (2000) insists that if the school did not give teachers enough time and support to get used to ICT in their teaching, there would be teacher resistance to technological change. She also emphasises that inadequate resources would lead to limited ICT use and thus, to restricted ICT experience for teachers and students. For the teachers, important influencing factors included their feelings, skills, attitudes, motivations, experiences with and commitment to ICT usage. Mumtaz (2000) also implies that teachers’ theories of teaching and learning played a decisive role in the use of ICT in their practice. If teachers are not “enthusiastic” about teaching with ICT, they would choose to go without it, even when they were provided with enough facilities and technical network support. In the perspective of Mumtaz (2000), the factors in relation to the teacher “outweigh[ed] the school factors” (p. 337). Of concern, however, is that Mumtaz’s (2000) framework presents a select set of teacher-related factors and does not consider the role of context or others such as students, on teacher decision-making.

2.2.2.4. Issues with identifying factors

As the literature review has shown so far, researchers have attempted to identify and categorise factors influencing the use of ICT in the classroom practice of teachers and therefore teacher mentors. There are, however, a number of issues with this review including that some research studies only ever present a partial view of the complex issues around teacher decision-making as they focus only on the barriers (Becta, 2004; Bingimlas, 2009; Groff & Mouza, 2008; Hew & Brush, 2007; Unal & Ozturk, 2012), while other research studies only focus on the enablers (Baek et al., 2008; Zhao et al., 2002). As such, this research literature can only present one side of the picture. The third issue relates to the practice of categorising and sub-categorising factors that influence use of ICT in teaching practice. While this is useful as it enables key ideas to be emphasised, it can lead to issues around complexity because often there is not a clear distinction between each of the factors.

This literature review has also identified teachers, and subsequently teacher mentors, as an important factor in integrating ICT (Ertmer, 1999; Groff & Mouza, 2008; Jamieson-Proctor & Finger, 2008; Mumtaz, 2000; Phelps & Graham, 2013). However, when it comes to exploring this influence, a techno-centric position is often adopted in the research literature, that is one in which the focus is on teacher technical knowledge and skill, computer competence or computer literacy. In recent times, Mishra and Koehler (2006) have attempted to address this issue through the development of their TPACK framework. This framework is discussed later in this chapter under the heading '2.4. The TPACK framework'.

2.2.3. Ongoing challenges for ICT uptake

As discussed, there are ongoing challenges for ICT uptake in the classroom. Since the early 1990s in Australia, both national and state and territory governments have encouraged an ICT agenda in Australian schools. Nowadays in Australia, the use of ICT in the classroom is an accepted part of a teacher's repertoire of teaching strategies. But the limited use of ICT in teaching practices is still a concern today. Groff and Mouza (2008) maintain that creating learning environments using ICT is a challenge for teachers. It is well-documented that despite the push to integrate ICT, many education providers struggle to find regular success (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training & Hartsuyker, 2007; Groff & Mouza, 2008; Henderson et al., 2013; Phelps & Graham, 2013; Selwyn et al., 2018). The investment in ICT is mainly for preparation of classwork, not for classroom instruction (Castañeda & Selwyn, 2018; Groff & Mouza, 2008; Jordan, 2011; Selwyn et al., 2018). As Groff and Mouza (2008) highlight, teachers use ICT to improve their own productivities rather than making “the quantum leap” to improving their application of ICT as an instructional tool. Selwyn et al. (2018) agree that use of ICT tends to focus on teachers completing tasks efficiently and so concentrate attention toward what is consequential rather than what is actually fundamental to teaching practice. What influences the integration of ICT into effective classroom instruction (or quality teaching) is complex (Cox, 2008a, 2018), and as previously discussed, a range of factors including barriers and enablers have been identified by researchers as contributing to this complexity.

2.2.3.1. Supporting pre-service teachers to be ICT-ready

There is much agreement that supporting pre-service teachers to develop their ICT capacity is a problematic task (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training & Hartsuyker, 2007; Ertmer, 2003; Jamieson-Proctor et al., 2010; Mirzajani et al., 2015; Ure, Gough, & Newton, 2009; Voogt & McKenney, 2017). While equipping pre-service teachers with capabilities to use ICT during teaching practicums is considered both a priority as well as a challenge, it is not a straightforward task.

> Some people suggest that young, beginning teachers will be change agents, expecting that they … will already be confident with technology. Because new teachers have had exposure to ICT integration ideas in their preservice education, the assumption is they will carry these ideas into their classrooms and be well-placed to spread knowledge, skills and practices to more experienced teachers. (Phelps & Graham, 2013, p. 8)

This is supported by Steketee (2005) who claims, although pre-service teachers may have greater access to ICT, "it is a mistake to assume that they [pre-service teachers] have developed sufficient skills outside their teacher education courses … [and that] access is not synonymous with competency" (p. 101). This is simply not the case, as the level of preparedness of pre-service teachers to use ICT is doubtful (Ertmer, 2003; Henderson et al., 2013; Steketee, 2005). Pre-service teachers may use ICT in their daily personal lives but knowledge about how to transfer it into the classroom for instruction is limited.

2.2.3.2. Barriers to lack of ICT capabilities of pre-service teachers

There has been a range of issues identified as to why pre-service teachers lack the capabilities to use ICT during teaching practicums, such as their beliefs and values (Ertmer, 2003; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Hsu, 2016; Phelps & Maddison, 2008); prior knowledge and experience (Mahdi & Al-Dera, 2013) and this is often coupled with their experiences during teaching practicums (Brown & Warschauer, 2006; Evans & Gunter, 2004; Koh et al., 2010). Wang (2002) claims that "teachers who hold teacher-centred beliefs of teaching and learning will be less likely to view ICT as an integral learning tool" (p. 152). Teachers, and therefore teacher mentors, who do not regularly use ICT in the classroom often hold didactic or teacher-centred, rather than student-centred approaches, to learning. According to Steketee (2005) "[b]ecause pre-service teachers tend to mimic the practices and beliefs of their tutor teachers [teacher mentors], even those [pre-service teachers] who are motivated to use ICT on the teaching practicums will be less inclined to do so if this approach is not generally promoted by the teacher [mentor]" (p. 113). This issue will be discussed in more detail in the second part of this chapter, under the heading '2.3. Mentoring'.

2.2.3.3. Criticisms of teaching practicums

Often, when it comes to supporting pre-service teachers to use ICT in teaching practice, it is university-based course work that is emphasised, and teaching practicums, where students gain direct experience teaching in schools, that are largely overlooked. This is despite teaching practicums being seen as an essential part of becoming a teacher (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training & Hartsuyker, 2007). Nevertheless, teaching practicums themselves have been the focus of much criticism.

It has been suggested that the "current distribution of responsibilities in teacher education … results in a fragmented approach to teacher education" (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training & Hartsuyker, 2007, p. 2). The Victorian Council of Deans of Education and the Victorian Institute of Teaching report 'Practicum partnerships: Exploring models of practicum organisation in teacher education for a standards-based profession' highlights the challenge in teacher education of the "… nature of the link between pedagogical theory and the placement experience" (Ure et al., 2009, p. 13). This report called for teaching practicums to be based on stronger partnerships and a higher quality teaching experience. The Australian government's 'Top of the Class report' suggests that underpinning this problem is the "current distribution of responsibilities in teacher education …" (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training & Hartsuyker, 2007, p. 2), in which theory components are taught at the university and a practical component occurs in schools. That is, there is a disconnect between theory components taught at the university and the practical component in schools (Walker, Morrison, & Hay, 2019).

2.2.3.4. Relationship between theory and teaching practicums

The teaching practicum provides pre-service teachers with supervised experiences and practical applications to assist them with gaining a comprehensive understanding of the role of teachers in the classroom. High-quality teaching practicum experiences are considered to be a critical element to developing teacher effectiveness (Behrstock-Sherratt, Bassett, Olson, & Jacques, 2014; Morrison, Masters, & Quentin-Baxter, 2018; Walker et al., 2019). The teaching practicums should provide pre-service teachers with an understanding of school life and its context, including sharing the experience of its culture, that is its vision, objectives and values. However, in Australia, the roles of in-service teachers in teaching practicums (i.e. teacher mentors) frequently lack guidance and support from universities in developing mentoring skills (Hudson, Spooner-Lane, & Murray, 2013). This is discussed further in the next section, under the heading ‘2.3. Mentoring’.

This research study examined the issues identified by Darling-Hammond (2006) concerning how “teacher education must venture out further and further from the university and engage ever more closely with schools in a mutually transformative agenda” (p. 302) to support both teacher mentors to enable high-quality teaching and mentoring, in regard to developing teacher knowledge for the effective integration of ICT during teaching practicums.

2.3. Mentoring

The third part of this chapter, written in four sections, focuses on the importance of teacher mentors in supporting pre-service teachers to gain knowledge and skills while on teaching practicums in schools. It begins by discussing the Teacher Education Ministerial Advisory Group (TEMAG) report (Teacher Education Ministerial Advisory Group, 2014) on the quality of teacher education in Australia, and its subsequent recommendations including the use of teacher mentors. It then explores, in the second section, how the focus on mentoring is becoming more prevalent in effective teaching practicum experiences of pre-service teachers. It also defines mentoring and explores how its roles differs from those of supervision, coaching and tutoring. Furthermore, it examines the qualities of effective mentoring and the benefits and limitations of mentoring for both teacher mentors and pre-service teachers in the final section.

2.3.1. Mentoring and pre-service teachers

This section explores the call to improve initial teacher education programs to ensure pre-service teachers are classroom-ready and perform at least at a “graduate standard” (AITSL, 2011). It also highlights recommendations made to enhance these programs, especially the importance of the provision of high-quality experiences for pre-service teachers when on teaching practicums.

2.3.1.1. The Australian Government Teacher Education Ministerial Advisory Group (TEMAG) recommendations

There is agreement in both Australian and international literature that there is room for improvement in the training of teachers (Australian Government Department of Education Employment and Workplace Relation; Australian Government Teacher Education Ministerial Advisory Group, 2015; Darling-Hammond, 2006; Finger et al., 2015; Steketee, 2005; Walker et al., 2019). “The Australian Government knows that having well trained and knowledgeable teachers provides the foundation for a strong, high quality education system in Australia” (Australian Government Teacher Education Ministerial Advisory Group, 2015, p. 3). As the Australian national government provides the majority of funds for tertiary courses to train teachers, it requires return on its investment when training teachers. Accordingly, in 2014 the then Australian minister for education, Minister Pyne established TEMAG to provide advice on teacher training. “The Australian Government…[was regarded as] well positioned to take action to improve the training of teachers through the work of the Australian Institute for Teaching and School Leadership (AITSL) and with the foundation of the nationally agreed standards for teaching in place" (Australian Government Teacher Education Ministerial Advisory Group, 2015, p. 3).

The TEMAG recommendations were published in a 2014 report entitled the 'Action now: Classroom ready teachers' (Teacher Education Ministerial Advisory Group, 2014). One of its key directions focused on improved and structural teaching practicums for pre-service teachers, with a greater emphasis on partnerships between initial teacher educations providers and schools. The Australian national government's response to this report identified that "[t]he quality of the placement [teaching practicum] is influenced by the relationship between universities and schools, as well as the supervising teachers [teacher mentors] selected to guide and assess teacher education students [pre-service teachers] and how well these teachers are prepared for the role" (Australian Government Teacher Education Ministerial Advisory Group, 2015, p. 7). The report highlighted "… that better partnerships between universities and schools are needed to deliver high quality practical experience" (Australian Government Teacher Education Ministerial Advisory Group, 2015, p. 7). The report argued that the development of strong and reciprocally-advantageous partnerships between schools and initial teacher education providers can result in more effective supervision of pre-service teachers and the growth of knowledge and skills for teacher mentors.

Initial teacher education programs are expected to provide pre-service teachers with genuine opportunities to integrate theory and practice so that there is development of a comprehensive understanding of content necessary for teaching with a robust understanding of teaching practices necessary for student learning. As teacher mentoring is considered to be integral to initial teacher education, teacher mentors are expected to ensure teaching practicums provide pre-service teachers with opportunities to integrate theory and practice. Teacher mentors are also expected to have the knowledge and skills to effectively supervise and provide feedback to pre-service teachers against the AITSL teacher standards (AITSL, 2018b) to ensure quality teaching. Thus, there is increasing pressure on initial teacher education providers to ensure that pre-service teachers are ready to teach at "graduate standard" (AITSL, 2018b), with teaching practicums perceived as being essential to this achievement.

2.3.1.2. Importance of quality teaching practicums

As previously highlighted, a chief component of initial teacher education programs is teaching practicums, sometimes called 'field experience' or 'professional experience' (Le Cornu, 2016). The teaching practicum is considered to be critical in preparing pre-service teachers for the world of teaching (Garvis et al., 2011; Le Cornu, 2016; Pendergast et al., 2011; Shinas, Karchmer-Klein, Mouza, Yilmaz-Ozden, & Glutting, 2015; Walker et al., 2019). As commented by the 'Top of the Class report', "[a] good measure of the effectiveness of teacher education courses is the quality of the graduates teaching in real school settings" (Australian Parliament. House of Representatives Standing Committee on Education and Vocational Training & Hartsuyker, 2007, p. xxii). The preparation of first-class teachers is reliant on a domino effect: training high-quality teachers requires high-quality teaching practicums; high-quality teaching practicums rely on high-quality relationships between initial teacher education providers and schools; and pre-service teachers are dependent upon the selection of highly-skilled teachers to mentor them to become effective teachers.

> The ['Top of the Class'] report makes it clear that practical in-class experience should give teacher education students [pre-service teachers] the opportunity to connect what they learn at university with real world practice … Placement must be supported by highly-skilled supervising teachers [teacher mentors] who are able to demonstrate and assess what is needed to be an effective teacher. (Australian Government Teacher Education Ministerial Advisory Group, 2015, p. 7)

Pre-service teachers rely on a range of human resources when undertaking teaching practicums. The proverb, 'it takes a village to raise a child' can apply to effective teacher training as it relies on a whole community of high-quality, yet different, stakeholders to train effective teachers. Two of these stakeholders include staff from both initial teacher education providers and from schools. The Australian Government Teacher Education Ministerial Advisory Group (2015) advocates stronger relationships between these stakeholders, arguing that there is a gulf between the theory of initial teacher education providers with what actually occurs during teaching practicums. It proposes that the teaching practicum needs to be viewed as a partnership between the school and its teachers and the initial teacher education provider and its pre-service teachers. According to Ure et al. (2009) there needs to be more communication and collaboration between schools and initial teacher education providers and better support for the work of teacher mentors throughout teaching practicums. According to Hudson and Hudson (2010), forming a constructive relationship is vital for the development of quality teaching practicums for pre-service teachers.

2.3.2. Characteristics of mentoring

This section provides an overview of mentoring, including a discussion about defining the term in relation to this research study, and how the roles of mentoring are important in supporting pre-service teachers in order to maximise teaching practicum experience and make pre-service teachers classroom-ready. It also specifically explores similarities and differences in the terms mentoring, supervision, coaching and tutoring, as well as the main roles of a teacher mentor.

2.3.2.1. Defining mentoring versus supervision, coaching and tutoring

In international literature when referring to the teacher mentor, there are references to myriad terms such as ‘practicum supervisor’, ‘supervising teacher’, ‘cooperating teacher’, ‘school sponsors’, ‘associate teacher’ and ‘school-based teacher educator’, which can contribute to much misunderstanding about mentoring. It also needs to be highlighted that there are numerous terms used for those being mentored including ‘mentee’, ‘protégé’, ‘student teacher’, ‘pre-service teacher’, ‘beginning teacher’ and ‘coachee’. This research study uses the terms ‘mentor teacher’ and ‘pre-service teacher’.

This research study adopted the term ‘teacher mentor’ as it is a commonly used term in the educational landscape in Australia. Importantly, as argued by numerous researchers such as Ambrosetti (2014), the term focuses on mentoring as a supportive and constructive role, inferring a collaborative partnership. “Mentoring is often described as an interpersonal relationship that comprises of a series of purposeful, social interactions” (Ambrosetti, 2014, p. 31). This description is similar to the qualities of supervision, however Ambrosetti (2014) distinguishes mentoring from supervision by asserting that mentoring is also about the development of the relationship between the mentor and mentee, and highlights that the mentoring relationship is more likely to be reciprocal. “Thus in mentoring, the relationship becomes central to the interactions that occur … [and both the teacher mentor and pre-service teacher] negotiate the journey together …” (p. 31). Other researchers such as Brett et al. (2018); Davis and Fantozzi (2016); Irby (2012); Keogh, Dole, and Hudson (2006); and Moyle (2016) also support the viewpoint that mentoring is about creating significant relationships. That is, there is a reciprocal and mutually beneficial relationship evident between teacher mentors and pre-service teachers.

2.3.2.2. Distinguishing mentoring from supervision

Conversely, supervision is considered to be more closely aligned with shaping pre-service teachers to fit in with the school’s context and culture through acquisition of the supervisor’s [teacher mentor’s] characteristics. As Walkington (2005) explains, “the term supervision has been closely associated with the role of socialization” (p. 55). In other words, the pre-service teachers become ‘facsimiles’ of their teaching context, rather than being provided with opportunities for them to understand and develop skills and knowledge at a more profound and philosophical level, like they would with mentoring. This is supported by other researchers (Ambrosetti, 2014; Keogh et al., 2006; Walkington, 2005), who discuss the more holistic, enduring and developmental process of mentoring.

> [M]entoring is more dynamic, involving interpersonal and psychosocial development, greater collegiality, professionalism and role fulfillment. It emphasizes evaluating beliefs and practices, questioning personal views and theorizing more about practice. (Walkington, 2005, p. 56)

Thus, in this research study, the concepts of mentoring are based around shared and long-lasting relationships, which focus on a deeper, but reciprocal, development of both teacher mentors and pre-service teachers that they negotiate as a partnership. The view of mentoring is much more synergetic between teacher mentors and pre-service teachers. Keogh et al. (2006) consider that “the view of supervisor as ‘expert’ and pre-service teacher as ‘novice’ may not be conducive to a fully productive and mutually beneficial relationship” (p. 1).

> Principles of ‘good’ supervision included welcoming and enculturating the pre-service teacher into the teaching staff and classroom; modeling and explaining; providing discussion and feedback. These are still relevant, but mentoring demands a much deeper treatment of the processes going on in the classroom and school. (Ambrosetti, 2014, p. 56)

Ambrosetti (2014) further elaborates “that mentoring is a holistic process that includes three components: relationship, development needs and contextual elements” (p. 31), and enables pre-service teachers to develop their individual personal and professional personas through discussion and reflection. That is, mentoring enables pre-service teachers to develop their own teaching identity (or persona) and philosophies, such as beliefs about theories of teaching and sense of teacher efficacy.

2.3.2.3. Distinguishing mentoring from coaching and tutoring

Many researchers distinguish mentoring from coaching by stating that one of mentoring's unique characteristics is that it involves typically longer relationships that develop over time (Carr, Herman, & Harris, 2005; Irby, 2012; McCarthy, 2013). The importance of relationships in mentoring is also emphasised by the Victorian Department of Education and Early Childhood Development (2010) that recognise "[a] mentor is not an instructor and the beginning teacher is not a student — he or she is a colleague" (p. 3). Mentoring is considered to be a formalised relationship that relies upon understanding and responsibility that is shared by both participants. By way of contrast, Irby (2012) and Moyle (2016) identify that coaching tends to focus on individuals who have explicit goals, which are related to improving performance that are specific to an event.

Likewise, tutoring is another concept closely related to mentoring and coaching, yet is different. According to Irby (2012), tutors typically work on an explicit goal in a short time frame, often in an educational setting; it therefore is narrower in scope than mentoring and coaching. Tutoring, like coaching, tends to focus on performance issues, but tutoring tends to be problem-based, rather than development of performance. Therefore, tutoring relates to having a responsibility to assist where there is a disparity in information or skills (Irby, 2012; Topping, 2017). There is a lack of reciprocity evident in a tutoring relationship.

Figure 1 depicts the relationship between the three concepts (mentoring, coaching and tutoring) as identified by Irby (2012). Also, brief differences noted between the three concepts are listed in Figure 1.

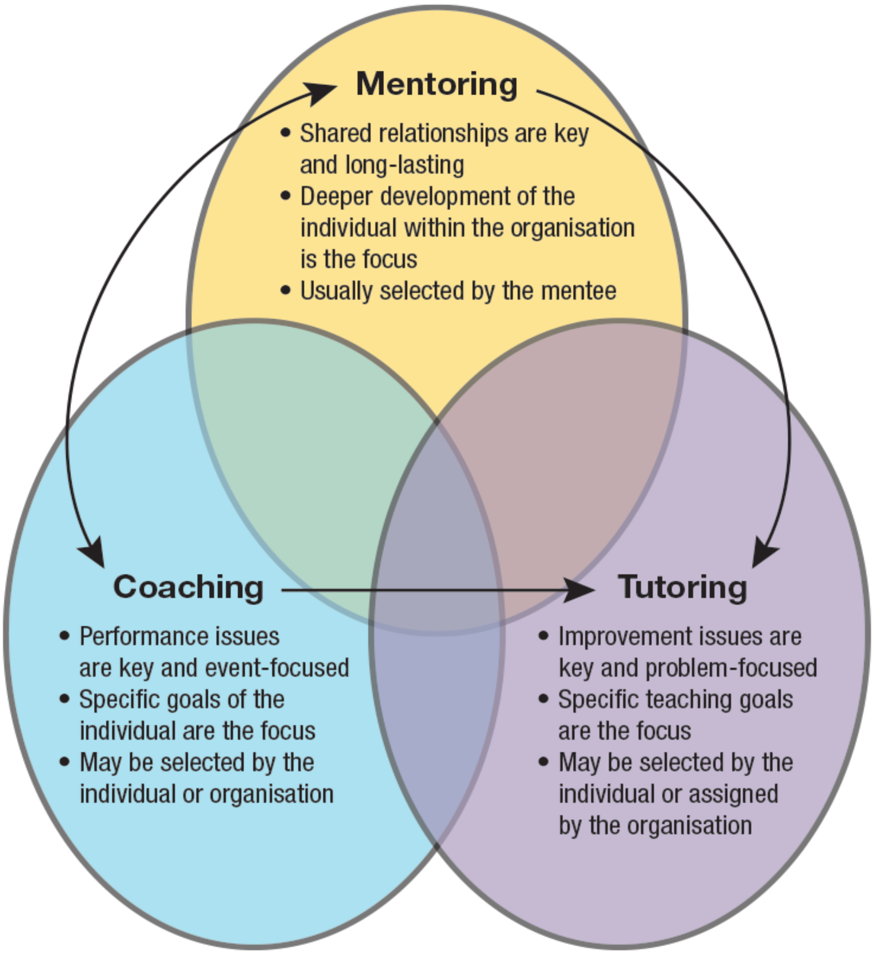

Figure 1: Irby's (2012) depiction of the relationship between mentoring, coaching, and tutoring. Adapted from "Editor's overview: Mentoring, tutoring, and coaching", by B.J. Irby, 2012, *Mentoring & Tutoring: Partnership in Learning*, *20*(3), p. 298.

Irby (2012) pertinently sums up the differences between mentoring, coaching and tutoring by asserting that "… mentors can coach, but coaches hardly ever mentor, and mentors and coaches can tutor, but tutors rarely mentor or coach" (p. 297). Therefore, mentoring is regarded as distinct from supervision, coaching and tutoring.

2.3.2.4. Mentoring and pre-service teachers

In my research study, mentoring will refer specifically to the professional and reciprocal relationship between teacher mentors and pre-service teachers, and as discussed previously, is regarded as separate from supervision, coaching and tutoring. This definition supports the description used by Ellul (2010) as the practice of sharing or imparting "wisdom and a depth and wealth of experience to a mentee or protégé [pre-service teacher]" (p. 13). While research literature identifies a power relationships with the term 'protégé', Clutterbuck (2004) states that there is a need to negotiate issues of power in any mentoring relationship.

In essence, mentoring refers to an equal and reciprocal professional relationship that supports the professional growth of teaching expertise. Bradbury (2010) refers to this as "the promotion of egalitarian relationships" (p. 1051), and Davis and Fantozzi (2016) reinforce the reciprocal relationship by stating that the process of the teaching practicum "… needs to be seen as a transactional relationship between mentor, pre-service teacher and context that results in the formation of attitudes about teaching and one's self" (pp. 2-3). The mentoring relationship is therefore dynamic – it influences the context, and the context influences the mentoring relationship. This relationship provides opportunities for pre-service teachers as well as teacher mentors to reflect on a range of aspects related to teaching, and development of their identity and philosophies as teachers. "While personal support is inherent in a mentoring relationship, the emphasis is on professional support, in this case supporting the growth of teaching expertise" (Victorian Department of Education and Early Childhood Development, 2010, p. 20). Barnett and Friedrichsen (2015) reinforce this by stating that "[teacher] mentors attend to the mentees' [pre-service teachers'] current needs while helping mentees [pre-service teachers] develop the ability to learn from and in their own practice" (p. 650). Mentoring of pre-service teachers enables them to apply their theory within the teaching practicum to make them classroom-ready.

2.3.3. Attributes for effective mentoring

This section highlights the complexity of mentoring by exploring the variety of knowledge needed by teacher mentors to provide quality mentoring. The discussion examines the importance of providing training to teachers to develop knowledge and skills for quality mentoring experiences, and considers the assumption that experienced teachers will naturally be suited to mentor pre-service teachers. The relationship between the provision of quality mentoring with the delivery of quality teaching practicums for pre-service teachers is also emphasised.

2.3.3.1. Complexity of mentoring

In the research literature, mentoring is depicted as complex; having many approaches; and reliant on the individuals in the relationship (Brondyk & Searby, 2013; Carr et al., 2005; Davis & Fantozzi, 2016; Hudson, Hudson, Gray, & Bloxham, 2012; Ingersoll & Strong, 2011; Irby, 2012). According to Ambrosetti (2014), the roles of the teacher mentor are considerably more than just using required knowledge and skills, as they are also about imparting emotional support with the development facets in the mentoring relationship. "Nevertheless understanding the nature of mentoring, the process of mentoring and the distinct components that are encompassed in mentoring, will provide an informed approach that can enable all participants to meet their goals" (Ambrosetti, 2014, p. 40).

2.3.3.2. Assumption with equating experience to best

Typically, in-service teachers are used as mentors for pre-service teachers. These teachers provide support to pre-service teachers about learning in a practical setting, namely the classroom. It is assumed that an effective teacher will also be an effective mentor – that an effective teacher can support a pre-service teacher to develop the knowledge and skills they need. However, numerous researchers contradict this assumption (Ambrosetti, 2014; Davis & Fantozzi, 2016; Morrison, 2016; PTR Consulting Pty Ltd, 2017; Zimpher & Rieger, 1988). As Ambrosetti (2014) argues "[m]entoring is not a natural ability that people inherently have, so an effective teacher may not necessarily make an effective mentor" (p. 30). This view is also shared by Davis and Fantozzi (2016) who argue that "[m]entor teachers are generally chosen for their teaching skill or years of experience, but not necessarily the knowledge of how to mentor; further, they are not always trained to be good mentors" (p. 1). Similarly, in the report prepared for AITSL entitled 'TEMAG Evaluation: Stakeholder perspectives on progress', AITSL also questioned the assumption that experience equates to best and asks whether the most experienced teachers are most suited to the role of teacher mentors (PTR Consulting Pty Ltd, 2017). Zimpher and Rieger (1988) highlight that the main factor taken in consideration when selecting teacher mentors is that the teacher mentors are viewed as an expert by their colleagues, and that this expertise is often measured in terms of their years of teaching experience. Correspondingly, Zimpher and Rieger (1988) also conclude that "… no one age category is more appropriate or more effective than another age [to be effective teacher mentors]" (pp. 179–180). Aptly, Morrison (2016) asserts that "… teaching experience alone is not a guarantee of [teacher mentor] effective" (p. 108).

2.3.3.3. Best practice for effective mentoring

There is considerable research arguing that teacher mentors need to have particular knowledge and skills to be effective. The Victorian Department of Education and Early Childhood Development (2010) states that to be an effective mentor "the primary consideration is that the mentor is motivated to be a mentor, enthusiastic in the role, and possesses the attributes of an effective mentor" (p. 3). These attributes include being empathetic and accessible, and possessing an ability and willingness to communicate and listen (Victorian Department of Education and Early Childhood Development, 2010). These considerations to be an effective teacher mentor are supported by Zeichner (2005), who adds that the importance of understanding conceptual and empirical literature in teacher education is also essential.

> If this new generation of teacher educators goes into their roles with knowledge of the scholarly literature related to the work of teacher education and with the dispositions and skills to study their practice to make it better, novice teachers and their pupils will benefit. (Zeichner, 2005, p. 123)

It is important to note that the research literature suggests that mentoring can be learnt and developed over time. Therefore, professional learning becomes an important element of effective mentoring (AITSL, 2015; Ambrosetti, 2014; Beutal & Spooner-Lane, 2009; Hudson, 2013; Hudson, Hudson, & Beutel, 2009). Yet while having knowledge and skills is recognised as important, teacher mentors are not required to undertake professional learning to develop such knowledge or skillset when working with pre-service teachers.

As previously stated, mentoring is complicated, so ensuring mentoring is effective is also not necessarily straightforward. "Best practices in mentoring are difficult to identify partially due to the complexity of the mentoring process" (Brondyk & Searby, 2013, p. 190). Although structural elements to support the mentoring relationship, such as working in close proximity to one another and timetabling regular meetings, are regarded as advantageous, there are other considerations for qualities of an effective mentor. These qualities generally relate to personal traits of teacher mentors, such as motivation, enthusiasm and as discussed, attributes such as empathy, accessibility and communication and listening skills, rather than the processes used to pair teacher mentors with pre-service teachers. Therefore, the knowledge and skills of teacher mentors greatly contribute to the success of mentoring relationships (Beutal & Spooner-Lane, 2009).

According to Nielsen et al. (2017), "teachers view the role of supervising [mentoring] as a way to give back to the field, suggesting that these teachers feel they have something to offer in terms of supporting the development of the next generation of teachers" (p. 10). There is a perceived benefit of contributing to the profession by being responsible for the development of pre-service teachers, so they can assist in renewing the profession.

Also as emphasised earlier, the knowledge and skillset of teacher mentors is different to that of teaching in the classroom. Although teacher mentors need to have an in-depth knowledge and understanding of content and pedagogy, teacher mentors also need to understand how to dissect multifaceted teaching practices into 'digestible' parts that are logical to pre-service teachers (as adult learners) to support their practice. In addition, teacher mentors also need to understand how to support pre-service teachers to facilitate their learning (Beutal & Spooner-Lane, 2009). The complexity of the qualities of teacher mentors is aptly and succinctly summed up by Walkington (2005) claiming “[e]ffective mentoring involves a complex relationship that draws upon personal and contextual factors and a range of tasks and tools” (p. 59).

2.3.3.4. Roles of the teacher mentor

Pre-service teachers require support when on teaching practicums. Therefore the teacher mentors need to comprehend and carry out multiple roles in a variety of ways to provide this guidance (Ambrosetti, 2014; Ambrosetti & Dekkers, 2010; Davis & Fantozzi, 2016; Hudson, 2010; Shih-Hsiung, 2014; Vumilia & Semali, 2016). Ambrosetti (2014) emphasises that mentoring entails various roles and while this in itself results in complexity, it can assist with ensuring effectiveness of the mentoring process. Ambrosetti (2014) argues “… being familiar with the roles in mentoring, having an increased understanding of what is required within each role and how the roles can be used in differing situations, can assist in creating a quality mentoring experience for the [teacher] mentor and mentee [pre-service teacher]” (p. 39). Ambrosetti and Dekkers (2010) also agree that there are numerous roles undertaken in the mentoring relationship by both teacher mentors and pre-service teachers and these roles are dependent upon the context and goals of the school. There is general agreement in the research literature that there are specific roles of teacher mentors: emotional support system; instructional coach; and socialising agent (Davis & Fantozzi, 2016; Shih-Hsiung, 2014; Vumilia & Semali, 2016). These three specific roles of the teacher mentor are unpacked in the ensuing paragraphs.

Providing emotional support

As identified previously, one role of teacher mentors is that of an emotional support system (Ambrosetti, 2014; Davis & Fantozzi, 2016; Vumilia & Semali, 2016). Teacher mentors have a substantial influence on pre-service teachers, especially as their teaching identities are shaped by teaching practicum experiences (Pendergast et al., 2011). These experiences can be demanding, encouraging, stressful, or destructive to the individual relationships and identities of pre-service teachers, and so teacher mentors play a significant role in providing an emotional support system for them during this ever-changing, transitional time. According to Davis and Fantozzi (2016) “[t]he emotional support system involve[s] warm, supportive, face-to-face conversations that focus … on more than just the mechanics of teaching, such as relationships with pupils and being present when the student teacher [feels] … the need for it.” (p. 3). This role of teacher mentors is not about judging and critiquing pre-service teachers as this in itself can result in resentment, angst and fear. Rather the role of teacher mentors is to provide advice and guidance, and is centred on creating a helpful and nurturing environment for developing the pre-service teachers’ teaching practices in a supportive manner. According to AITSL (2015), teacher mentors identified a “need for excellent interpersonal and emotional intelligence. … Attributes like patience, respect, empathy, clear and effective communication, honesty and self-reflection were mentioned frequently” (p. 22) when interacting with pre-service teachers in the mentoring relationship.

Instructional coach

Another important role of a teacher mentor is that of instructional coach. This role is juxtaposed to the emotional support system role as teacher mentors observe and evaluate pre-service teachers. This role is to provide feedback to assist the pre-service teachers to develop their teaching practices, often through reflective questioning. The focus is on providing an extensive support structure, including instructions to pre-service teachers as to how to teach in the classroom as well as how to be a professional colleague within the school community (Davis & Fantozzi, 2016; Nielsen et al., 2017). Teacher mentors support pre-service teachers to navigate the landscape of the classroom, as pre-service teachers often find it challenging to understand content and pedagogy and what resources are available to support learning as well as the other professional roles expected within the school context. For example, teacher mentors provide guidance to pre-service teachers to help with creating lessons; assist with student learning, including engaging different types of learners and differentiating learning; measure student achievement; build relationships with colleagues; and negotiate policy and practices such as use of mobile phones during classes, what to do for a fire drill and how to purchase classroom resources (Davis & Fantozzi, 2016; Nielsen et al., 2017). It is worth noting that the Victorian Department of Education and Training banned the general use of mobile phones (as well as other student-owned digital devices such as wearable devices and tablets) in Victorian government schools from Term 1 2020 unless documented reasons such as specific learning activities are provided by the school or teacher (Victorian Department of Education and Training, 2020c). All government schools are required to develop a 'Students using mobile phones policy', which must include how this ministerial policy will be implemented at a local level. Therefore, this has implications for teacher mentors and pre-service teachers as they will need to not only know how to manage these student-owned devices but also how to deal with non-compliance in the classroom.

Socialising agent

The third role of teacher mentors is that of socialising agents through guiding pre-service teachers into "… replicating their practice or the culture of the school" (Davis & Fantozzi, 2016, p. 3). Vumilia and Semali (2016) agree that mentoring exerts strong socialisation effects on pre-service teachers and emphasise that "… a pre-service teacher goes through a socialization process where beliefs, attitudes, behaviors, and teaching philosophies are imparted" (pp. 6–7). The process of teaching practicums, according to Davis and Fantozzi (2016), "needs to be seen as a transactional relationship between [teacher] mentor, pre-service teacher and context that results in the formation of attitudes about teaching and one's self" (pp. 2–3). Soccorsi (2013) emphasises the importance of teacher mentors to develop personal teaching philosophies of pre-service teachers, and the implications as personal beliefs, values and experiences of pre-service teachers are powerful elements in guiding teaching practice and perceptions of teaching and learning.

Beauchamp and Thomas (2009); Pendergast et al. (2011); and Garvis et al. (2011) draw attention to the importance of teacher mentors not only in preparing pre-service teachers for classroom instruction, but also for supporting their development of identity. Garvis et al. (2011); Lee and Lee (2014); Lemon and Garvis (2015); Pendergast et al. (2011); and Topkaya (2010) emphasise the importance of development of self-efficacy in pre-service teachers, that is beliefs about their ability to achieve desired outcomes. In particular, Garvis et al. (2011) and Pendergast et al. (2011) assert that self-efficacy is fundamental for perseverance, and so helps prepare pre-service teachers for the realities of the challenges within the school context, and influences their thoughts and emotions that can support classroom actions such as greater use of innovative teaching methods like using ICT in the classroom. Therefore, teacher mentors play an central role in assisting pre-service teachers to negotiate their beliefs about teaching and assist them to develop resilience and thereby maintain their passion for teaching (Pendergast et al., 2011).

2.3.3.5. Lack of formal training

Teacher mentors acquire the knowledge, skills and understandings used to support pre-service teachers through a variety of channels, including teaching practice and experience; through collaboration with teaching colleagues; and during training and development (Clarke, Killeavy, & Moloney, 2013). However, teachers often consider the skills, knowledge and expertise required for mentoring as something that is learned "… 'on the job', within the context of a full-time teaching position … [where] the complex set of professional, academic subject and pedagogic skills and all they entail can be fully learned" (Clarke et al., 2013, p. 372). In particular, teachers regard "the acquisition and improvement of their teaching skills to be an important source of knowledge in their work as mentors" (Clarke et al., 2013, p. 369). Even though it is acknowledged that mentoring encompasses a variety of roles, which require a diversity of knowledge and skills, most teacher mentors are not provided with formal training to develop knowledge and skills for mentoring (Davis & Fantozzi, 2016;

Hudson & Hudson, 2010; Hudson et al., 2013; Invargson et al., 2014; MacDougall, Mtika, Reid, & Weir, 2013; Nielsen et al., 2017).

Hudson et al. (2013) also argue that teacher mentors infrequently receive training and do not gain much support from initial teacher education providers to develop mentoring knowledge and skills. AITSL (2015) endorses this by referring to a survey of teacher mentors in Australian schools that revealed only 36% indicated that they received support from their school, and of this cohort, only 18% received formal professional learning. Bahr and Mellor (2016) identify it as a "sink or swim approach" while Zeichner (2005) refers to it as a "seat of your pants approach". According to Nielsen et al. (2017), the identified lack of mentor training "is surprising for such an important area as preservice teacher supervision" (pp. 2–3).

2.3.3.6. Professional learning

According to Victorian Institute of Teaching (2019), teachers, and therefore teacher mentors, need to participate in at least 20 hours of professional learning each year to maintain registration as a teacher in Victoria. However, there are no legislative requirements regarding the overall types of professional learning, let alone anything specifically for mentoring. However, according to the Victorian Auditor-General's Office (2019), both "principals and teachers have obligations to continually engage with innovative and emerging research (p. 15), and this is pertinent for the training of teacher mentors. There are several formal programs available that teachers can undertake to strengthen their mentoring practice. An example of a program is the 'AITSL supervising pre-service teachers—online program', which is a free, online, self-directed, interactive program designed to develop the knowledge, skills and confidence of teacher mentors to effectively support pre-service teachers during teaching practicums (AITSL, 2019b). In addition, mentoring programs are run by the Victorian Institute of Teaching (VIT) (Victorian Institute of Teaching, 2019), Victorian Department of Education and Training (DET) (Victorian Department of Education and Training, 2020a), and Victorian Principals Association (Victorian Principals Association, 2019), along with school-based and university-led mentoring programs that are offered, but do not necessarily target pre-service teachers. These programs highlight that the importance of supporting teachers to become mentors. The Victorian Auditor-General's Office (2019) emphasises that professional learning needs to be framed as a critical lever in improving the knowledge and skills of teachers.

2.3.3.7. Issues with relying on own experiences

Lack of formal training is likely to result in teacher mentors relying on past experiences when working with pre-service teachers. Researchers such as Nielsen et al. (2017), Walkington (2005) and Clarke et al. (2013) assert that due to lack of training, teacher mentors often use their own experiences of being both a pre-service, and an in-service, teacher. According to Walkington (2005), teacher mentors often have little understanding of what the pre-service teacher training program entails because of a lack of guidance or formal training. This lack of understanding results in teacher mentors relying their values, beliefs and experiences as the crux to support and assess pre-service teachers. “It is not surprising, therefore, that the idea that ‘school is where you really learn to teach’ is commonly held by many in schools” (Walkington, 2005, p. 55).

Clarke et al. (2013) also asserts that teacher mentors often regard teaching as “something learned ‘on the job’” (p. 372) and emphasises that teacher experience is often pivotal to decision-making by teacher mentors when supporting pre-service teachers. Relying on one’s own experiences, whether of the classroom or pre-service teacher training, can be challenging as individual practices may not necessarily be supportive of current pre-service teacher learning. Using personal teaching experiences “is problematic because unarticulated and tacitly held beliefs about one’s own supervisory [mentoring] practices can be detrimental to preservice teacher learning whilst on practicum” (Nielsen et al., 2017, p. 2). If assumptions and values related to teaching are typically implicit and undeclared, teacher mentors may proceed without questioning or reflecting on practice as they think their instinctive actions are the way things should be (Clarke et al., 2013). For example, assumptions such as 'teach like your favourite teachers' will be presumed to be acceptable by pre-service teachers rather than understanding they need to develop their own teaching identity and philosophies, and learn and shape the individual traits and talents they bring to teaching. Nielsen et al. (2017) and Clarke et al. (2013) discuss how reflecting on one's tightly-held but unspoken beliefs and assumptions is a useful start to dispelling unfavourable assumptions and beliefs. Nielsen et al. (2017) states that "[a] key focus for teacher professional learning is reflection on practice where teachers have opportunities to frame and reframe their understandings" (p. 3) so reflecting on practice should also be critical for pre-service teachers to develop and nurture over time in order to become quality teachers and acquire one's teaching identify and philosophy.

Beutal and Spooner-Lane (2009) too acknowledge that "[t]he success of mentoring lies in the skills and knowledge of mentors" (p. 1), and that a professional learning program that is well-constructed and delivered effectively can enhance the ability of teacher mentors to work with pre-service teachers to advance the use of ICT during teaching practicums. In addition, the Victorian Department of Education and Early Childhood Development (2010) emphasises the importance of developing knowledge and skills in mentoring, and Clarke et al. (2013) highlights that "… [teacher mentors] require support within programmes to reflect upon the impact of their early socialisation experiences, their identification with their roles as teacher mentors and their attachment to practice-based experience as a source of professional knowledge" (p. 374).

So fundamentally, effective mentoring is complicated—it entails various roles including being an instructional coach, providing emotional support and acting as a socialising agent, and is underpinned by a range of skills and knowledge, as well as the relationships between teacher mentors and pre-service teachers. Mentor training is important to dispel implicit values and beliefs so that teacher mentors can reflect on practices, rather than considering that their instinctive actions are the way things should be and support the pre-service teachers to do so as well. Professional learning to support teachers to understand the various roles of mentoring is also critical. All these factors add to the complexity of quality mentoring.

2.3.4. Benefits and limitations of mentoring

Mentoring is often regarded as a symbiotic relationship in which both teacher mentors and pre-service teachers benefit from the mentoring relationship that they negotiate together as a partnership. That is, the relationship is mutually beneficial for both teacher mentors and pre-service teachers as they obtain reciprocal gains from the relationship. Hudson et al. (2012) refer to the mentoring relationship as the two-way learning process that can benefit both teacher mentors and pre-service teachers. Therefore, mentoring affords specific benefits for teacher mentors and specific benefits for pre-service teachers.

2.3.4.1. Benefits for teacher mentors

Many researchers acknowledge the reasons why teachers become mentors include contributing to the profession or regarding it as an opportunity for their personal and professional growth (Ambrosetti, 2014; Clarke et al., 2013; Hobson, Ashby, Malderez, & Tomlinson, 2009; Shih-Hsiung, 2014; Smith & Nadelson, 2016). Although teacher mentors are typically considered to be an expert in the practice of teaching, mentoring provides opportunities for teacher mentors to reflect on their own teaching practices when assisting pre-service teachers to analyse classroom practices, including lesson plan development and classroom instruction. Smith and Nadelson (2016) claim that “[b]eing a [teacher] mentor, even for a rather brief period of time, can positively influence teacher perceptions, reflection and ideas for teaching” (p. 69), and elaborate on examples of personal and professional growth.

> [T]he situated learning of being a mentor teacher to preservice teachers in their classrooms with their students would dramatically influence the mentor teachers' levels of reflection on their teaching, their perceptions of what they teach, their engagement in inquiry teaching, and their adoption of innovation. (Smith & Nadelson, 2016, p. 67)

Ambrosetti (2014) also agrees that mentoring provides teacher mentors with opportunities for their personal and professional growth, such as reflecting on their classroom practices; renewed passion for teaching; providing opportunities to "make a difference" to the professional and/or personal life of a colleague; contributing to improved collegiality; and a self-improved work ethic. Likewise, Hobson et al. (2009) and Clarke et al. (2013) affirm that mentoring impacts on teacher mentors positively by providing opportunities for them to critically reflect on their teaching practices and revitalise these practices, which is extremely beneficial to their learnings and self-beliefs.

> [The mentoring relationship enables the teacher mentor to] … talk to others about teaching and learning in general or about their mentees' or their own teaching in particular [this results in] … consolidation of mentors' teacher identity and professional status and an increase their self-worth, resulting from the responsibility involved and a correspondingly enhanced recognition in the professional community. (Hobson et al., 2009, pp. 209-210)

Hobson et al. (2009) assert that "[teacher] mentors have reported learning new and improved teaching styles and strategies, enhancing their knowledge and use of ICT" (p. 209). Hudson et al. (2012) highlights reciprocity in the relationship by discussing that teacher mentors have opportunities to learn from pre-service teachers, who can share new and creative concepts from their university experiences that could be incorporated in the classroom by the teacher mentors. There can be also a great deal of pride and fulfillment gained by teacher mentors from observing the professional growth of pre-service teachers and realising their impact on this development. Teacher mentors also have opportunities for enhancing their communication and listening skills as they collaborate with pre-service teachers and provide feedback (AITSL, 2015).

So, the mentoring experience affords many benefits to the personal and professional growth of the teacher mentors. Specifically, these benefits include constructive professional learning and improved teaching knowledge and skills; greater self-reflection; and improved confidence, enthusiasm and responsibility for the teaching profession.

2.3.4.2. Benefits for pre–service teachers

Mentoring also offers myriad benefits to pre-service teachers, including opportunities to participate in genuine teaching experiences in real-life classrooms, and gain knowledge, understandings and experiences about students, classroom and behavioural management; experience school-life including its sub-cultures and infrastructures; and be part of education systems (Hudson & Hudson, 2018). Specifically, facilitating reflective practices, as part of the mentoring process, is considered extremely valuable for pre-service teachers as it provides opportunities for them to develop autonomy and expertise during teaching practicums and assist in making sense of the classroom environments as well as generate change in beneficial ways (Hudson & Hudson, 2010).

Researchers also acknowledge that pedagogical content knowledge (PCK) is one of the many benefits of mentoring (Barnett & Friedrichsen, 2015; Hudson et al., 2013; Smith & Nadelson, 2016). According to Hudson et al. (2013) “[m]entoring pedagogical knowledge is fundamental towards developing preservice teachers’ practices” (p. 1). This view is endorsed by Barnett and Friedrichsen (2015) who maintain that “[r]esearch suggests discipline-specific, educative mentoring can help preservice teachers develop more sophisticated pedagogical content knowledge” (p. 647).

2.3.4.3. Challenges with mentoring

The challenges with mentoring relate to that of both teacher mentors and pre-service teachers. A major concern with mentoring is finding suitable, enthusiastic staff to become teacher mentors. As commented by Walkington (2005) "[t]he identification of a sufficient number of willing experienced teachers to take on this role can be an ordeal for universities as they attempt to find suitable placements for their students" (p. 55). As previously identified, being a good teacher does not necessarily mean one is a good mentor so it is imperative that suitably identified staff are provided with time for their training and professional learning, which is also another challenge with mentoring. MacDougall et al. (2013) assert that typically insufficient or no support is given to teacher mentors to undertake the role. As Walkington (2005) maintains that"[l]ocating a sufficient number of teachers to be [teacher] mentors is a challenge; the ability to dedicate time to their professional development is extremely difficult" (p. 54).

2.3.4.4. Limitations for teacher mentors

Limitations identified by Walkington (2005) and AITSL (2015) for teacher mentors relate mainly to augmented workload and responsibilities and pressures associated with mentoring. "Research has described limitations of mentoring such as increased workload, added responsibility and stress, uncertainty about how to mentor and having to assess the progress of the pre-service teacher" (Walkington, 2005, p. 54). According to Davis and Fantozzi (2016), often the roles of teacher mentors are considered to be quite evident and accessible to experienced teachers, yet this may not be necessarily so because mentoring requires different knowledge and skills to teaching. Smith and Nadelson (2016) discuss how the reciprocal roles of mentoring may be challenging to experienced teachers. "While the secondary teacher may consider themselves content experts, they may not consider mentoring as an opportunity to reflect on their instructional practice, due to a limited instructional-approach perspective" (Smith & Nadelson, 2016, p. 68).

Unclear roles and responsibilities

The ambiguity or absence of roles, and accompanying responsibilities, associated with mentoring is another challenge. Davis and Fantozzi (2016) discuss how the roles, and therefore responsibilities, for teacher mentors can be ill-defined, or the expectations of roles can be incompatible between that of the initial teacher education providers and the schools. Davis and Fantozzi (2016) go on to state that “a significant challenge in studying, supporting, and developing the teacher mentor-student teacher [pre-service teacher] relationships is a lack of clarity and consensus on the roles and responsibilities of the mentor teacher” (p. 250). They identify that lack of training of teacher mentors often leads to this uncertainty about roles, emphasising that training of teacher mentors is essential and lack of provision of training is a limitation of the mentoring relationship. Specifically, Davis and Fantozzi (2016) assert that it is very evident when teacher mentors are provided with training as they are able to articulate the roles and associated responsibilities. Lack of role clarity with mentoring is also associated with a power relationship in the mentoring relationship. According to Davis and Fantozzi (2016), despite being intended as a reciprocal relationship that is negotiated together, teacher mentors tend to have more power in mentoring relationships than pre-service teachers, and determine the extent of involvement that pre-service teachers have during teaching practicums.

Lack of incentives

MacDougall et al. (2013) identifies that there is a lack of incentives for teacher mentors to take on the extra roles associated with mentoring. The roles of the teacher mentors require individuals with explicit knowledge and skills and individual attributes, and so it can be challenging to find teachers who meet these criteria, and who are willing to participate in mentoring. This is especially worrying, when as often discussed, it is difficult to find willing schools, let alone willing teachers with the attributes to be an effective teacher mentor.

2.3.4.5. Limitations for pre-service teachers

There are several aspects of the nature and quality of the mentoring relationship that can be quite challenging to pre-service teachers. The first issue relates to lack of support from teacher mentors. According to Hobson et al. (2009) "some mentors have failed to provide sufficient support for beginner teachers' emotional and psychological well-being, characterised in many instances by general 'unavailability'" (p. 210). Hobson et al. (2009) also highlights that some teacher mentors create angst in pre-service teachers by providing them with very demanding workloads during teaching practicums.

When pre-service teachers are not being challenged or given enough autonomy within the classroom during the teaching practicums, there can be a negative impact on the mentoring relationship. According to Beck and Kosnick (2000), teacher mentors do not necessarily provide opportunities for pre-service teachers to have the freedom to determine how they will teach content (i.e. lack of opportunities to develop PCK), and so are not providing them with the flexibility to be creative or innovative in their approaches to teaching. This also impacts on the ability of pre-service teachers to develop their teaching identity and philosophies.

Having a focus on the mechanics of teaching, such as a sole emphasis on classroom and behavioural management and teaching content, is where, according to Hobson et al. (2009), "… some teacher-mentors themselves hold a 'transmission perspective' on teaching and learning" (p. 211). Such an approach is not considered beneficial for pre-service teachers. As discussed previously, the roles of teacher mentors are vast, and therefore attention to other teaching issues such as pedagogy and support of reflective practice, including scrutiny of principles behind teaching practice, would be more comprehensive for pre-service teachers. Invargson et al. (2014) agree that concentrating solely on the technical aspect of teaching is detrimental to pre-service teachers as they may focus on existing knowledge and the preferred practices of teacher mentors, rather than creating new knowledge. Hobson et al. (2009) also suggest that having a limited style of mentoring may contribute to pre-service teachers being less forthcoming in the future to seek reformist and learner-centred approaches to teaching and not be inclined to progress the teaching profession. Hobson et al. (2009) contend that pre-service teachers, who experienced restricted or restrictive forms of mentoring, are “less likely to challenge the inherent conservatism in teaching or to advance social reform and social justice agendas” (p. 211).

In summary, this part of the chapter has focused on exploring the important and complex roles that teacher mentors play in schools as they support pre-service teachers to develop knowledge and skills in teaching. Defining the roles of mentoring is complex, but what is clear is that it is distinct from coaching, supervising and tutoring. Mentoring presents many challenges and benefits for both the teacher mentors and pre-service teachers alike and is considered critical in ensuring quality experiences for pre-service teachers when on teaching practicums.

2.4. Mishra and Koehler’s TPACK framework (2006)

This final part of the chapter turns attention to understanding the complexity of the domains of knowledge that teachers draw on as they integrate ICT into their practice, and focuses on the highly influential TPACK framework developed by Mishra and Koehler (2006). It begins by exploring the origins in the research of Shulman (1986, 1987) and his highly significant Pedagogical Content Knowledge (PCK) model. It then moves to explore the evolution of the TPACK framework, including adjustments made by Mishra and Koehler to the original representation. The third section discusses the characteristics and limitations of the framework. Finally, the fourth section provides an overview of research relating to pre-service teachers and relevance of using the TPACK framework to support their development as educators.

2.4.1. Origins of TPACK in PCK

The TPACK framework, developed by Mishra and Koehler (2006), has its roots in the PCK model developed by Shulman (1986) and the domains of knowledge identified as critical for quality teaching (or effective instruction), including the proposition that technological knowledge (TK) is included within content knowledge (CK). Shulman's work was the first significant study on teacher knowledge (Finger et al., 2010; Gess-Newsome, 1999; Phillips, 2017). Shulman was one of the first researchers to articulate specific knowledge for quality teaching in his quest "to increase the respect afforded to the teaching profession by carefully illustrating the extensive and specialized knowledge teachers possessed" (Brantley-Dias & Ertmer, 2013, p. 107). Prior to Shulman's (1986) research, there was little appreciation of the distinct teacher knowledge needed, with many thinking that anyone could teach (Bachy, 2014). The next section explores these roots and scrutinises, in further detail, the relationship between PCK and quality teaching. Finally, some of the issues identified in the research literature around PCK and the implications then on the subsequent TPACK framework are considered.

2.4.1.1. Unpacking seven categories of Shulman's (1986) set of knowledge for teachers

In his ground breaking research, Shulman (1986) developed "a set of knowledge for teaching" composed of seven categories. These categories are shown in Table 2.

Table 2: Shulman's (1986) seven categories of the set of knowledge for teaching

Set of knowledge for pedagogical content knowledge (PCK)	Other elements of the set of knowledge for teaching
• content knowledge, that is knowledge of representations of subject matter and its organising structures	• curriculum knowledge, that is understanding of aims, rationale and scope of curriculum along with content and achievement standards
• general pedagogical knowledge, that is teaching strategies that are cross-curricular	• knowledge of learners and their characteristics, that is understanding of student conceptual and procedural knowledge, conceptual errors and level of understanding,
• **pedagogical content knowledge (PCK)**, that is understanding of students' comprehensions of the subject and the learning and teaching outcomes that relate to the specific subject matter	• knowledge of educational contexts, that is contextual understanding of school and community aspirations and expectations as well as understanding of school infrastructure and resources
	• knowledge of purposes of education including philosophical and historical origins, that is its goals and values

At the time, knowledge of curriculum, learners, educational contexts and purposes of education were the backbone of initial teacher education programs, and considered essential in addressing the universal constructs of teacher knowledge. Of the seven categories within the set of knowledge, it was content knowledge, pedagogical knowledge and the resultant pedagogical content knowledge (PCK) that Shulman (1986, 1987) argues is the most fundamental role for quality teaching. Shulman describes PCK as a special type of knowledge.

> It represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organised, represented and adapted to the diverse interests and abilities of learners, and presented for instruction. Pedagogical content knowledge is the category most likely to distinguish the understanding of content specialist from that of pedagogue. (Shulman, 1986, p. 8)

Focusing on PCK

Shulman (1986, 1987) argues that teachers draw on three specialised types (or constructs) of knowledge to teach subject matter (also referred to as 'content knowledge' or 'curriculum'). He defines the three constructs as (1) content knowledge (CK), and (2) pedagogical knowledge (PK) that form (3) pedagogical content knowledge (PCK). Shulman (1987) suggests therefore that there is a specific type of knowledge for teaching at the intersection of content and pedagogy, which enables "a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variation in ability and background presented by the students" (p. 15). The PCK model (Shulman, 1986, 1987) represents the three constructs of knowledge – content knowledge, pedagogical knowledge and pedagogical content knowledge – (see Figure 2), which are explored in further detail in ensuing paragraphs.

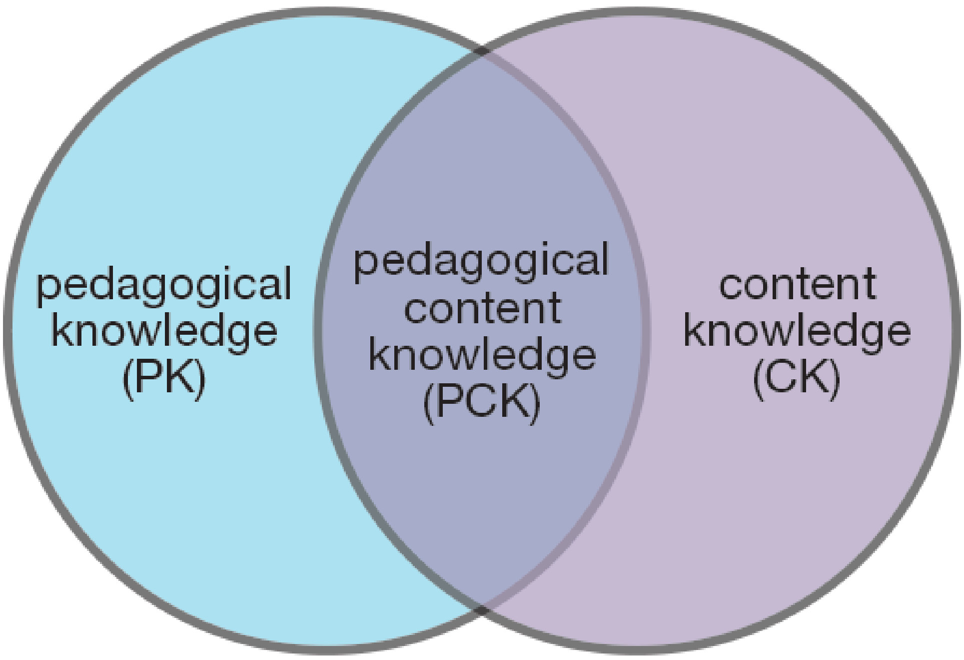

Figure 2: Shulman's PCK model (1986, 1987), identifying the combination of the knowledge for content and pedagogy to form pedagogical content knowledge. Attributed to the work of Shulman (1986, 1987).

Unpacking content knowledge (CK)

Shulman (1986, 1987) describes content knowledge as the ‘what to teach’ – the knowledge of the curriculum or subject matter taught by the teacher such as the knowledge of Mathematics or Science or Home Economics or Health Education. It includes comprehension of the structures of knowledge of a subject as well as knowing facts and action; it requires teachers to know about the various ways that the concepts and principles underlying the subject matter are established. Examples of applications of this construct include knowledge about Victorian Curriculum F–10: Science (VCAA, 2019j), Victorian Curriculum F–10: Mathematics (VCAA, 2019k), VCE Food Studies (VCAA, 2019b), and VCE Health and Human Development (VCAA, 2019c).

Unpacking pedagogical knowledge (PK)

Shulman (1986, 1987) defines pedagogical knowledge as the knowledge of ‘how to teach’ – the knowledge of the strategies used by the teacher to teach subject matter (or curriculum or content knowledge), so students gain understanding. It is the general knowledge about teaching pedagogies (Shulman, 1986, 1987). These teaching strategies are cross-curricular and include knowledge of the principles and approaches of classroom management and organisation. Examples of applications of this construct include knowledge about how to use inquiry-based learning or problem-based learning.

Unpacking pedagogical content knowledge (PCK)

Shulman (1986, 1987) regards pedagogical content knowledge (PCK) as the content knowledge that deals with the teaching process. Accordingly, this type of knowledge blends both content and pedagogy to enable improved teaching practices in specific content areas and is unique for different content (or subject or curriculum) areas. Consequently, PCK is knowledge for teaching within a specific discipline (Shulman, 1986, 1987). Shulman contends that expert teachers combine a deep knowledge of content with an insightful understanding of what is good for learning – this is referred to as pedagogical content knowledge (PCK), and what teachers are doing is more than just looking at content knowledge and at pedagogical knowledge in isolation. Accordingly, this type of knowledge melds both content and pedagogy to enable improved teaching practices in specific content areas, and is unique and specific for different content areas (Shulman, 1986, 1987). Shulman's PCK model (1986, 1987) represents the combination of content and pedagogy in a concept of how distinct aspects of teaching subject topics are structured, modified, and characterised for instruction. According to Shulman, PCK is entrenched in the typical classroom practice of teachers. Examples of applications of this domain include knowledge about how to use experiments to teach scientific concepts in relation to functional properties of ingredients in VCE Food Studies (VCAA, 2019b), or knowledge of analogies to teach concepts in the circulatory system in Victorian Curriculum F–10: Health and Physical Education (VCAA, 2019i).

Significance of pedagogical content knowledge

Shulman's model (1986, 1987) helps demonstrate that PCK is a new type of knowledge that is created when a teacher organises content knowledge using teaching and learning strategies to transform it into meaningful learning for students. The work of Shulman was considered important as he was the first to define teacher knowledge and identify the intersection between pedagogical and content knowledge. "Among those [seven] categories [of a set of knowledge for teachers], pedagogical content knowledge is of special interest because it identifies the distinctive bodies of knowledge for teaching" (Shulman, 1987, p. 8).

Shulman's PCK model (1986, 1987) establishes that, at its core, is the way in which content is transformed for teaching – this transformation occurs when the teacher processes content by finding ways to characterise it and therefore make it understood by students. That is, regardless of a teacher's deep understanding of content, they need to be able to nurture a comprehension of the content's concepts for students. PCK is about a teacher's skills to combine knowledge about what to teach and how to teach, and "[t]he fusion is what enabled…teachers to transform subject content and represent it in ways that make it accessible to individual learners in their specific contexts" (Teaching Teachers for the Future, 2018, para 1).

Relationship between PCK and quality teaching

The work of Shulman (1986, 1987) on PCK has been significant in the research on quality teaching. Prior to the articulation of PCK, it was commonly assumed that anyone could teach and there was no special knowledge needed to teach. Yet Shulman argues to the contrary that teaching content was a vital part of a teacher's continuing learning as their teaching activities will be influenced by the depth of their PCK.

Shulman (1986, 1987) asserts that PCK is critical to encapsulate the knowledge of quality teaching – he contends that while having the knowledge of both subject matter and general pedagogical strategies is important, it is not enough to exemplify the complex ways in which teachers consider how specific content should be taught. Shulman maintains that it is not appropriate to emphasise only content knowledge, as by itself is insufficient for instruction to be effective; nor should general pedagogical knowledge be considered individually, as this would not prepare teachers to deal with the specific content of the lessons taught. "[M]ere content knowledge is likely to be as useless pedagogically as content-free skill" (Shulman, 1986, p. 8). Shulman's intent was to garner discussion about the significance of both content knowledge and pedagogical knowledge in order to demonstrate how these two types of knowledge are intertwined. He argues that teachers require a unique set of knowledge to integrate content knowledge with appropriate pedagogical knowledge so that students can understand meaning in content knowledge – he identifies PCK as the knowledge that integrates the content knowledge of a specific subject and the pedagogical knowledge for teaching that subject matter.

Therefore, according to Shulman (1986, 1987), PCK is more than the accumulation of two distinct types of knowledge (content and pedagogical) – it is a new and unique type of knowledge that refers to "… the particular form of content knowledge that embodies the aspects of content most germane to teachability" (Shulman, 1986, p. 9). Consequently, Shulman developed a set of knowledge for teachers to afford respect amongst the teaching profession.

The notion of the how PCK discriminates an expert teacher from a subject expert is significant to the work of Shulman (1986, 1987) as he emphasises that the "[p]edagogical content knowledge is the category most likely to distinguish the understanding of the content specialist from that of the pedagogue" (p. 8). The distinct combination of content and pedagogy to form the construct of PCK is what differentiates an expert teacher in a subject area from a subject area expert (Angeli & Valanides, 2009; Cochran, DeRuiter, & King, 1993; Loughran, Mulhall, & Berry, 2004).

> [T]eaching requires considerably more than delivering subject content knowledge to students, and that student learning is considerably more than absorbing information for later accurate regurgitation … PCK is the knowledge that teachers develop over time, and through experience, about how to teach particular content in particular ways in order to lead to enhanced student understanding. (Loughran et al., 2004, p. 7)

This difference between 'experts' and 'experienced teachers' is also supported by Hattie (2009), who like Shulman, suggests that the way in which the content knowledge is organised and used in teaching practice is most important. Hattie (2009) asserts that while content knowledge is important, PCK is more significant in quality teaching.

Technology and PCK

Shulman's PCK model (1986, 1987) did not explicitly represent technological knowledge as a separate construct of knowledge but rather included it in content knowledge. Arguably this is because at the time, digital technologies, or ICT, had not permeated classroom practices as significantly as it has today in 2020. Shulman did not ignore technological knowledge but rather included it with content knowledge.

> Technology could be considered a part of knowledge of content representations or even curriculum and media. Shulman (1986) explained that the concept of curricular knowledge was included in the larger concept of content knowledge. Curricular knowledge was defined as teachers' knowledge of the available education tools and materials including software, programs, visual materials, and films. (Graham, 2011, p. 1956)

There is substantial debate in the research literature as to whether Shulman's representation of technological knowledge within content knowledge is accurate, or whether technological knowledge should be seen as a separate knowledge domain as argued by Swan and Hofer (2011).

> In the mid-1980s, educational technology was limited primarily to nondigital tools (e.g., chalkboards, overhead projects, video cassette recorders), and it was assumed these technologies required little additional training (although the operation of the Dusquesne projector and 16 mm films may suggest otherwise) … With the advent of more complex digital tools, the knowledge required for using technology in teaching has increased. (p. 79)

Schmidt et al. (2009); Swan and Hofer (2011); Angeli and Valanides (2009); and Brantley-Dias and Ertmer (2013) contend that adding a technological construct is not required as this is represented in content knowledge.

> Although computer technology was not mentioned specifically, other technologies (software, film) were, suggesting that if the article had been written a few years later, computer technologies likely would have been included among the list of relevant instructional materials. (Brantley-Dias & Ertmer, 2013, p. 106)

As these researchers elaborated, the fundamental question is whether Shulman (1986, 1987) would have considered ICT to be appreciably different from the more traditional technologies to warrant a separate construct.

However other researchers such as Angeli and Valanides (2005, 2009) suggest that while technology (ICT) is included in the model, the lack of explanation around how the constructs of knowledge connect is a limitation. They contend that Shulman (1986, 1987) intended for technology (ICT) to be included in his PCK model but "… [did] not explicitly discuss technology and its relationship to content, pedagogy, and learners, and thus PCK in its original form does not specifically explain how teachers use the affordances of technology to transform content and pedagogy for learners" (Angeli & Valanides, 2009, p. 156). As the place of technological knowledge is integral to understanding the knowledge that teachers need to integrate ICT, it will be discussed in further detail later in this chapter under the heading, '2.4.2. Evolution of TPACK' why ICT was advocated to be included as a standalone domain of knowledge in the TPACK framework (Mishra & Koehler, 2006).

2.4.1.2. Issues with PCK

Shulman's PCK model (1986, 1987) is not without criticism, and while an in-depth discussion of the challenges it presents is outside the scope of this research, it is important to have a broad understanding "[b]ecause PCK is foundational to the TPACK framework, [and] researchers must clearly understand PCK before they can understand and effectively measure TPACK constructs" (Graham, 2011, p. 1955). Criticisms tend to relate to unclear boundaries of the knowledge constructs (i.e. content knowledge, pedagogical knowledge and pedagogical content knowledge) and the consequences of this in regard to having a robust model.

This ambiguity of the boundaries makes it problematic to identify each of the triads of knowledge (content knowledge, pedagogical knowledge and pedagogical content knowledge) easily, as well as understand how each knowledge construct interacts. It is also unclear what Shulman (1986, 1987) is exactly saying about the model. While, he argues that the constructs of knowledge are interconnected, Shulman does not say what drives teachers' understanding about the constructs of knowledge. He states that there is a need for three knowledge constructs for quality teaching in the classroom. Yet, the PCK model (Shulman, 1986, 1987) does not depict where you begin with the knowledge domains – is the order content knowledge and then pedagogical knowledge, or is it the other way around? Shulman's PCK model highlights that the knowledge needed to teach is not straightforward, but rather quite complex. The 'flakiness' (or flawed characteristics) of the constructs of Shulman's PCK model are discussed in further detail later in this chapter under the heading '2.4.3.1. Building on a flawed model' so too the implications for the development of the TPACK framework.

In summary, this section has explored the PCK model Shulman (1986, 1987), as it provides the foundation for the TPACK framework (Mishra & Koehler, 2006). The PCK model presents teacher knowledge as complex and that teachers draw upon their content knowledge and pedagogical knowledge to form a unique construct of knowledge, namely pedagogical content knowledge (PCK). Discussion has also shown that there are issues with this framing, including the lack of clarity around how the constructs connect. As well, it has shown that technological knowledge was represented as part of content knowledge. This representation is important, as I now turn to the next the section to explore the TPACK framework.

2.4.2. Evolution of TPACK

The TPACK framework, developed by Mishra and Koehler (2006), has received considerable interest in the research community as it offers an account of the knowledge that teachers require to integrate ICT into their practice. The TPACK framework has gained considerable support in the research literature (Carr, 2013; Jamieson-Proctor et al., 2013; Jordan & Dinh, 2012; Polly, 2011; Thomas, Herring, Redmond, & Smaldino, 2013; Voogt, Fisser, Pareja, Tondeur, & van Braak, 2013) as an influential conceptualisation of the domains of knowledge needed by teachers to use ICT in their teaching practices. This section explores this framework, beginning with an overview of how it built upon the work of Shulman (1986, 1987) by adding a discrete technological knowledge domain, followed by further details of the relationship of the knowledge domains to each other, using examples to do so. The importance of TPACK as a guiding framework for the integration of ICT into classroom practice concludes this section of the chapter.

2.4.2.1. Introducing the TPACK framework

The TPACK framework (Mishra & Koehler, 2006) expands on the PCK model of Shulman (1986, 1987) by explicitly adding technological knowledge (TK) as a separate domain. This required pulling out 'technology' (ICT) from the content knowledge in Shulman's model (1986, 1987) and arguing that technological knowledge needed to be represented as a distinct domain. The framework was developed and used initially in Science and Mathematics education with pre-service teachers using a "learning technology by design methodology" (Koehler, Mishra, & Yahya, 2007, p. 744). "The basis of…[the TPACK] framework is the understanding that teaching is a highly complex activity that draws on many kinds [domains] of knowledge…[and] is a complex cognitive skill occurring in an ill-structured, dynamic environment" (Mishra & Koehler, 2006, p. 1020).

The TPACK framework (Mishra & Koehler, 2006) proposes that focusing on content knowledge, pedagogical knowledge and technological knowledge simultaneously delivers a model for the integration of ICT in teaching practice. As Koehler and Mishra (2009) argue, "[t]he skills, competencies, and knowledge specified by the TPACK framework require teachers to go beyond their knowledge of particular disciplines, technologies, and pedagogical techniques in isolation" (p. 16). They go on to state that "TPACK is the basis of effective teaching with technology [ICT] and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content" (Koehler & Mishra, 2009, pp. 17–18).

2.4.2.2. Complexity of teaching

Throughout this chapter I have argued that teaching is complex and that fundamentally as it is multifaceted, describing what teachers know, is complicated. This discussion will now examine how the use of ICT introduces a new set of variables into the context of teaching, and therefore increases this complexity, especially due to the ever-changing nature of ICT.

2.4.2.3. Visualising the TPACK framework

The TPACK framework (Mishra & Koehler, 2006) is most commonly represented using a Venn diagram with three identically-sized, overlapping circles, each representing a distinct domain of teacher knowledge as well as the overlapping domains. Initially Mishra and Koehler (2006) represented seven domains (or types) of knowledge in the TPACK framework. In a later iteration of the TPACK framework, 'contexts' was added (Koehler & Mishra, 2008, 2009), represented by a dotted line creating a circle around the domains (Mishra, 2012). Contexts was then updated to conteXtual knowledge (Mishra, 2019), creating the eight domains of knowledge (see Figure 3). Mishra (2019) highlights that the added benefit of identifying conteXtual knowledge in the TPACK framework is that it makes "the outer circle another knowledge domain that teachers must possess to integrate technology in teaching (p. 76).

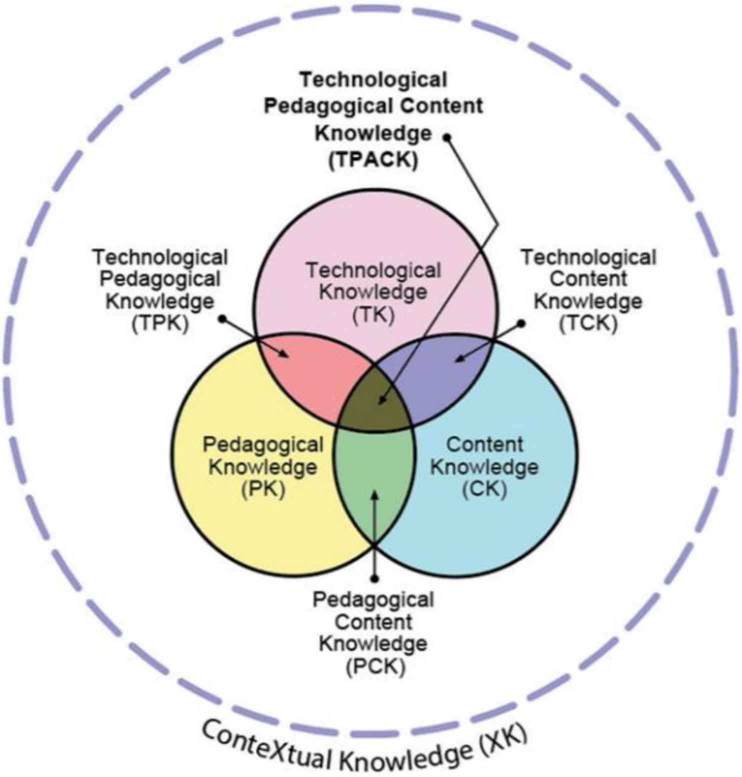

Figure 3: Mishra and Koehler's TPACK framework (2006), identifying eight domains of knowledge. Reprinted from "Considering contextual knowledge: The TPACK diagram gets an upgrade", by P. Mishra, 2019, *Journal of Digital Learning in Teacher Education*, *35*(2), p. 77. (Used with permission).

So, the knowledge in the TPACK framework consists of the three domains of knowledge, the four domains that emerge from the intersection of these three domains and an overarching domain of conteXtual knowledge. That is, the TPACK framework's eight domains include three main knowledge domains; three intersecting knowledge pairs; one triad; and one conteXtual knowledge domain encompassing the seven other domains of knowledge.

Mishra and Koehler (2006) explicitly argue that contexts experienced by teachers need to be considered when making decisions about content and pedagogy when using ICT, as contexts differ from class to class, (including subjects taught and year level of students) and school to school. "Technology [ICT] integration is made even more complex by the kinds of social and institutional contexts in which teachers work" (Mishra & Koehler, 2007, p. 2). Examples of school contexts include such situations as access to specific ICT tools; whether students have access to laptops, iPads or desktop computers; whether schools have BYOD programs; types of technical infrastructure available; whether use of smartphones for learning in the classroom is permitted; and the teacher's knowledge of school ICT policies and guidelines. "The diverse contexts of teaching and learning suggest that there is not "one way" that will work for everyone" (Mishra & Koehler, 2007, p. 2). This is why the knowledge domain of context was also included as a part of the framework in a later version.

> By simultaneously integrating knowledge of technology, pedagogy, content, and the contexts within which they function, expert teachers bring TPACK into play any time they teach. Each situation presented to teachers is a unique combination of these three factors, and accordingly, there is no single technological solution that applies for every teacher, every course, or every view of teaching. (Koehler, Mishra, & Cain, 2014, p. 17)

Mishra (2019) emphasises that conteXtual knowledge is highly variable and important to develop as part of TPACK.

> …[C]ontextual knowledge is something that we (as teacher educators) can act on, change, and help teachers develop. Just as we seek to develop teachers' knowledge types and overall TPACK, it becomes clear that we ought to work toward increasing their contextual knowledge as well. (Mishra, 2019, p. 76)

Initially the framework uses the acronym TPCK, but later "… [this] acronym was renamed TPACK (pronounced "tee-pack") for the purpose of making it easier to remember and to form a more integrated whole for the three domains of knowledge addressed: technology, pedagogy, and content" (Schmidt et al., 2009, p. 123). That is, it relates to the term 'package' and thereby referencing the 'packaging up' of the domains of knowledge needed to teach using ICT to represent the synergetic nature of these knowledge domains (Thompson & Mishra, 2007, p. 38).

2.4.2.4. Unpacking the TPACK framework

As previously highlighted, the TPACK framework expands on Shulman's PCK model (1986, 1987), and endeavours to identify the set of knowledge needed for the integration of technology [ICT] in the classroom, while acknowledging "… the complex, multifaceted and situated nature of teacher knowledge" (Mishra & Koehler, 2006, p. 1017). The TPACK framework enables teachers to identify the domains of knowledge needed to teach effectively with ICT, and highlights "… the kinds of knowledge that lie at the intersections between three primary knowledge bases: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK)" (Mishra, 2012). The TPACK framework is considered to be unique, yet complex, while expanding on earlier ideas of teacher knowledge from Shulman's PCK model (1986, 1987) that centred around the notion that quality teaching required an understanding of the content as well as an understanding of the pedagogy, that is instructional strategies and knowledge and skills that are appropriate for students. These domains of knowledge (content knowledge, pedagogical knowledge and pedagogical content knowledge) were explored previously in this chapter, under the heading '2.4.1.1. Unpacking seven categories of Shulman's (1986) set of knowledge for teachers'. The concept of technological knowledge will now be explored in the discussion to follow, along with each of the newly-created domains of the TPACK framework (technological content knowledge; pedagogical content knowledge; technological pedagogical knowledge; and technological, pedagogical, content knowledge) and conteXtual knowledge.

Technological knowledge (TK)

Technological knowledge refers to the knowledge about different technologies to teach content, including the knowledge about the features, capabilities and applications of digital technologies (or ICT). It relates to all technologies, tools and resources, and includes ways of thinking about and working with them, so includes knowledge about how to use technology safely, responsibly and ethically. It is about computer literacy and the ability to apply ICT tools for everyday tasks (Mishra & Koehler, 2009).

> [TK] includes understanding information technology broadly enough to apply it productively at work and in everyday life, being able to recognize when information technology can assist or impede the achievement of a goal, and being able continually adapt to changes in information technology. (Koehler & Mishra, 2009, p. 64)

Examples of applications of this domain include knowledge about how to use web 2.0 tools such as a blog and other social media; how to install and remove apps from various digital devices; or how to create, file and archive digital documents.

Technological knowledge is one of the three primary domains of knowledge. These three knowledge bodies (content, pedagogical and technological) interact, afford and limit each other, and this will now be explored in the ensuing paragraphs.

Technological content knowledge (TCK)

Technological content knowledge refers to knowledge of the relationship between content and technology (ICT), especially in regard to how technology can create new representations for specific content, without consideration about teaching (i.e. pedagogy). Mishra and Koehler (2006) assert that TCK is the relationship between technology and content that emphasises the way in which technology and content are “reciprocally related”. They highlight that technology can be used to change delivery of content. That is, technology changes what we teach, for example by the selection of content-specific apps. Technological content knowledge recognises the influence of technology regarding how it is used in exploring particular content, and it suggests teachers, and subsequently teacher mentors, realise that by using a particular technology (or ICT) that they can change the approaches to how students practise and understand concepts in a specific content area. Content knowledge is often defined and controlled by technology and its functionality. An example of the application of this domain is the knowledge about using animations to show the operations of the digestive system in Victoria Curriculum F–10: Health and Physical Education (VCAA, 2019i).

Technological pedagogical knowledge (TPK)

Technological pedagogical knowledge refers to knowledge of various technologies [ICT] that can be used for teaching and learning without reference to content. It includes an understanding of the influence of ICT on teaching and learning, as well as the benefits and limitations of each ICT tool and suggests that teachers need to have an understanding that using technology (or ICT) may change the way they teach (Koehler & Mishra, 2009).

In addition, technological pedagogical knowledge refers to the relationship between technology and pedagogy, which includes the capacity to recognise particular pedagogical strategies and the methods that can be used to apply ICT (Mishra & Koehler, 2006). It is about the "… knowledge of the existence, components and capabilities of various technologies as they are used in teaching and learning settings" (Mishra & Koehler, 2006, p. 1028), and includes knowledge about learning theories incorporating ICT, and using ICT to prepare lessons, cater for individual learning styles, assess student learning and for classroom management. That is, the use of ICT changes how we teach. An example of the application of this domain is the knowledge to use online polling to enhance student participation and contribution in class feedback or the use of a learning management system to disseminate information to students.

Technological, pedagogical and content knowledge (TPACK)

Technological, pedagogical and content knowledge (TPACK) refers to knowledge of the complex interaction between the three primary domains of knowledge (content, pedagogy and technology). It is the knowledge needed by teachers for integrating ICT into their teaching practices in any subject area, or in other words, knowledge about using various ICT tools to teach and characterise the specific content of the subject. That is, it is the knowledge about how ICT tools can be combined with content and pedagogical strategies to produce meaningful student outcomes within specific contexts (Mishra & Koehler, 2006). Examples of the applications of this domain include knowledge about webconferencing tools as a communication tool to enhance collaborative learning in the Victorian Curriculum F–10: Geography (VCAA, 2019h) or simulation software to replicate electrotechnological-mechanical concepts to demonstrate understanding in VCE Systems Engineering (VCAA, 2019d).

ConteXtual knowledge

The final and eighth domain of knowledge that surrounds all the other seven domains is conteXtual knowledge. "Knowledge of technology, content, and pedagogy does not exist in a vacuum; it exists and functions with specific contexts. Teachers face a wide array of elements that make their contexts unique and different from other teachers" (Mishra & Koehler, 2009, p. 17). Context is broader than just a school's physical environment (which includes the available resources and facilities); it also refers to the surrounding social, institutional and personal environments that influence how a school operates and includes its processes, structures, decision-making, and overall leadership aspects (Muller, 2015).

2.4.2.5. The heart of TPACK

According to Mishra and Koehler (2006), teachers become designers of teaching and learning programs through using the three primary domains of knowledge, and knowing how to integrate ICT comes from understanding these three domains and their interactions.

> At the heart of TPCK [TPACK] is the dynamic, transactional relationship between content, pedagogy and technology. Good teaching with technology [ICT] requires understanding the mutually reinforcing relationships between all three elements taken together to develop appropriate, context specific strategies and representations. (Koehler et al., 2007, p. 741)

In essence, the justification for the development of the TPACK framework comes primarily from recognising that teaching is an unquestionably complex activity that draws on many domains of knowledge, and using ICT in teaching practices increases these intricacies. “TPACK is … increasingly [used] to describe what teachers need to know to effectively integrate technology into their teaching practices” (Schmidt et al., 2009, p. 123).

2.4.2.6. Why is TPACK important?

The TPACK framework, proposed by Mishra and Koehler (2006) “to describe the unique knowledge needed to achieve effective teaching with technology” (p. 62), captured a great deal of attention and gained growing recognition (Graham, 2011) as a “… powerful framework which has many potential generative uses in the research and development related to the use of ICT in education” (Chai, Koh, & Tsai, 2013, p. 32). Prior to the articulation of the TPACK framework, “the notion of a unifying conceptual framework was lacking in the educational technology literature” (Archambault & Barnett, 2010, p. 1656).

> The TPACK framework [is considered important as it] attempts to identify some of the main aspects of teacher knowledge necessary for technology integration in teaching, while addressing the multifaceted, complex, and situated nature of this knowledge. It emerged as a useful framework for describing and understanding the aims of using technologies in preservice teacher education programs. (Schmidt et al., 2009, p. 123)

Carr (2013) highlights the usefulness of the framework by stating “TPACK provides a very useful theoretical schema for thinking about the relationships between different areas of teacher knowledge, and how these elements [domains] of teacher knowledge need to interact if teachers are to develop effective pedagogical approaches using ICT” (p. 49). Taimalu and Luik (2019) also highlight that the TPACK framework is useful in understanding how to integrate ICT purposefully in the classroom. They explain that it is important to understand how to explicitly integrate technological knowledge with content knowledge and pedagogical knowledge. TPACK is considered to be accomplished when the teacher knows how the ICT tools used to teach specific concepts are able to transform the approaches to content and pedagogy within a specific school context. Therefore, teachers need a strong understanding of the technological and pedagogical affordances within their curriculum areas to attain TPACK.

The importance of gaining an understanding of the TPACK framework (Mishra & Koehler, 2006) in educational research and its influence in the education space is reflected in the proliferation of articles published about TPACK (Abbitt, 2011b; Bate & Maor, 2010; Brantley-Dias & Ertmer, 2013; Jamieson-Proctor et al., 2013; Mouza, Karchmer-Klein, Nandakumar, Yilmaz Ozden, & Hu, 2014; Polly & Brantley-Dias, 2009). For example, Abbitt (2011b) identified 300 articles on databases related to TPACK and teacher education and Jordan and Dinh (2012) located 286 articles published from 2006–2011 on the TPACK website. The TPACK framework enabled these educational researchers to consider the different domains of knowledge needed for ICT uptake as well as how teachers themselves could develop these knowledge domains. Consequently, the TPACK framework is regarded as a useful way to consider how teachers could integrate ICT in their classrooms especially as it helps to identity the domains of knowledge required to support ICT uptake.

TPACK endeavoured to encapsulate the specialised knowledge that subject-expert teachers create. According to Mishra and Koehler (2009) this knowledge was a "deep, pragmatic, and nuanced understanding of the three types [domains] of knowledge – content, pedagogy , and technology" (p. 17). Subject-expert teachers "… orchestrate and coordinate technology, pedagogy, and content" into every aspect of their classroom practices, whether it be intentionally or unintentionally. Mishra and Koehler (2009) said effective teaching represents a "dynamic equilibrium" (p. 1029) when ICT is effectively integrated and enabled.

Mouza (2011) also supports the discussion about the uniqueness of the TPACK framework by stating that the framework has three dimensions of distinctiveness.

> Although TPACK builds on earlier notions of teacher knowledge, it is also a unique and intricate construct. Specifically, three characteristics are fundamental to TPACK: (a) it is highly situated, local and specific; (b) it is developed in practice in response to specific needs; and (c) it is influenced by contextual factors, such as teachers' beliefs about how students learn, teachers' practice experiences with what works and what does not work in real classrooms, the availability of resources, culture, and other organization factors. (Mouza, 2011, p. 4)

The distinctiveness of the TPACK framework to capture what teachers, and subsequently teacher mentors, need to know to incorporate effective use of ICT into their classroom practice is explored in the next sub-section.

2.4.2.7. Uniqueness of TPACK

The TPACK framework (Mishra & Koehler, 2006), although not a brand-new idea as many educational researchers have argued that knowing how ICT relates to content and pedagogy is critical for quality teaching, the representation is unique in that it builds on earlier research to create an innovative framework for exploring teacher knowledge based around content, pedagogy and technology. The following sub-section will analyse the justification for the development of the TPACK framework. Reasons why technology was added as a distinct domain and discussion of the contributions of the TPACK framework to both teaching practice and to the body of educational research will be considered.

2.4.2.8. Rationale for development of TPACK

The TPACK framework (Mishra & Koehler, 2006) provides a theoretical lens to understand the domains of knowledge teachers need to incorporate ICT into their teaching practices.

> It [TPACK framework] is more than simply adding ICT to traditional [teaching and learning] approaches. It depends upon deep knowledge of how ICT can be used to access and process subject matter (TCK) [technological content knowledge] and understanding how ICT can support and enhance learning (TPK) [technological pedagogical knowledge] in combination with PCK [pedagogical content knowledge]. (Teaching Teachers for the Future, 2018, para 3)

As mentioned, the TPACK framework sought to develop a more explicit conceptualisation of technology [ICT] knowledge, which was considered to be missing from Shulman's (1986, 1987) model. The value of adding the technological knowledge domain to the existing PCK model has been debated by numerous researchers such as Cox and Graham (2009), Harris, Mishra, and Koehler (2009) and Hammond and Manfra (2009). Other researchers such as Angeli and Valanides (2009); Niess (2005); and Chai, Koh, and Tsai (2011) scrutinised the reasonings behind the development of TPACK and why technology was added as a discrete domain. As suggested earlier, other researchers built on Shulman's PCK model and developed additional frameworks that included technological knowledge.

2.4.2.9. TPACK and other researchers

Although frameworks developed by other researchers Angeli and Valanides (2005); Niess (2005); Pierson (2001); and Saad, Barbar, and Abourjeili (2012) have not gained the significant influence like the TPACK framework (Mishra & Koehler, 2006), it is worth noting their work. These are explored in further detail below.

Angeli and Valanides' model (2005, 2009)

Angeli and Valanides (2005, 2009) constructed the ICT-PCK model (see Figure 4). Angeli and Valanides (2005) claim that their model "constitutes a special amalgam of several sources of teachers' knowledge base including pedagogical knowledge, subject area knowledge, knowledge of students, knowledge of environmental context, and ICT knowledge" (p. 294). Their ICT-TPCK model indicates more specificity on the application of ICT.

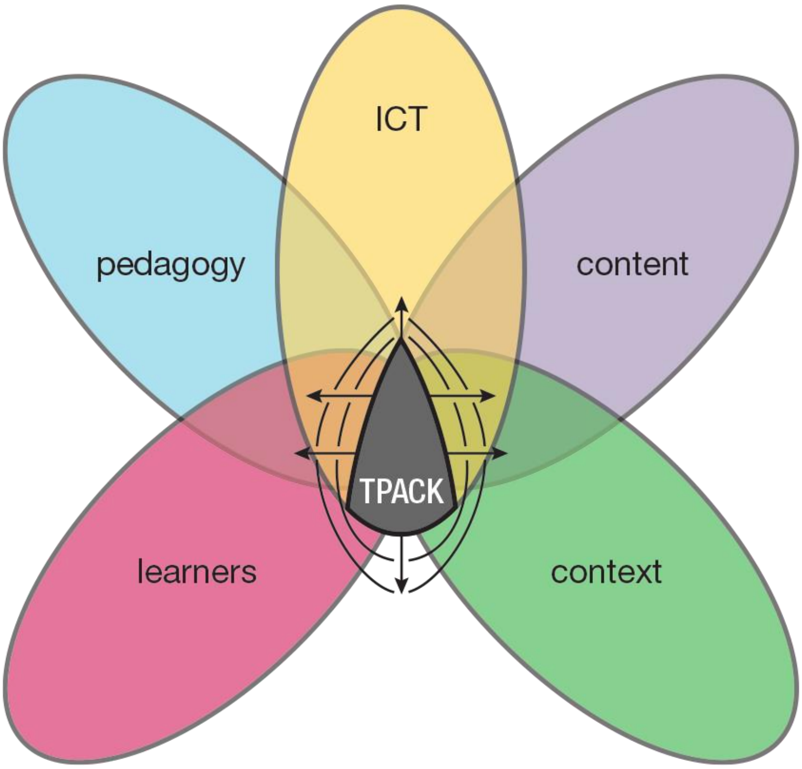

Figure 4: Angeli and Valanides' ICT-PCK model (2005, 2009), depicting the relationship between ICT, content, pedagogy, learners and context. Adapted from "Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK)", by C. Angeli and N. Valanides, 2009, *Computers & Education*, *52*(1), p.159.

Angeli and Valanides (2005) refer to their model as an "…integrated body of knowledge…" (p. 294), representing what teachers must possess to teach with ICT, and include knowledge of students and contexts. In their depiction of the ICT-PCK model, Angeli and Valanides (2005, 2009) identify five components of teacher knowledge: pedagogy; content (or subject area); learners (or students); environmental context; and ICT. ICT knowledge is by defined Angeli and Valanides (2005) as "knowing how to operate a computer, knowing how to use a multitude of tools/software and about their affordances" (p.294).

According to Angeli and Valanides (2005), ICT-PCK is defined as knowing how to "identify topics to be taught with ICT … identify representations for transforming content… [and]…identify teaching strategies that were difficult with traditional technology … [as well as how to] … select ICT tools to support content and teaching strategies … [and] infuse ICT activities in classrooms" (p. 294).

> These aspects of ICT-related PCK are meant to be regarded as an integrated body of knowledge for guiding the design of ICT-enhanced learning. Thus, they should not be acquired separately and then put together somehow, but should be experienced simultaneously in the design of technology-rich lessons. (Angeli & Valanides, 2005, p. 294)

This representation of Angeli and Valanides (2005, 2009) was also based on Shulman's PCK model (1986, 1987) but technological knowledge was incorporated differently to that of the TPACK framework (Mishra & Koehler, 2006). The ICT-PCK model diverges from the TPACK framework as it includes the addition of technological knowledge within the constructs of PCK while the TPACK framework encompasses technological knowledge as its own domain. This difference is further elaborated on later in this chapter, under the heading '2.4.3.9. Integrative versus transformative'.

Pierson's model (1999, 2001)

Like the TPACK framework, Pierson (1999, 2001) also conceptualises the three types of knowledge (content, pedagogical and technological) in a Venn diagram. However, Pierson's (1999, 2001) model depicts each type of knowledge as an elliptical shape, with technological knowledge being much smaller in size than the other two elliptical types of knowledge. This sizing is different to Mishra and Koehler (2006) who uses three identically-sized circles, signifying that all three circles "play equally important roles in 'good teaching'" (Hammond & Manfra, 2009, p. 162). Pierson (1999, 2001) uses a fourth ellipse to explicitly represent PCK, and so represents the relationship between the three types of knowledge differently (see Figure 5).

> Section A represents knowledge of content-related technology resources. Section B represents such knowledge as the methods to manage and organise learning technology use. Section C represents the intersection, or technological pedagogical content knowledge, which is true technology integration. (Pierson, 2001, p. 427)

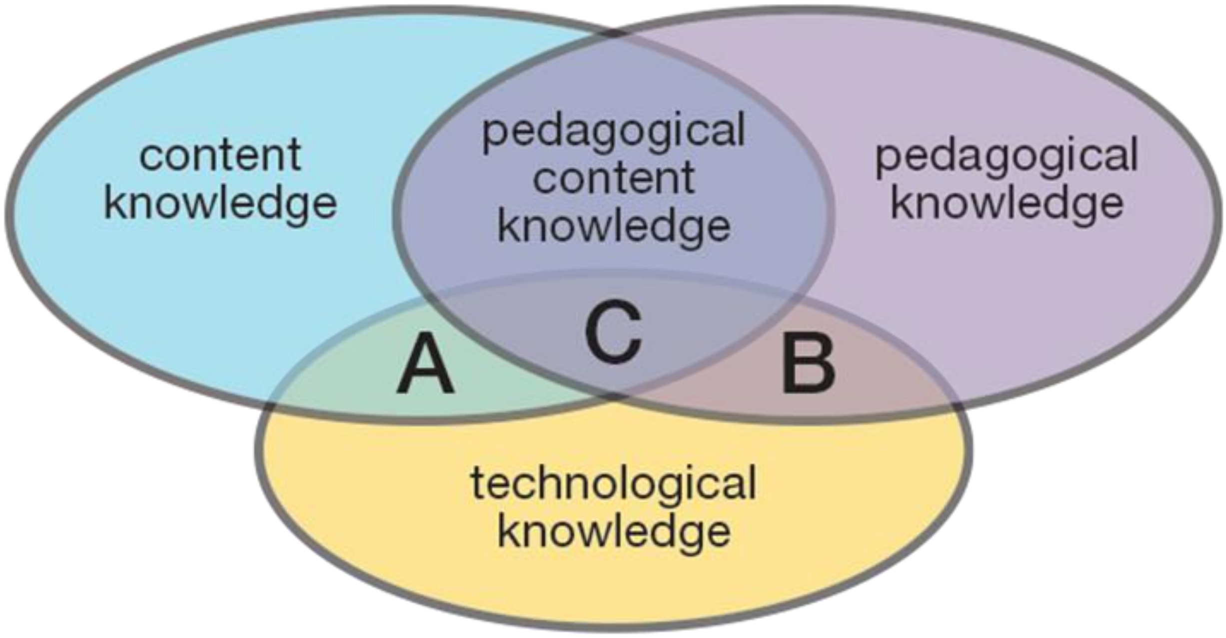

Figure 5: Pierson's model (1999, 2001), representing an alternative view of technological content and pedagogical knowledge. Adapted from "Technology integration practice as a function of pedagogical expertise" by M.E. Pierson, 2001, *Journal of Research on Computing in Education, 33*(4), p.427. (Used with permission).

According to Pierson (2001) "[a] teacher who effectively integrates technology [ICT] would be able to draw on extensive content knowledge and pedagogical knowledge in combination with technological knowledge" (p. 427). Pierson (1999, 2001) considers that technological knowledge is a significant construct of a teacher's set of knowledge for them to use any ICT in their classroom practices. In this model, true integration of ICT is represented as being only "… understood as the interaction of the multiple types of teacher knowledge" (Pierson, 2001, p. 427). Pierson (1999, 2001) claims that technological pedagogical content knowledge is the intersection of the three knowledge areas and this intersection would define effective ICT use. However, she did not identify knowledge of students and contexts in the model.

Niess' model (2005, 2011)

The "Technology PCK (TPCK)" model was developed by Niess (2005, 2011), who based it on the work of Shulman (1986, 1987) as well as Grossman (1990) (see Figure 6). According to Niess (2005, 2011), Technology PCK (TPCK) depicts how technology, content and pedagogy interrelate when teachers use ICT. Niess (2005, 2011) used the term for the model to describe technology-enhanced PCK.

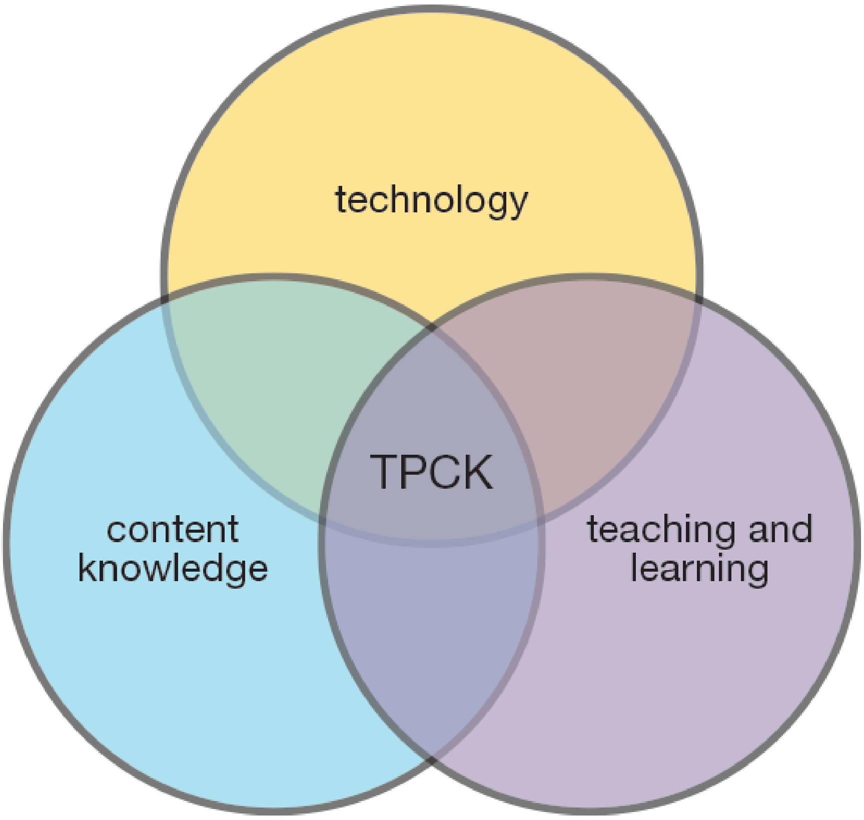

Figure 6: Niess' Technology PCK (TPCK) model (2005, 2011), depicting TPCK [TPACK] at the centre of technology, content knowledge and teaching and learning. Adapted from "Investigating TPACK: Knowledge growth in teaching with technology", by M.L. Niess, 2011, Journal of Educational Computing Research, *44*(3), p. 302. (Used with permission).

Saad, Barbar, and Abourjeili's TPACK-XL (2012)

Saad et al. (2012) developed the TPACK-XL theoretical framework model (see Figure 7) to contribute to further discussions about how to support the use of ICT by pre-service teachers. The resultant TPACK-XL theoretical framework model depicts thirty-one constituent knowledge constructs, and provides a detailed depiction of the interrelated knowledge bases and has been described by Saad et al. (2012) to "… serve as an advanced lens of ICT-TPCK" (p. 41). At the heart of the TPACK-XL theoretical framework is TPCLX (Technology, Pedagogy, Content, Learner, and Context Knowledge), representing interdisciplinary knowledge, which is considered a transformative view of the ICT-TPCK model (Angeli & Valanides, 2005, 2009). However, it is suggested that this sophisticated model sacrifices parsimony and possibly its capacity to communicate with teachers, including teacher mentors and pre-service teachers (Saad et al., 2012).

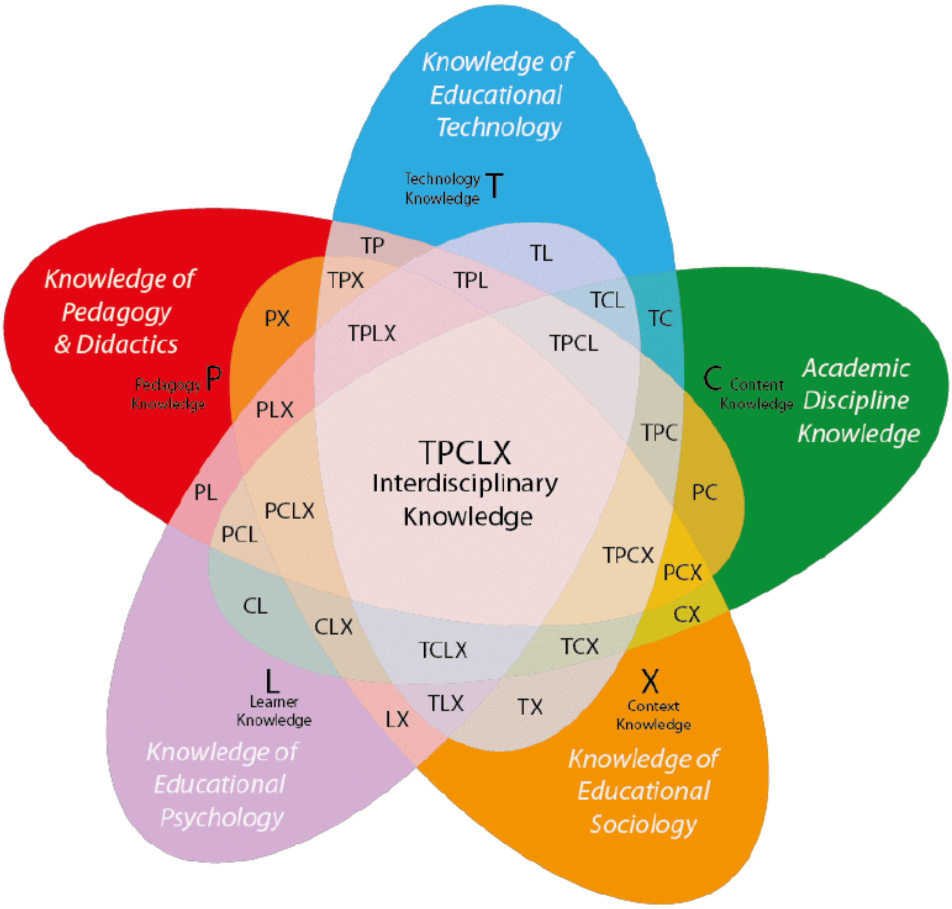

Figure 7: Saad, Barbar, and Abourjeili's TPACK-XL theoretical framework (2012), depicting TPCLX at its centre. Adapted from "Introduction of TPACK-XL, a transformative view of ICT-TPCK for building pre-service teacher knowledge base", by M. Saad, A. Barbar, and S. Abourjeili, 2012, *Turkish Journal of Teacher Education*, *1*(2), p. 50. (Used with permission).

2.4.2.10. Triumph of TPACK

The TPACK framework developed by Mishra and Koehler (2006) and refined over time has gained the most attention by educational researchers. Yet, despite the rationale for the development of the TPACK framework and its prevalence in research literature, it is not without criticism. Identification of the issues with the TPACK framework and discussion of the challenges of the TPACK framework will now be presented. In particular, there will be a scrutiny of how TPACK built upon Shulman's PCK model (1986, 1987) and so 'inherited' many of its deficiencies.

2.4.3. Characteristics and limitations of the TPACK framework

There is shared understanding nowadays among researchers in the field of educational technology that there are tensions and contradictions within the TPACK framework (Mishra & Koehler, 2006) so this discussion will scrutinise a number of "theoretical concerns [that] have been continued to be raised in the literature [about the TPACK framework]" (Jordan, 2014, p. 225), including lack of clarity around boundaries (Archambault & Barnett, 2010; Archambault & Crippen, 2009; Chai et al., 2011; Cox & Graham, 2009; Graham, 2011; Parr, Bellis, & Bulfin, 2013) and subsequently definitions of its domains of knowledge (Angeli & Valanides, 2009; Graham, Borup, & Smith, 2012; Niess, 2011); weighting of its domains of knowledge (Pierson, 2001); the balance between complexity and simplicity of the framework (Angeli & Valanides, 2009; Brantley-Dias & Ertmer, 2013; Koh et al., 2010; So & Kim, 2009); and discussion about whether TPACK is considered an integrative or transformative approach (Angeli & Valanides, 2009; Angeli, Valanides, & Christoudou, 2016; Graham, 2011).

While Mishra and Koehler (2006) argue that the domains of knowledge have distinct characteristics, that is each domain can be clearly defined, other researchers such as Chai et al. (2013) and Graham (2011) contend that its boundaries are somewhat blurred because definitions are unclear and so the boundaries of each knowledge domain are not well-defined. Concerns about the overlapping nature of the domains and ensuing misunderstandings between these domains have been emphasised by researchers, such as Archambault and Crippen (2009); Graham (2011); Graham et al. (2012); and Parr et al. (2013), who claim that TPACK definitions do not provide enough clarity to enable researchers to confidently identify what each knowledge domain represents. Graham et al. (2012) construes that the TPACK framework must have more exact definitions of its knowledge domains as disparities of interpretations between researchers have significant consequences for understanding and measuring these domains. This is explored later in the subsequent discussion.

2.4.3.1. Building on a flawed model

Graham (2011) suggests that any theory needs to have three elements related to "the what", "the how" and "the why" of the phenomenon of interest, and I used these to frame this discussion. Graham (2011) identifies "the what" as "… essential variables or constructs that contribute to the phenomenon of interest" (p. 1955); "the how" as "… how the elements of the theory relate to one another" (p. 1956); and "the why" as "…the rationale for the theory and the underlying assumptions that give credence to it" (p. 1958).

As previously highlighted, the TPACK framework (Mishra & Koehler, 2006) builds upon the concept of pedagogical content knowledge (PCK) (Shulman, 1986, 1987), and so one of the main criticisms of the TPACK framework is that it was built on an existing theoretical framework that itself lacked theoretical clarity. Graham (2011) contends that "… because PCK is foundational to the TPACK framework, researchers must clearly understand the limitations of PCK before they can productively understand and effectively measure TPACK constructs" (p. 1954). Parr et al. (2013) concur that TPACK framework reproduces the organisational deficiencies of the PCK model yet conceals these limitations with the appeal of new digital technologies (or ICT). It is therefore important to understand that the limitations with the PCK model impact on the TPACK framework, especially regarding the lack of clarity concerning the boundaries and definitions of the knowledge domains.

2.4.3.2. Definitions of domains

Graham (2011) argues that essentially it is difficult to work out what is, and what is not, included in each knowledge domain. This view is also supported by Cox (2008b) who identified a multitude of definitions for various domains of the TPACK framework (Mishra & Koehler, 2006), including 13 discrete definitions for technological content knowledge, 10 different definitions for technological pedagogical knowledge and at least 89 definitions for TPACK and its domains. Cox (2008b) discusses that these definitions lack precision, which results in researchers making personal, rather than objective, interpretations, resulting in studies possibly measuring different things. Cox (2008b) also highlights that this lack of precision in the definitions makes it problematic to make informed contributions to the development of the original model.

Angeli and Valanides (2009) also suggest that the boundaries between each knowledge domain are not clear cut, and this blurring may result in debate about where each domain begins and ends. According to Angeli and Valanides (2009), "TPCK's [TPACK's] degree of precision needs to be put under scrutiny. The degree of precision of a construct [knowledge domain] refers to the discriminating value of the construct [knowledge domain] and has important implications for its development and assessment" (p. 157). Precise definitions of the knowledge domains are important as they enable findings to be discussed among researchers in consistent and meaningful ways and are essential to a coherent theory. It ensures consistency and reliability with research findings. Niess (2011) describes the attempts by many educational researchers to interpret these boundaries correctly and refers to this as the "TPACK struggle". For example, there is considerable concern in the research literature around how technological knowledge is defined. The TPACK framework (Mishra & Koehler, 2006) adds technological knowledge as a third knowledge domain to the PCK model, and encompasses an all-embracing definition that applies “equally to analog and digital, as well as new and old, technologies” (Koehler & Mishra, 2009, p. 61).

Yet, this all-inclusive definition of technology used by Mishra and Koehler (2006) is criticised as it considers technology to be not only physical devices but also processes applied to solving problems. It also includes both hard technologies, such as devices and peripherals as well as pencils and whiteboards, and soft technologies, such as the skill and artistry that goes with using problem-solving processes (Graham, 2011). Graham (2011) castigates Mishra and Koehler (2006) for including all types of technologies in technological knowledge, as he claims the definition of technology does not adequately build on the PCK model (Shulman, 1986, 1987), nor does it adequately define the scope of TPACK. He asserts that to use a definition that does not discriminate between older and newer technologies is meaningless as all classrooms would require TPACK. “According to this expansive perspective, every teaching situation would require TPACK because one doesn’t typically teach without using some kind of tool” (Graham, 2011, p. 1956). Defining and limiting the scope of how technological knowledge is perceived is considered important for clarity of the framework. Angeli and Valanides (2005, 2009) agree that the term ‘technology’ is misleading and renamed it ‘ICT’ to provide more specificity as evident in their ICT-PCK model (see Figure 4).

2.4.3.3. Fine-tuning the definition of technological knowledge

This lack of definitional clarity in relation to technological knowledge creates confusion and ambiguity. In particular, the vagueness of the term ‘technology’ has resulted in inconsistencies amongst educational researchers with some tweaking of the definition of ‘technological knowledge’ to suit their interpretation of the scope of their research of TPACK. This has resulted in variations of the TPACK framework (Mishra & Koehler, 2006), such as those described earlier: the “ICT-PCK model” (Angeli & Valanides, 2005, 2009) with more specificity on the application of ICT (see Figure 4) and “TPACK-XL” (Saad et al., 2012) (see Figure 7) that emphasises the complex interrelations between the knowledge bases of ICT-TPCK (Angeli & Valanides, 2005, 2009) and the TPACK framework (Mishra & Koehler, 2006) explicitly for pre-service teacher educators (see Figure 7). Other variations include:

- “G-TPCK” (Doering & Veletsianos, 2007) that highlights geospatial technologies such as global positioning systems (GPS) and Google Maps™ (Google, 2019b)
- “TPCK-W” (Lee & Tsai, 2010) that signifies an emphasis on world wide web technologies.

It has been suggested that focusing the definition of technological knowledge on digital technologies may help with clarification of the definition. Yet clarifying a definition may not necessarily assist with the greater challenge of teaching with technology (or ICT). As highlighted, teaching is complex and incorporating ICT adds further complications such as staying abreast of recent developments in an expeditious pace of change and also dealing with its “protean, unstable and opaque” (Koehler & Mishra, 2009) nature, as well as understanding that technologies are not neutral (Selwyn et al., 2018; Strate, 2012).

The use of technology depends on the individual’s knowledge in regard to content, pedagogy and technology. The knowledge of each individual domain interconnects in unique ways so it is important to know how to use technology in content and pedagogy – there are nuances and accents when using technologies, and this highlights that technologies are not neutral. If technology was neutral it would have no power, but this is not the case. Selwyn (2016) highlights that ICT in education entwines with values, ideas, ambitions and agendas, and asserts technology is used to force some kind of change, such as to be more economically efficient or to be more democratic. As Selwyn et al. (2018) states, “digital technologies in schools are not neutral but political; and that they are carriers of assumptions and ideas about the future of society” (p. 15). Any tool (including technologies) has the capability of particular capacities and certain features or designs; they have the capacity to enable particular actions and not enable other actions. Selwyn et al. (2018) discuss how a school's learning management system is often coded to reflect the school's infrastructure, pre-existing structures and processes and therefore is not neutral. How ICT tools are designed and made before they reach the classroom may influence the decisions that each teacher makes about which tools to use. Teachers also need to have a critical awareness that particular ICT tools will have affordances and constraints, and that these affordances and constraints will change over time according to factors such as context and purposes. Technological knowledge is in a state of fluidity, more so than knowledge of content or pedagogy. As Strate (2012) states "[i]f technology leads to change, and change is not neutral, then technology is not neutral' (p. 6). Although it is relevant, further discussion of this issue is beyond the scope of the research study.

2.4.3.4. Reasoning for adding technology

Mishra and Koehler (2006) contributed to the discourse about using ICT to add value to teaching activities and contend that the TPACK framework provides a structure to enable teachers, and subsequently teacher mentors, to consider how ICT can enable learning, rather than just using ICT in teaching for the sake of it.

> One of the most frequent criticisms of educational technology is that it is driven more by the imperatives of the technology than by sound pedagogical reasons … The TPACK framework, we argue, has given us a language to talk about the connections that are present (or absent) in conceptualizations of educational technology. In addition, our framework places this component, the relationship between content and technology, within a broader context of using technology for pedagogy. (Mishra & Koehler, 2006, p. 1044)

Mishra and Koehler (2006) argued for a discrete technological knowledge domain. However, their argument to add the technological domain to the pedagogical content knowledge (PCK) model is not a strong one. While having appeal to numerous researchers, their argument is rather simplistic as the types of technology included in this knowledge domain were not defined nor limited, and so included both older technologies such as pen and paper as well as newer digital technologies such as computers. Mishra and Koehler (2006) do not provide sufficient evidence or elaborate on their reasons for adding the domain of technological knowledge, other than stating new technological knowledge was evident with changes to ICT. "Rapid changes in technology have added a new kind of knowledge that educators have to integrate with pedagogical and content knowledge" (Koehler & Mishra, 2009, p. 16). They have undertaken little further research about this domain of knowledge. In addition, according to Mishra and Koehler (2006) technological knowledge could include not only physical tools but also processes applied to problem-solving.

2.4.3.5. Unclear boundaries

Issues about lack of specific definitions of the domains of knowledge in Mishra and Koehler's TPACK framework (2006) are also associated with a deficiency of clear-cut boundaries between these domains. Providing a clear definition of the domains in the TPACK framework would enable a clear distinction between the boundaries of the domains. These two limitations of the TPACK framework (i.e. lack of specific definitions and deficiency of precise boundaries) are intertwined.

In the TPACK framework (Mishra & Koehler, 2006), definitions must enable discrimination between domains of knowledge, specifically those that share a boundary (Graham, 2011). However, researchers such as Archambault and Barnett (2010), Archambault and Crippen (2009); Chai et al. (2011); and Cox and Graham (2009) suggest that there is 'fuzziness' of boundaries between the knowledge domains and that the delineation of boundaries of these domains in the TPACK framework is not necessarily evident. Chai et al. (2011) states that "…researchers have commented that the boundaries of TPACK constructs [domains] can be at times rather vague, making it difficult to categorise instances of ICT integration" (p. 596).

Chai et al. (2011) specifically identifies the difficulties in developing valid instruments to measure the knowledge domains of the TPACK framework.

> Even though the TPACK framework was conceptualized as having seven [now eight according to Mishra (2019)] constructs, researchers have only successfully validated the constructs of technological knowledge (TK) and content knowledge (CK). Constructs such as pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and TPACK have been found to be difficult to differentiate via factor analysis. (Chai et al., 2011, p. 595)

Angeli and Valanides (2009) go on to emphasise that the blurring of boundaries in the TPACK framework limits its accuracy and useability in educational research.

> The boundaries between some components of TPCK [TPACK], such as, for example, what they define as technological content knowledge and technological pedagogical knowledge, are fuzzy, indicating a weakness in accurate knowledge categorization or discrimination, and, consequently, a lack of precision in the framework. (Angeli & Valanides, 2009, p. 157)

Cox and Graham (2009) emphasise that when discussing the characteristics of the knowledge domains, each should have no reference other knowledge domains, in order to clearly define boundaries between each of the domains. This is supported by Chai et al. (2013) who states that "…when discussing knowledge pertaining to TPK [technological pedagogical knowledge] such as the principles of the use of online forum for discussion, there should be no reference towards the subject matter (CK)" (p. 33).

2.4.3.6. Minimal attempts to address limitations

As previously identified, there has been minimal theoretical development to make precise distinctions between the knowledge domains since the inception of the TPACK framework developed by Mishra and Koehler (2006). Graham (2011) states that the "research community has not done the theoretical work required to make clear distinction between model elements" (p. 1953), and goes onto assert that this lack of theoretical development has meant minimal contribution to the body of research regarding the TPACK framework.

> The imprecision in defining TPACK constructs [domains] has allowed a proliferation of research to be conducted with very few studies making a substantive contribution to the development of the theoretical framework. In many published articles, the term TPACK could be substituted with the words technology integration without any significant change in meaning. What differentiates the constructs TCK and TPK from other constructs varies widely in articles. For example, pedagogical knowledge considerations are often mentioned in the context of TCK [technological content knowledge] despite the fact that PK [pedagogical knowledge] does not contribute to all TCK [technological content knowledge] according to the framework, (i.e. there is no overlap between PK [pedagogical knowledge] and TCK [technological content knowledge] in the model). (Graham, 2011, p. 1956)

However, Angeli et al. (2016) remind us that up until 2005, research on ICT integration in teaching was "mainly atheoretical in nature" (p. 11). Therefore, it has only been in recent times that educational researchers have participated in systematic and assiduous research studies concerning TPACK, developing a common language and jointly constructing knowledge. Yet "[w]hile TPCK [TPACK] research is recognized as a significant contributor to the existing body of the educational literature, it is also regarded as a rather young research field that is still searching for a generally accepted and solid theoretical conceptualization" (Angeli et al., 2016, p. 11). They also state that educational researchers have tended to explore proving the validity of the structural components of TPACK (e.g. domains of technological pedagogical knowledge, technological content knowledge etc.) rather than researching the contribution of each knowledge domain to the development of TPACK as a whole body of knowledge.

2.4.3.7. Weighting of domains

Mishra and Koehler (2006) are also not clear why technological knowledge is weighted the same as content and pedagogical knowledge. Other depictions of TPACK such as Pierson (1999, 2001) give technology less influence as a domain (see Figure 5). Yet Mishra and Koehler (2006) provide no reasonings why the knowledge domain of technology was equal in size to content and pedagogy knowledge domains. Thus, the lack of clear explanation and justification as to why technological knowledge should be a separate knowledge domain is another weakness of the TPACK framework.

2.4.3.8. Balance between simplicity and complexity

Another challenge with the TPACK framework (Mishra & Koehler, 2006) relates to achieving a balance between the “parsimony” and complexity of the framework, as argued by Graham (2011).

> Like PCK, TPACK is easy to understand at a surface conceptual level. One intuitively recognizes the importance of integrating knowledge domains related to pedagogy, subject matter, and technology. However, the simplicity of the model hides a deep underlying level of complexity, in part because all of the constructs being integrated are broad and ill-defined. (p. 1957)

According to Brantley-Dias and Ertmer (2013), the complexity of the TPACK framework (Mishra & Koehler, 2006) greatly confuses the nature of integrating technology in the classroom. They argue that the TPACK framework is too complex and unwieldy, claiming that some domains of knowledge are not necessarily dissimilar from each other. This “hidden complexity” of the TPACK framework has also been argued by other researchers such as So and Kim (2009) and Koh et al. (2010), who have been less multidimensional, and so less complex, with their interpretations of TPACK. For example, So and Kim (2009) defined only five constructs concerning teacher knowledge: content knowledge (knowing what to teach); pedagogical knowledge (knowing how to teach in general); technological knowledge (knowing about various technical tools and their capabilities); pedagogical content knowledge (knowing about how to teach particular subject matter content) and technological, pedagogical content knowledge (knowing how to represent subject matter with technology in pedagogically sound ways).

Koh et al. (2010) defined seven constructs of teacher knowledge, however in a more streamlined way: technological knowledge (knowledge of technology tools); pedagogical knowledge (knowledge of teaching methods); content knowledge (knowledge of subject matter); technological pedagogical knowledge (knowledge of using technology to implement teaching methods); technological content knowledge (knowledge of subject matter representation with technology); pedagogical content knowledge (knowledge of teaching methods in regard to subject matter content; and TPACK (knowledge of using technology to implement constructivist teaching methods for different types of subject matter).

Conversely, Angeli and Valanides (2009) assert that the TPACK framework (Mishra & Koehler, 2006) lacks specificity as it overlooks various significant aspects such as the teacher's epistemic beliefs and values about teaching and learning and that the affordances of usability of the ICT was low in comprehensiveness. Yet, despite these concerns about its complexity (or lack of), the TPACK framework highlights the complex relationship between ICT skills and pedagogy and provides opportunities to evaluate the effectiveness of the integration of ICT in the classroom.

2.4.3.9. Integrative versus transformative

Another area of discord with the TPACK framework (Mishra & Koehler, 2006) relates to its operational function of TPACK. There is disagreement amongst educational researchers about whether knowledge, as a construct, takes on an integrative or a transformative approach when using ICT in teaching.

The integrative view of TPACK refers to the domains of knowledge (content, pedagogy, and technology) operating to 'integrate' ICT into learning. Therefore, each knowledge domain is considered separately, even though there are areas where the different domains overlap. This viewpoint highlights that TPACK is about the combination (or accumulation) of the separate domains of knowledge and their interacting relationships that occur instinctively when using ICT during teaching. The TPACK framework (Mishra & Koehler, 2006) depicts an integrative model as it represents the integration of the distinct domains of knowledge and their interplaying associations that occur during teaching (see Figure 3). This integrative view assumes teachers will be equipped to teach effectively with ICT if they are provided with adequate professional learning about content, general pedagogy and technological knowledge and skills. Researchers such as Schmidt et al. (2009); Chai et al. (2011); and Harris and Hofer (2011) accept this approach and concentrated on separating and measuring examples of each of the knowledge domains of the TPACK framework, for example, technological pedagogical knowledge and technological content knowledge.

At the other end of the spectrum is the transformative perspective of TPACK. This view interprets TPACK as an 'growing' type of knowledge that is greater than just the individual domains of content, pedagogical, and technological knowledge, and is explained by the creation of a new and different domain of knowledge. That is, TPACK is referred to as a unique and separate domain of knowledge, which is created by the amalgamation and contributions of the other domains of knowledge, and is greater than the sum of its individual knowledge domains. The ICT-PCK model (Angeli & Valanides, 2005, 2009) (see Figure 4), exemplifies the transformative perspective of TPACK. That is, TPACK is conceptualised as a unique and separate domain of knowledge that goes beyond integration (or accumulation) of the domains of content knowledge, pedagogical knowledge and technological knowledge to transform them into new and unique knowledge. Angeli and Valanides (2005, 2009) refer to the affordances of ICT to transform content knowledge and pedagogical knowledge and argue that the knowledge domains of TPACK and pedagogical content knowledge cannot be described by the combination of the individual knowledge domains that contribute to their synthesis – they contend that the domains of TPACK and pedagogical content knowledge are essentially new and unique domains of knowledge and therefore have a transformative function. Angeli and Valanides (2005, 2009) highlight that TPACK as a transformative body of knowledge is expressed as knowledge about how to transform content and pedagogy using ICT for particular learners in explicit contexts, and in ways that indicate the added value of using ICT. As previously highlighted, their ICT-TPACK framework depicts the relationship between ICT, content, pedagogy, learners and context. According to Angeli and

Valanides (2005, 2009), the omission in TPACK framework (Mishra & Koehler, 2006) to address affordances of ICT tools is a major limitation of the framework.

All in all, the TPACK framework (Mishra & Koehler, 2006) is regarded as a useful framework for the theoretical basis of teachers' knowledge, even though educational researchers still have questions in relation to its lack of clarity in definitions, blurred boundaries and whether its knowledge as a construct is considered integrative or transformative. Despite these limitations, there have been valuable considerations that have contributed to its theoretical underpinnings and TPACK is a suitable framework to use for this research study.

2.4.4. Using the TPACK framework to overcome challenges with ICT uptake

Pre-service teachers need experience using ICT during the teaching practicum, with explicit support provided by teacher mentors to develop these ICT capabilities (Abbitt, 2011b; Graham et al., 2012; Jamieson-Proctor et al., 2010; Polly, 2011; Polly & Brantley-Dias, 2009; Tondeur et al., 2012). A number of researchers (Abbitt, 2011b; Graham et al., 2012; Jamieson-Proctor et al., 2010; Polly & Brantley-Dias, 2009) have identified the specific benefits of the TPACK framework (Mishra & Koehler, 2006) in regard to initial teacher education programs. Specifically, Polly and Brantley-Dias (2009) describe the TPACK framework as beneficial to guide the training and professional learning of both pre-service and in-service teachers. "Using TPACK as a framework for measuring teaching knowledge could potentially have an impact on the type of training and professional development experiences that are designed for both preservice and inservice teachers" (Polly & Brantley-Dias, 2009, p. 125).

Graham et al. (2012) consider the TPACK framework (Mishra & Koehler, 2006) to be a valuable lens for understanding how pre-service teachers can make decisions about the use of ICT in their teaching practicums. Abbitt (2011b) discusses how the application of the TPACK framework to preservice teacher education "is a unique context in which teacher knowledge emerges as the result of the learning environment of courses, workshops, and other preservice experiences" (p. 285).

Therefore, the TPACK framework (Mishra & Koehler, 2006) has been considered heartening as an approach for initial education providers to assist with overcoming challenges to preparing pre-service teachers to use ICT effectively in teaching practicums: it is regarded as providing a framework for initial teacher education programs, guiding ICT professional learning, and being a lens for decision-making regarding ICT in teaching practicums.

2.5. Summary of review of literature

This chapter has reviewed relevant research literature pertaining to this study. In the first part it discussed the development of the Australian and Victorian curriculums, as a means for exploring the curriculum imperatives facing pre-service teachers. It explored how ICT is represented differently in the two curriculum frameworks: as a General Capability in the Australian Curriculum F–10 where ICT is addressed through the content of the learning areas (ACARA, 2017) while in the Victorian Curriculum F–10 (VCAA, 2015b), ICT is required to be taught in, and through, the curriculum areas. This review also highlighted the investment by Australian governments to support the delivery of this ICT curriculum. It also examined the development of Australian Teacher Professional Standards (AITSL, 2018b), including those relating to ICT that pre-service teachers must demonstrate to graduate from their initial teacher education programs. It then turned in the second part to explore the important role that teacher mentors play in supporting pre-service teachers to teach the curriculum explored in the first part of the chapter. This part also explored how mentoring is complex, that it requires specific knowledge, skills and qualities and that performing its associated roles is complicated. The third part of this chapter then focused attention on the knowledge that teachers require to integrate ICT into their practice. It examined the development of the TPACK framework (Mishra & Koehler, 2006), which has been highly influential in shaping this space. This framework has its roots in the research of Shulman

(1986, 1987), who advocates that teacher knowledge is complex; he identifies pedagogical content knowledge (PCK) as a type of knowledge that is unique to teachers and based on the way in which teachers relate their pedagogical knowledge to their content knowledge. In this model, technological knowledge is incorporated into content knowledge. Mishra and Koehler (2006) then built on Shulman's notion of PCK; however, they argue that technological knowledge, because of its pervasiveness, needed to be represented as a separate domain. Their ensuing framework then is built around three domains: content knowledge, pedagogical knowledge and technological knowledge, and the creation of four new domains of knowledge that lie at their intersections: pedagogical content knowledge; technological content knowledge; technological pedagogical knowledge; and technological pedagogical content knowledge and encompassed by an eighth domain of conteXtual knowledge that contained these seven domains. The discussion around the TPACK framework highlights the challenge to classify the knowledge needed by teachers for ICT uptake in their classroom, while addressing the complex and situated nature of teacher knowledge.

The TPACK framework (Mishra & Koehler, 2006) has been highly influential and has generated considerable research interest. The framework, however, is not without its critics, with attention focused on several aspects: first, concern around the knowledge domains themselves and what constitutes each set of knowledge; secondly, the boundaries between the knowledge domains, with numerous researchers arguing that these boundaries are not clearly defined, but rather are blurred. The third criticism relates to how the domains connect. Despite these concerns, the TPACK framework continues to lead the theoretical thinking in this space, and as a consequence was useful to frame my research study on the knowledge that teachers need to use ICT. Therefore, an investigation into what knowledge is needed by teacher mentors to support pre-service teachers to use of ICT was deemed necessary.

In the next chapter, I describe the research methodology used to investigate the knowledge needed by teacher mentors to support pre-service teacher use ICT during teaching practicums. The research question/s, the researcher's pragmatic worldview and the decision for selecting a mixed methods approach to the research are explored. I also describe the selection of the research setting and participants and data collection methods, including use of a questionnaire, semi-structured interviews and artefact analysis. A discussion on the reliability and validity of data collection and analysis and ethical considerations is also provided in chapter 3.

3. Research methodology

The research methodology of this study is discussed in this chapter; the discussion is divided into three parts. The first part of this chapter explores the main research question and its research sub-questions, and examines the researcher's pragmatic worldview and the decision for selecting a mixed methods approach to the research, including an overview of the significance of using this type of methodology. In this first part, there is also a discussion of the distinction between basic and complex mixed methods designs. The second part of this chapter describes the reason for the selection of the research setting and participants in this study, including an examination of the justification for the use of purposeful sampling. The final part describes the data collection and analysis methods that are considered to be most appropriate for addressing this study's research question and research sub-questions. There is a description of the data analysis methods, including the collection and analysis of data, as well as the ethical considerations involved in this research study. The chapter concludes with a brief summary overview.

3.1. A mixed methods approach

The overall purpose of this research study was to investigate what knowledge teacher mentors need to support pre-service teachers to use ICT during teaching practicums. As discussed in the introductory chapter, this research study is guided by the following research question and research sub-questions:

Research question: What knowledge do teacher mentors need to support pre-service teachers to use ICT during teaching practicums?

Research sub-questions:

1. What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?

2. What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?

3. What are the teachers' beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?

4. What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?

In this research study, both quantitative research questions (research sub-question 1) and qualitative research questions (research sub-questions 2, 3 and 4) were constructed. So, the choice of a mixed methods approach was suitable. This research study is framed by a pragmatic paradigm framework (Biesta, 2010; Creswell & Plano Clark, 2007, 2018; Creswell & Poth, 2018; Teddlie & Tashakkori, 2003) and uses a mixed methods approach (Creswell & Creswell, 2018; Creswell & Plano Clark, 2018; Creswell & Poth, 2018; Teddlie & Tashakkori, 2003), with a sequential explanatory design (Creswell, 2009) and case study methodology (Yin, 2003, 2014). The findings were written up as case studies. I will unpack this methodology in the ensuing paragraphs.

3.1.1. Pragmatic paradigm framework

"A paradigm is a way of looking at the world. It is composed of certain philosophical assumptions that guide and direct thinking and action" (Mertens, 2015, p. 8). A paradigm operates as a metaphysical framework that directs researchers to identify and explain their beliefs in regard to reality, knowledge, ethics and methodology. That is, a paradigm or worldview "is composed of beliefs and assumptions about knowledge that informs … [one's] study" (Creswell & Plano Clark, 2007, p. 39).

The pragmatic paradigm has a pluralistic approach that enables researchers to study areas of interest, using methods of collecting and analysing data that are considered most appropriate to make use of findings in a constructive way, in agreement with their value system (Biesta, 2010; Creswell & Plano Clark, 2007, 2018; Creswell & Poth, 2018; Teddlie & Tashakkori, 2003). Pragmatism is about finding solutions to real-world problems, and so a pragmatic framework "is characterized by an emphasis on communication and shared meaning-making in order to create practical solutions to social problems" (Shannon-Baker, 2016, p. 322). Cherryholmes (1992) states that "[f]or pragmatists, values and visions of human action and interaction precede a search for descriptions, theories, explanations, and narratives" (p. 13). Pragmatism is based on the belief that "theories can be both contextual and generalisable …" (Shannon-Baker, 2016, p. 322) by scrutinising these theories for transferability to another setting. Accordingly, Shannon-Baker (2016) states that the pragmatic researcher is able to uphold both "subjectivity in their own reflections on research and objectivity in data collection and analysis" (p. 322).

Creswell and Poth (2018) also state that "[i]ndividual researchers have a freedom of choice. They are 'free' to choose the methods, techniques, and procedures of research that best meet their needs and purposes" (p. 27). Accordingly, Glogowska (2011) claims that the pragmatic approach "is chosen for its aptness for answering the research questions posed …" (p. 52). So, pragmatic options about what to research and how to tackle it are adjusted by "where we want to go in the broadest of senses" (Cherryholmes, 1992, p. 13). In other words, the researcher will make choices about use of methods and sources of data collection to ensure conducting the research "… best addresses the research question" (Creswell & Poth, 2018, p. 27). Consequently, pragmatism is about choices which represent that one approach is better at constructing anticipated outcomes than another approach.

Cherryholmes (1992) goes on to state that “[p]ragmatism denies foundationalism, the view that grounded meaning and truth can be determined once and for all” (p. 15). That is, ‘[t]he pragmatic response is that we have no way of knowing” (Cherryholmes, 1992, p. 15), and so the emphasis is on the research problem being studied rather than the methods being used (Creswell & Poth, 2018). Pragmatic research is guided by anticipated outcomes, a disinclination to convey a true story, and the belief that there is an outside world that is independent of our thoughts (Cherryholmes, 1992; Creswell & Creswell, 2018; Creswell & Poth, 2018). The aim of qualitative and quantitative research is to seek answers and/or interpretations of phenomena under investigation while the pragmatic research “seeks to clarify meanings and looks to consequences” (Cherryholmes, 1992, p. 13).

According to Creswell and Poth (2018), pragmatic researchers believe that “[t]ruth is what works at the time” (p. 27). Furthermore, “[p]ragmatists choose some explanations or theories or stories and dismiss others when the former produce results they desire better than the latter” (Cherryholmes, 1992, p. 15). The pragmatic paradigm has an intuitive, insightful appeal to the researcher. There is emphasis on understanding not only what the research participants do but also how they do things in particular ways. There is agreement that research does not occur in a vacuum, but rather it is influenced by social, historical, political and other contexts (Creswell & Poth, 2018).

As Creswell and Poth (2018) state “[p]ragmatist researchers look to the “what” and “how” of research based on its intended consequences – where they want to go with it” (p. 27). Therefore, I chose a pragmatic paradigm framework in this research study as it allowed me to make decisions regarding the methodology to undertake the research to address the research question/s guiding this study (Teddlie & Tashakkori, 2003). As a result of my own experiences as a teacher and my observations of the complexities involved in using ICT in practice, I decided to undertake this research study using “how” and “why” questions (Creswell & Poth, 2018) to obtain a deep understanding of the knowledge needed by teacher mentors to support pre-service teachers to use ICT in teaching practicums.

According to Johnson and Onwuegbuzie (2004), pragmatism's "logic of inquiry … [enabled me to include] the use of induction (or discovery of patterns), deduction (testing of theories and hypotheses), and abduction (uncovering and relying on the best of a set of explanations for understanding" (p. 17). I was able to focus on problem-solving and outcomes related to my research question/s, using "… myriad of methods for the practical purposes of induction, deduction, and abduction" (Mertens, 2015, p. 131).

3.1.2. Selection of mixed methods approach

Mixed methods research has emerged as another methodological approach in response to the limitations of solely using quantitative or qualitative research methods. Mixed methods research includes both quantitative and qualitative attributes in the design and collection and analysis of data (Creswell & Creswell, 2018; Mertens, 2015; Teddlie & Tashakkori, 2003). Mixed methods design rejects dogmatism and endorses the use of multiple approaches to addressing research questions, rather than restricting or constraining researchers' choices. It is considered to be an expansive and creative form of research, advocating that researchers take an eclectic approach to the selection of methods and the organisation of the research.

I collected both quantitative and qualitative data and this enabled me to gather different types of information, that is I gathered closed-ended data with the quantitative research method and open-ended data with the qualitative research methods. In other words, mixed methods research involves numbers (quantitative) and words (qualitative) (Creswell & Creswell, 2018). Creswell and Creswell (2018) acknowledge that "[m]ixed methods research is an approach to inquiry involving both quantitative and qualitative data, integrating two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks" (p. 4). Correspondingly, Johnson and Onwuegbuzie (2004) affirm that "[m]ixed methods research is formally defined … as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (p. 17). Likewise, Tashakkori and

Creswell (2007) define mixed methods "as research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry" (p. 4). Mertens (2015) also states that "mixed methods have an intuitive appeal, [and] they also demand that the researcher be expert in both approaches to research or work with a team that has such expertise" (p. 304).

I adopted a mixed methods approach supported by the work of researchers such as Creswell and Creswell (2018); Creswell and Plano Clark (2007); and Teddlie and Tashakkori (2003) because I believed I needed to use a combination of both quantitative and qualitative data to investigate the main research question and four research sub-questions. The research question/s guided the selection of research methods that were 'mixed' (also referred to as 'integrated' or 'combined') in terms of gathering both quantitative and qualitative data because of the complexity and nature of these research question/s. The quantitative data aimed to illustrate "what" is happening while the qualitative research situated me in the research to tell "why" it was happening (Moore, 2000). Specifically, a quantitative questionnaire was designed to gather information about the demographics of the participants that could be quantified, including type of classes taught (i.e. primary versus secondary); sex, years of teaching experience, and types of ICT used (relating to research sub-question 1) as well as information about the types of mentor training undertaken (relating to research sub-question 3). In addition, a qualitative semi-structured interview was designed to gather insights into domains of knowledge needed to mentor pre-service teachers (relates to research sub-question 4); previous experience with mentoring; and teacher beliefs about their role as mentors to support ICT during teaching practicums and thoughts about ways to support teacher mentors (relates to research sub-question 3); and considerations of barriers and enablers with mentoring pre-service teachers to use ICT (relates to research question 2). I also gathered qualitative data in the form of school artefacts including school ICT policies, eLearning plans, My School website data, school website data and information about technical infrastructure of schools, which I subsequently interrogated (relates to research sub-question 2). Therefore, a mixed methods approach enabled me to gather more information by using both quantitative and qualitative data to address the research question/s guiding this research study; this approach enabled me to use quantitative and qualitative data to explore different, but complementary, questions related to the research study.

According to Creswell and Plano Clark (2007), a mixed methods approach is advantageous to some research studies such as mine as “[b]y mixing the datasets, the researcher provides a better understanding of the problem than if either dataset has been used alone” (p. 7). They go on to state that mixed methods approaches can provide “more comprehensive evidence for studying a problem [than] either quantitative or qualitative research alone” (p. 12). Creswell and Creswell (2018) endorse this by stating “[t]he core assumption of this form of inquiry is that the integration of qualitative and quantitative data yields additional insights beyond the information provided by either the quantitative and qualitative data alone” (p. 4). Yin (2006) also highlights the value of mixed methods research to make connecting evidence “more compelling than might have been produced by any single method alone” (p. 41). In addition, Teddlie and Tashakkori (2010) reinforce this benefit by stating we gain knowledge using mixed methods approaches through “the combination of action and reflection” (p. 112).

Creswell and Creswell (2018) also refer to a mixed methods design as enabling the researcher to focus on integrating (or mixing) the data and not just simply mining the data in isolation. According to Mertens (2015), mixed methods “can be used to answer questions that could not be answered in any other way [and enriches the researcher’s] … ability to draw conclusions about the problem under study” (p. 304). The strengths of each data collection method can be combined to develop a more robust understanding of the research question/s as well as overcome the limitations of each data collection method. “This “mixing” or integrating of the data…provides a stronger understanding of the problem or question than either by itself" (Creswell & Creswell, 2018, p. 213). In other words, I was able to draw on the strengths of both the quantitative and qualitative research while minimising the limitations of these approaches to gain a more complete understanding of my main research question and research sub-questions. I also was able to seek out opportunities for a broader collection of divergent views and avoid methodological bias (Dhanapati, 2016) and so gain a better insight of the reality of the phenomenon being researched and address the research question/s more comprehensively.

3.1.3. Pragmatic paradigm coupled with mixed methods approach

A pragmatic framework is characteristically associated with mixed methods research (Biesta, 2010; Creswell & Creswell, 2018; Creswell & Plano Clark, 2007; Teddlie & Tashakkori, 2003). As identified earlier, a mixed methods approach refers to "mixing" of quantitative and qualitative data during the research study (Creswell & Creswell, 2018), and so the pragmatic paradigm has emerged as one of the fundamental theoretical frameworks for particular advocates of mixed methods approaches to research (Creswell & Creswell, 2018; Creswell & Poth, 2018; Teddlie & Tashakkori, 2003).

According to Teddlie and Tashakkori (2010), there is general agreement on the broad characteristics of mixed methods research, and although there is not consensus regarding them, "they represent a place to start the dialogue" (p. 8). Creswell and Creswell (2018) state that a mixed methods approach has a pragmatic worldview that involves the collection of both quantitative and qualitative data, either sequentially or concurrently, in the design.

"A hallmark of MMR [mixed methods research] is its replacement of the either-or from the paradigm debates" (Teddlie & Tashakkori, 2010, p. 8) where it was considered that the paradigms of quantitative and qualitative research were mutually exclusive and so incompatible – it was thought that combining quantitative and qualitative research, as is the case for mixed methods research, was problematic. However, pragmatism embraces a mixed methods approach and circumvents the ‘either-or’ view of positivism and constructivism. Positivism refers to a belief that knowledge is universal and absolute and so uses quantitative approaches to research reality in the universe (Howell, 2016). On the other hand, constructivism refers to a belief that there may be more than a fixed knowledge about a phenomenon and that such knowledge is imperfect in the universe, and so uses qualitative approaches to construct meaning of the phenomenon being researched (Dhanapati, 2016; Howell, 2016).

It is this “rejection of the incommensurability” (Teddlie & Tashakkori, 2010, p. 10) of the paradigms that separates advocates of mixed methods research from other researchers. According to Creswell and Poth (2018) “[p]ragmatists do not see the world as an absolute unity. In a similar way, researchers look to many approaches to collecting and analysing data rather than subscribing to only one way” (p. 27). The pragmatic approach takes the view that the most suitable research methods are those that will assist the researcher to most effectively address the research question/s (Creswell & Creswell, 2018; Creswell & Poth, 2018; Glogowska, 2011; Johnson & Onwuegbuzie, 2004; Saunders, Lewis, & Thornhill, 2012).

The philosophical underpinning of pragmatism enables researchers of mixed methods approaches to use a range of techniques to address research question/s that cannot be answered using just one method alone. Biesta (2010) claims that “[r]ather than starting from particular philosophical assumptions or convictions, the choice of a mixed methods approach is seen as one that should be driven by the very questions that research seeks to answer” (p. 96). A pragmatic paradigm is coupled with a mixed methods approach and its use of strategies that include gathering data in a concurrent or sequential manner, employing methods that are drawn from both quantitative and qualitative approaches in a way that addresses the research question/s most appropriately (Creswell & Creswell, 2018; Creswell & Plano Clark, 2007; Creswell & Poth, 2018). Pragmatism enables a mixed methods researcher to consider different worldviews, different assumptions and multiple methods, and therefore opens the door to different forms of collecting and analysing data in a mixed methods study (Creswell & Plano Clark, 2007). This approach enabled me to have the flexibility to choose both quantitative and qualitative research methods that I thought best complemented my research study, and I will discuss each specific research method that I used later in this chapter under the headings '3.6.2. Questionnaires' and '3.6.3 Interviews'.

Teddlie and Tashakkori (2010) identify nine common core characteristics of mixed methods research, and one of these characteristics is "methodological eclecticism [which refers to] selecting and then synergistically integrating the most appropriate techniques from a (*sic*) myriad of QUAL [qualitative], QUAN [quantitative] and mixed methods to more thoroughly investigate a phenomenon of interest" (p. 9). It goes further than mixing quantitative and qualitative methods to overcome the weaknesses of one or the other methods, because according to Teddlie and Tashakkori (2010), the researcher instinctively and intelligently selects the best techniques available to investigate the research questions that often develop as a study progresses. "Methodological eclecticism means that we are free to combine methods and that we do so by choosing what we believe to be the best tools for answering our questions" (Teddlie & Tashakkori, 2010, p. 10). Therefore, the pragmatic worldview uses a range of methods and sources to collect data to best answer the research question/s. The practical implications of the research are also emphasised along with the value of undertaking research that best addresses the research question (Creswell & Poth, 2018). Consequently, the use of a mixed methods approach suggests that the researcher eliminates methodological bias in order to better comprehend the reality of the phenomenon being researched. According to Dhanapati (2016) a mixed methods approach offers "a very practical and applied research philosophy" (p. 571).

3.1.4. Types of research designs

"Research designs are types of inquiry within qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures in a research study" (Creswell &

Creswell, 2018, p. 11). It is considered that a research design is the “logic” that connects the collection of data and therefore conclusions that are drawn to the research questions of the study, and so every empirical study has a research design, whether it is implicit or explicit (Creswell, 2014). Developing a mixed methods research design can be challenging as the researcher must design a research study using the quantitative and qualitative approaches that they have decided are most suitable to address the research question/s. Therefore, there are numerous ways to combine these approaches because mixed methods research takes advantage of the multiple ways to explore the research question/s. Consequently, there are no absolute guidelines for designing a mixed methods research study, resulting in myriad classifications.

In addition, different terminology to classify approaches to research designs is used by various disciplines, and so there are numerous ways that mixed methods approaches are classified as the separate classifications represent distinct disciplines and use diverse terminology (Creswell & Creswell, 2018; Creswell & Plano Clark, 2007; Teddlie & Tashakkori, 2003). For the purposes of this research, Creswell’s definition of mixed methods research (2009) was utilised as it incorporates the pragmatism worldview and includes the notion of mixed methods as a methodology for educational research. According to Creswell (2009, 2014) and Creswell and Creswell (2018) there are three basic (or core) designs to mixed methods research: sequential exploratory; sequential explanatory; and convergent. For the purposes of this research study, I used a sequential explanatory design, according to Creswell (2009, 2014) which I elaborate on in the following paragraphs.

3.1.5. Sequential explanatory research design

A sequential explanatory research design consists of initially collecting quantitative data and then collecting qualitative data to assist with complementing and elaborating on the quantitative data. The quantitative data is analysed, and the qualitative results build upon these results to explain them in more detail. “It is considered explanatory because the initial quantitative data results are explained further with qualitative data. It is considered sequential because the initial quantitative phase is followed by the qualitative phase" (Creswell & Creswell, 2018, p. 15). The "straightforward nature" (Creswell, 2009) of a sequential explanatory research design is considered to be one of its strengths. Each step in my research study is founded in two well-defined, distinct phases, making it easy to follow and implement, as well as making it quite logical to describe and report on the data.

The reason for using this approach in my research study was that the quantitative data and results afforded a general depiction of a cohort of teacher mentors but more analysis, explicitly through qualitative data, was required to assist specifically with addressing research sub-questions 2–4. Therefore, the analysis of quantitative data informed the collection of qualitative data. "Connecting [or mixing] the data means that the analysis of one data set is used to lead into or build into the second data set" (Creswell & Creswell, 2018, p. 237). I collected and analysed the quantitative data in the first phase to produce numeric results, and I then collected and analysed qualitative data to build on the first, quantitative phase and gain a greater understanding of the phenomenon being investigated. I mixed the quantitative and qualitative data by purposefully selecting participants for the interviews (second, qualitative phase) from those who completed the questionnaire (first, quantitative phase); I also mixed the quantitative and qualitative data by developing the interview questions to explain or elaborate on the questionnaire results obtained in the first phase and also collecting artefacts from the schools of those teacher mentors who were interviewed to be analysed. That is, the initial quantitative phase informed the second qualitative phase. Equal weight was given to both the quantitative and qualitative data, and the mixing of the data occurred "when the initial quantitative results ... [informed] the secondary qualitative data collection" (Creswell, 2009, p. 211). So, although the quantitative data is separate from the qualitative data, the two types of data are connected and complement each other. The purpose of this combination of data enabled the qualitative data to assist in the explanation and interpretation of the quantitative component of the research study.

3.1.6. Integration, triangulation and interpretation

Characteristically, a sequential explanatory design is used to describe and interpret quantitative results, then is complemented by gathering and examining accompanying qualitative data. As pointed out, the rationale underlying this approach in my research study was quite simple in that the analysis of the qualitative data refined and explained the analysis of the quantitative data and so enabled the examination in more depth of the research participants' views from the qualitative data. (Dhanapati, 2016). The collection of qualitative data after the collection of quantitative data also enabled the scrutiny of any anomalous or unexpected results in more detail. Furthermore, when gathering qualitative data via semi-structured interviews, I was simultaneously gathering qualitative data from artefacts such as school ICT policies, eLearning plans, My School website data, school website data and information about technical infrastructure of schools. This data from the collection and analysis of artefacts was to identify further information to address the research question/s, in particular the barriers and enablers to using ICT in teaching practice as identified by researchers such as Becta (2004); Ertmer (1999); Groff and Mouza (2008); Hew and Brush (2007); and Mumtaz (2000).

However, one of the main limitations of a sequential explanatory design is the length of time required to collect data as two separate phases are required. As previously described, I initially collected and analysed the quantitative data from the questionnaire, and then used qualitative methods to examine, clarify, and triangulate the quantitative results. I gathered qualitative data from interview transcripts and analysis of artefacts, which I also used to examine, clarify and triangulate the previous quantitative data I had collected. I discuss the use of triangulation in more depth later in this chapter under the heading '3.4.3. Triangulation'. These two separate phases were more time-consuming as they were required to be completed sequentially, and were "especially a drawback" (Creswell, 2009, p. 211) as I gave equal priority to the two phases.

I have discussed why and how my research study involved the use of a sequential explanatory mixed methods design (Creswell, 2009). I now turn to discuss the incorporation of case study methodology into this basic research design.

3.1.7. Basic and complex mixed methods designs

As a methodology is a set of steps that guide the use of design, another methodology approach can be added to a mixed methods design and therefore, a mixed methods design can "involve more steps and procedures" (Creswell & Creswell, 2018, p. 226). This does not mean the design is more advanced, but rather more complex as it "incorporates the core [basic] designs into "processes" of research". (Creswell & Creswell, 2018). The research can add to the three basic designs, and include a complex design such as multistage; intervention; case study; or participatory research (Fetters, Curry, & Creswell, 2013).

In my research study, I added case study methodology (complex design) to a sequential explanatory design (basic design). That is, findings from the questionnaire responses of 50 teacher mentors were used to inform the collection of interview data from four teacher mentors, and subsequently the collection and analysis of artefacts from their schools, and these results were written up as case studies; a mixed methods design was added to a case study methodology and is referred to specifically by Creswell and Creswell (2018) as the "mixed methods case study design" (p. 230).

In a case study methodology, both quantitative and qualitative data are collected to create an in-depth understanding of the case that is the focus of the study (Schwandt & Gates, 2018; Yin, 2014). Creswell and Poth (2018) claim it is not sufficient to rely only on one source of information in order to gain an in-depth understanding of a case study, and so by using both quantitative and qualitative data, my research study was able to gather rich information to address the research question/s. In the following sections, I first unpack the case study methodology and then explain the 'more complex' mixed methods case study design.

3.2. Case study methodology

Incorporating case study methodology into my research study seemed most appropriate due to this approach being flexible and beneficial to gathering in-depth portrayals of real-life events using multiple sources of data. It also enabled me to conduct an empirical inquiry that examined a phenomenon within its real-life context. Yin (2003, 2014) emphasises that case studies can be used to explore, explain or describe phenomena or events in commonplace settings in which they arise, and this was the approach that I wished to take to address my research question/s.

In case study research, the researcher can conduct four major types of designs (Creswell, 2009; Yin, 2003, 2014). This is depicted in a two-by-two matrix design, with each of the designs including the ability to analyse contextual factors in relation to the case, represented by dashed lines around each case. The researcher can implement either a single-case design or a multiple-case (or collective) design, and within each "there also can be unitary or multiple units of analysis" (Yin, 2014, p. 50). Holistic designs require one unit of analysis, whereas embedded designs require multiple units of analysis. This results in four types of design for case studies: single-case (holistic) designs; single-case (embedded) designs; multiple-case (holistic) designs; and multiple-case (embedded) designs (Creswell, 2009, 2014). I discuss my selection of a multiple-case holistic case study design later in this chapter.

My research study highlighted the empirical nature of research and the significance of context to the case. As highlighted, case study methodology was considered the best choice to address my research question/s. Yin (2014) does caution however that although the case study provides a unique insight into the individual, organisational, social and political processes in context, it can seldom be generalised. In order to undertake rigorous research regarding the knowledge of teacher mentors to support pre-service teachers to use ICT in teaching practicums, consideration was given to the prerequisite for a systematic framework to collect, interpret and integrate data from multiple data sources across the two phases of this study. The approach of Creswell (2009, 2014); Creswell and Creswell (2018); and Yin (2003, 2014) was what I believed I needed to undertake to address the research question/s and reasons for this are discussed in this section of the chapter.

However, case study research is a contested landscape occupying a perplexed position in educational research, characterised by a variety of perspectives from many research design methodologist authors such as Merriam (1998); Stake (1995, 2000); and Yin (2003, 2014). Consequently, there are a variety of approaches to case study methodology that centre around diverse epistemological approaches, that is particular stances towards the nature of knowledge; differing definitions of the term ‘case’ and ‘case studies’; and divergent views on how to design a case study and conduct its subsequent collection, analysis and validation of data. Fundamentally, “[w]hat constitutes a case study is disputed” (Schwandt & Gates, 2018).

In my research study, I decided to refer to the works of Creswell (2009, 2014); Creswell and Plano Clark (2007, 2018); and Yin (2003, 2014) when using case study methodology. This was because the works of these researchers reflected features that I believed were central to addressing my research question/s. Yin (2014), for example, considers that case study is a form of empirical inquiry and presents a more positivist approach to case study research. He refers to using a “realist perspective” (Yin, 2014) and giving attention to maintaining objectivity in his approach to case study. Yin (2014) also discusses four “conditions” for judging the quality of research designs – construct validity; internal validity; external validity; and reliability – and recognises that how researchers deal with these characteristics of quality control are significant at each step in the case study research. These conditions for judging the quality of design designs are discussed later in this section of the chapter.

Creswell (2009, 2014) describes case studies as an in-depth description and analysis of a bounded system. Similarly, Yin (2003) agrees that bounding the case is important and describes a case as “a contemporary phenomenon within its real-life context, especially when the boundaries between a phenomenon and context are not clear and the researcher has little control over the phenomenon and context” (p. 13). Yin (2014) emphasises that bounding the case by time and place enables the researcher to determine the scope of their collection of data, and also helps discriminate data about the intent of their case study, (i.e. the ‘phenomenon’) from that of data external to the case, (i.e. the ‘context). Merriam (2010) also asserts that the crucial attribute of case study research is the identification of the case and emphasises that the unit of analysis is what “[w]hat makes a case study a case study…” (p. 456). She defines “boundness” by describing a unit that is chosen for study, (i.e. a unit of analysis) around which there are boundaries, and aptly states that “[w]e can fence in what we are going to study” (Merriam, 2010, p. 456). The sample in my research study is contained by those teacher mentors from government and Catholic schools in the North Western Metropolitan region of Melbourne, Australia who worked with pre-service teachers from RMIT University – this was the unit of analysis, that is there were boundaries to the sample in my research study. Therefore, a unit of analysis defines my case study, rather than the topic of the research study, and enables me to determine the scope of my collection of data. That is, I was able to identify the focus and extent of my research study.

Creswell (2009, 2014); Creswell and Poth (2018); Schwandt and Gates (2018); and Yin (2002, 2003, 2014) advocate that both quantitative and qualitative sources should be combined in case study research, and accentuate that the researcher cannot depend on only one data collection method and most likely needs to utilise various sources of evidence to attain a richness of understanding of the research question/s. Creswell and Poth (2018) describe mixed methods case study design that collects both quantitative and qualitative data as more detailed and contextualised than case studies that rely only on quantitative or qualitative data. I also decided to collect, analyse and mix both qualitative and quantitative data, using a questionnaire, semi-structured interviews and collection of artefacts from schools. I planned to use both quantitative and qualitative sources of data; I decided that using this approach to case study research, which was supported by Creswell (2009); Creswell and Creswell (2018); Creswell and Poth (2018); and Yin (2003, 2014) was most appropriate because these researchers advocate for the use of both quantitative and qualitative data collection in case study research.

Like a number of other researchers (Merriam, 1998; Merriam, 2010; Yin, 2003, 2014), Creswell and Poth (2018) also “choose to view case study research as a methodology: a type of design in qualitative research that may be an object of a study as well as a product of the inquiry” (p. 96). Accordingly, Creswell and Poth (2018) define case study research as a qualitative approach in which the researcher explores a contemporary, real-life bounded system (referred to as a case), or multiple bounded systems (referred to as cases), over time through comprehensive and in-depth collection of data; it uses multiple sources of information and details a description of a case study and its themes. Therefore, as a methodology, case study is the lens through which the researcher observes and gives decisions about the research study (Creswell & Poth, 2018).

Creswell and Poth (2018); Schwandt and Gates (2018); and Miles, Hubernman, and Saldaña (2014) support the view that “boundaries” are essential to ensure case study research remains feasible. These researchers indicate that bounding the case creates a logical and realistic scope for a study. Miles et al. (2014) also “define a case as a phenomenon of some sort occurring in a bounded context. The case is, in effect, your unit of analysis” (p. 28). Miles et al. (2014) emphasises the importance of bounding the case by stating that “[t]here is a focus or “heart” of the study, and a somewhat indeterminate boundary defines the edge of the case that will not be studied” (p. 28). Yin (2003, 2014) specifically discusses the importance of distinguishing the unit of analysis (especially if it is a small group) from the context of the case study, that is those who are outside of it. Creswell and Poth (2018) elaborate on these descriptions of “boundness” by asserting that ‘[t]he unit of analysis in the case study might be multiple cases … or a single case” (p. 97). Miles et al. (2014) concur by expressing that “[s]tudies may be just one case or of several” (p. 28).

In essence, case study research is a hotbed of differing viewpoints and there is a vast array of approaches to case study methodology – I have unpacked a variety of approaches and discussed their characteristics, similarities and differences and identified researchers who are aligned with particular features of these approaches. This analysis of different case study approaches has been useful to assist with conceptualising, designing and conducting my research study; it has enabled me to eclectically mix different research methods in order to best address my research question/s. I now discuss my decision to use case study methodology and my position for the approach that I undertook.

3.2.1. Selection of case study approach

Despite disparity in the approaches of the different advocates, case study methodology is described constantly as a useful method of qualitative inquiry, suitable for a wide-ranging, all-inclusive, and detailed investigation of a complex phenomenon (Creswell, 2009, 2014; Creswell & Creswell, 2018; Creswell & Poth, 2018; Darke & Shanks, 2002; Merriam, 2010; Stake, 1995, 2000; Yin, 2002, 2003, 2014). Case study research is considered to be a flexible approach that is conducive to obtaining meaningful features of real-life events. The case study is preferred in examining contemporary events when the relevant behaviours cannot be manipulated and/or should not be. According to Moore (2000), "[c]ase studies are used when it is necessary to develop a detailed understanding of what is happening in complex circumstances" (p. xiii). In particular, there is an increasing use of case studies to describe educational practices that are context-specific and to draw generalised conclusions.

However, one of the major concerns with using a case study approach is ensuring that the research question/s are not too general. As identified by Rowley (2002), a challenge of using case study research is to ensure that it "… lift[s] the investigation from a descriptive account of "what happens" to a piece of research that can lay claim to being a worthwhile, if modest addition to knowledge …" (p. 16) and so elaborates on the research question/s guiding the study. Case study research can be contained by clearly defining the sample, as well as identifying the breadth and depth of the study. The end-product of the research is a bounded system/s, and as previously discussed, this means that explicit statements are made about the focus and extent of the research being undertaken. (Creswell, 2009; Merriam, 1998; Merriam, 2010; Stake, 1995, 2000; Yin, 2002, 2014).

Case study research is also considered to place emphasis on the use of multiple sources of data as well as multiple experiences. Researchers such as Creswell and Poth (2018), Rowley (2002) and Yin (2014) and recognise that one of the unique strengths of case studies is the ability to collect and use evidence from numerous sources to corroborate the findings. My case study research facilitated the examination of a phenomenon within its context, using a variety of methods to gather rich and meaningful data. “This ensures the issue is not explored through one lens, but rather a variety of lenses which allows for multiple facets of the phenomenon to be revealed and understood” (Baxter & Jack, 2008, p. 544). Therefore, a range of tools appropriate for my research study were selected (a questionnaire, in-depth semi-structured interviews and a collection of artefacts such as school ICT policies, eLearning plans, My School website data, school website data and information about technical infrastructure of schools) to be used to construct an understanding to address the research question/s in my study.

Appropriately, my research study is conducive to case study methodology as it was necessary to examine in detail what was happening in a smaller number of cases, (i.e. teacher mentors) to obtain a depth of understanding of the domains of knowledge needed to support pre-service teachers to use ICT in teaching practicums. In relation to my research study, there are very large numbers of teacher mentors and so theoretically there is an enormous number of people who could be interviewed; this example is a “… sample is without boundaries” (Merriam, 2010, p. 456). However, the sample in my research study is contained by those teacher mentors from government and Catholic schools in the North Western Metropolitan region of Melbourne, Australia who work with pre-service teachers from RMIT University.

Therefore, incorporating case study methodology into my research study seemed most appropriate due to it being a flexible approach that is beneficial to gathering in-depth portrayals of real-life events using multiple sources of data. It also enabled me to conduct an empirical inquiry that examined a phenomenon within its real-life context.

3.2.2. Decision to use Yin's (2003, 2014) approach

I decided the approach for my case study methodology was best characterised by the work of Yin (2003, 2014), that is Yin's case study methodology reflects features that I believed were central to addressing my research question/s. As stated earlier, Yin (2003, 2014) emphasises that case studies can be used to explore, explain or describe phenomena or events in commonplace settings in which they arise, and this was the approach that I wished to take to address my research question/s. Harrison, Birks, Franklin, and Mills (2017) affirms that "[p]recision, process, and practicality …" are fundamental qualities of Yin's approach to case study; in particular, they highlight that the features of design are "… sequentially structured and motivated by empirical appreciation" (p. 10).

Like Yin (2003, 2014), my research study highlighted the empirical nature of research and the significance of context to the case. I had little control over the phenomenon and context in my research study, and therefore, Yin's approach was considered the best to address my research question/s. The discussion of Yin (2002, 2014) regarding the collection and analysis of data is also much more structured and systematic than reflective in its approach. Yin (2003) advocates a well-organised design for case study method, with a "… logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions" (p. 20). He advocates six interconnected steps in the process (plan; design; prepare; collect; analyse; and share) and this was the approach I believed I needed to undertake to address the research question/s.

I also decided to collect, analyse and mix both qualitative and quantitative data, using a questionnaire, semi-structured interviews and collection of artefacts. Therefore, because I planned to use both quantitative and qualitative sources of data, I decided that using Yin's (2003, 2014) approach to case study research was most appropriate because he advocates for the use of both quantitative and qualitative data collection in case study research. Thus, in order to undertake rigorous research regarding the knowledge of teacher mentors to support pre-service teachers to use ICT in teaching practicums, consideration was given to the prerequisite for a systematic framework to collect, interpret and integrate data from multiple data sources across the two phases of this study.

I now turn to the specific details of my approach to case study research. I discuss how it followed guidelines that are based on the six interdependent stages of Yin's (2003, 2014) case study process, and also additional principles from the broader methodological literature.

3.3. Mixed methods case study design

According to Creswell (2009), a mixed methods case study design uses at least one of these three basic designs, (i.e. sequential explanatory; sequential exploratory; or convergent) within the framework of a single- or multiple-case study design. In my research study, I used a sequential explanatory approach of a multiple-case holistic design (Yin, 2003, 2014). The purpose of a mixed methods case study design "… is to develop or generate cases based on both quantitative and qualitative results and their integration" (Creswell & Creswell, 2018, p. 230).

An explanatory study attempts to explain an event, act or characteristic being investigated in the research study. I researched one unique environment (government and Catholic schools used for teaching practicums in one region, i.e. North Western Metropolitan region of Melbourne, Australia) and investigated the practice of teacher mentoring to support pre-service teachers to use ICT in teaching practicums. The multiple-case holistic design was relevant for providing a larger depiction of a complex picture and enabled me to study multiple cases to understand the similarities and differences between the cases to address the research question/s. Yin (2003) claims that evidence from multiple-case designs is more convincing and therefore the research study is considered to be more robust.

There are variations to this research design, depending on whether the researcher identifies the cases before or during the research study. These two alternatives are referred to as a deductive or an inductive approach. I identified the cases during the research study and recorded similarities and differences in each case through the quantitative and qualitative data I collected – this is therefore referred to an inductive approach (Creswell & Creswell, 2018). The challenge for me was to identify the cases during the research study.

Another challenge was to understand case study research and effectively intersect case study design with a mixed methods approach. The type of basic design embedded within a mixed methods approach can vary. As mentioned, I used a sequential explanatory mixed methods approach to gather quantitative data from the questionnaire, which then informed the selection of participants to be interviewed. That is, analysis of quantitative data produced results that were used to identify specific themes (or phenomena) that I then used to select the participants to be interviewed. I then collected qualitative data from the interviews with the participants and analysis of artefacts from the participant's schools to enable me to explore the phenomena in more detail. This information was written up as cases to represent different profiles found in the datasets and were examined in a cross-case comparison (see Figure 8).

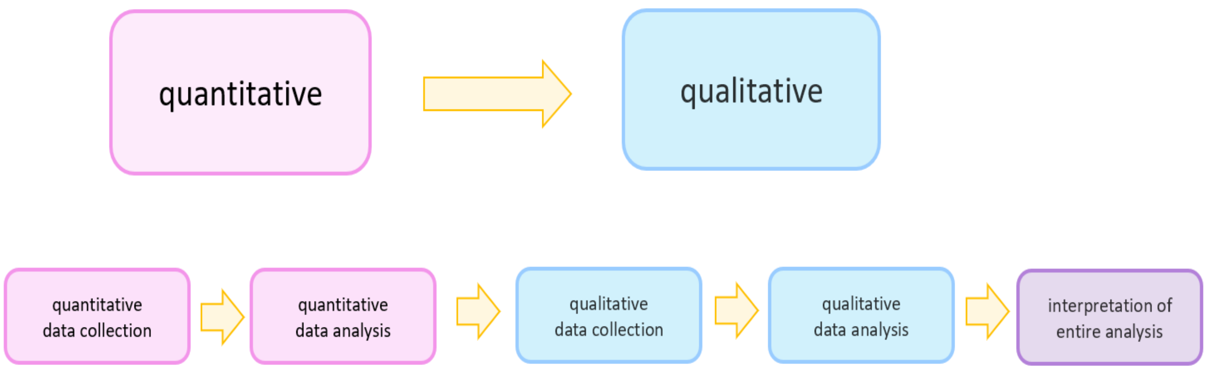

Figure 8: Sequential explanatory mixed methods case study design

3.3.1. Case study designs

As a case study can be a single- or multiple-case study (Creswell, 2009; Yin, 2003, 2014), I needed to consider which one would be best for understanding the phenomenon in my research study. Yin (2014) identified five rationales for a single-case design: “critical”; “unusual”; “common”; “revelatory”; or “longitudinal” (pp. 52-53) cases, where it is appropriate when the case is a single unit of analysis. Concerns about the validity of a single-case are countered by Yin (2013) who asserts that it is essential to be upfront that the purpose of a case is to expand and generate, but not to prove theory; it is about “analytic generalization” rather than statistical generalisation, as the role of the case study is for explanatory purposes. “[T]he analytic generalization should aim to apply to other concrete situations and not just to contribute to abstract theory building” (Yin, 2013, p. 325). Subsequently, the analytic generalisation should explain the “how” or “why” of the phenomenon being studied (Yin, 2003, 2014). This is supported by Stake (1995, 2000), who states that it is possible to achieve typicality and representativeness from one case and he maintains that the main purpose of a single case study is to maximise the opportunity of the researcher to learn from the case. “We do not study a case primarily to understand other cases. Our first obligation is to understand this one case” (Stake, 1995, p. 4).

A multiple-case study, on the other hand, is organised around two or more cases within the same study. Each case is selected so they either replicate each other to either forecast similar results, referred to as “literal replication”, or opposing results for foreseeable reasons, referred to as “theoretical replication” (Yin, 2003). That is, literal replication in cases is where they are designed to corroborate each other, and theoretical replication in cases is where they are designed to produce different, contradictory results. A multiple-case study enables the researcher to analyse the data within each context and across different contexts, which is not the situation when a single-case study is selected. Also, according to Yin (2014), “most multiple-case designs are likely to be stronger than single-case designs” (p. 24). Multiple-case design is relevant for providing a bigger picture of a complex phenomenon. However, Stake (1995) cautions that the representation of a small sample, even if it is a multiple-case study, is “difficult to defend” (p. 5). Yet Stake (1995) does counter this with Yin (2002) to assert that if a multiple-case study is used then the opportunity for generalisations increases.

The researcher needs to choose whether to study the entire case, that is a holistic design, or multiple sub-units within the case, that is an embedded design. Creswell and Poth (2018) claim that the holistic design depicts a complete case better than the embedded design, although it may be more abstract. However, although the embedded design commences with a scrutiny of sub-units, Creswell and Poth (2018) also state that it allows for the “detailed perspective”, should the questioning change during the field work.

3.3.2. Multiple-case design

I researched a multiple-case study as I considered it judicious for the understanding of the phenomenon being researched because the data I collected could be analysed within each case and across the cases, including different school contexts. Stake (1995, 2000) highlights that multiple-case studies enable the researcher to understand similarities and differences between each. I investigated four teacher mentors to present an explanation of the “how” and “why” (Creswell & Poth, 2018) in relation to the research question/s. The decision to select four teacher mentors was based on applying a set of three pre-determined selection criteria: type of classes taught (i.e. primary versus secondary classes); sex; and if they had undertaken mentoring training or not – this decision is discussed in more detailed later in this chapter, under the heading ‘5.1.1.Purposeful selection of each case’. As mentioned, I also decided to study the entire case, i.e. a holistic design. This involved reporting multiple perspectives and explaining the complex interactions of factors that influence the issues related to the research question/s, thereby creating a larger picture of the issues.

3.4. Validity and reliability

Validity refers to the credibility of the research and relates to how sound the research is and how solid the claims are, that is the amount of relevant information provided by the data – it applies to both the design and the methods of the research. Reliability refers to trustworthiness of the research, that is the accuracy of the data gathered.

Validity and reliability in research are considered to be essential in regard to the ability to verify outcomes of the research, (i.e. providing the correct responses) and the ability to replicate the research design, (i.e. providing the same responses). Yin (2013) declares that when conducting case study research, researchers need "… to continue to confront the challenge of strengthening validity" (p. 324). Yin (2003, 2014) presents four criteria for judging the quality of research designs, and identifies them as construct validity; internal validity; external validity; and reliability. I will discuss each of these criteria in the following paragraphs and provide examples of tactics that I used to judge the quality of my research design.

3.4.1. Construct, internal and external validity

Construct validity refers to the extent to which interpretations can be made from the research study – in other words, the research study reports what it claims to be measuring. Construct validity relates to the collection of data. To guarantee construct validity of my research study, I used triangulation of multiple sources of evidence as well as member checking.

Internal validity refers to the degree to which conclusions drawn from the research study are acceptable. Internal validity relates to the data analysis. I used pattern matching to ensure internal validity in my research study.

External validity refers to the degree to which the results of a research study can be generalised to other circumstances or other individuals. External validity relates to the research design. I used replication logic in multiple-case studies as a strategy for external validity, that is “[i]f two or more cases …[were] shown to support the same theory, replication … [was] claimed” (Rowley, 2002, p. 20). Generalisations are therefore based on repetition, and so are analytical, not statistical, in nature.

3.4.2. Case study protocols and reliability

I used a case study protocol during data collection to ensure reliability. A case study protocol refers to a set of detailed guidelines that keep the case study focused. The protocols are an important element of the case study research design and comprise the methods for undertaking the research: the research instruments themselves; and the strategies for data analysis. Examples of a case study protocol include a synopsis of the case study research; fieldwork procedures including ethical considerations; instruments for questioning; and a proposal for how to write up the case study report. Having a case study protocol meant that I was required to consider all issues pertinent to my research study and this provided a more rigorous research study. I was able to “… maintain a chain of evidence” (Rowley, 2002, p. 23) and clearly identify the datasets used in the research study and make appropriate citations of interviews and artefacts. I based the development of the case study protocol on the case study research approach of Yin (2003), using the six interconnected steps, discussed earlier in this chapter under the heading ‘3.2.2. Decision to use Yin’s (2003, 2014) approach’, to guide the data collection; I deemed this approach necessary to address the research question/s. According to Yin (2003, 2014), it is fundamental to “make as many steps as operational as possible” (p. 49) to increase reliability, so my research study was conducted “… as if someone [was] looking over … [my] shoulder” (p. 49).

3.4.3. Triangulation

Triangulation is one type of strategy that a researcher can incorporate into a research study to improve its validity and objectivity. Stake (1995, 2000) recognises triangulation as a strategy to ensure that case study research is not a matter of common sense, but rather based on a disciplined approach. Similarly, Flick (2011) refers to triangulation in educational research as taking “different perspectives on an issue you study or in answering your research questions” (p. 186). Also, Chilisa and Kawulich (2012) maintain that “[o]bjectivity can … be achieved by using multiple measures and observations and triangulating the data to gain a clearer understanding of what is happening in reality” (p. 55). There are at least four types of triangulation: data source (or data) triangulation; analyst triangulation; theory/perspective triangulation; and methods triangulation (Patton, 2002). Yin (2013) asserts that of the four types of triangulation, data triangulation and methods triangulation are most likely to “strengthen the validity” of case study research. Therefore, I used these two types of triangulation in my research study.

3.4.3.1. Data triangulation

Data triangulation refers to collecting data using the same method but from different sources. It refers to combining different sources of data on the same topic and examining consistency between the findings, according to different points of time and places and from different individuals (Farquhar & Michels, 2016; Zohrabi, 2013). Obtaining the same results from different data sources can provide reassurance to the researchers that the data is valid. Creswell and Creswell (2018) affirm the importance to “[t]riangulate different data sources by examining evidence from the sources and using it to build a coherent justification for them” (p. 200). Zohrabi (2013) also emphasises that “collecting varied types of information through different sources can enhance the reliability of the data and the results … [and] the replication of the study can be carried out fairly easily” (p. 259).

3.4.3.2. Methods triangulation

Methods triangulation refers to examining the consistency of findings between different methods of data collection to assure the validity and reliability of the research study. The use of multiple sources of data collection serves the purpose of triangulation (Denzin, 1989; Flick, 2018; Mertens, 2015; Morse, 1991; Williamson, 2005; Zohrabi, 2013). This is conducive to mixed methods research where there is both quantitative and qualitative data used in the research study, and so triangulation occurs when the findings from both quantitative and qualitative data are compared. As Zohrabi (2013) asserts "through triangulation we gain qualitative and quantitative data in order to corroborate our findings …" (p. 258). Zohrabi (2013) also highlights that "[i]n order to triangulate the data, the researchers can obtain information through different procedures to heighten the dependability and trustworthiness of the … [data] and their interpretation" (p. 254).

Consequently, using a mixed methods approach strengthens a research study as the use of more than one method of data collection enables the researcher to triangulate and corroborate evidence from different sources to provide better understanding of the phenomenon being examined. The intention of using mixed methods research is "… to obtain different but complementary data on the same topic" (Morse, 1991, p. 122) in order to best comprehend the research question/s. Therefore, methods triangulation refers to taking different perspectives on a phenomenon being studied, and these perspectives can be validated through using different data collection methods or combining different types of data. As Flick (2011) simply states "… [methods] triangulation means to view a research issue from at least two vantage points" (p. 186). Moore (2000) also maintains that the combination of research methods enables the researcher to provide a number of different views on an issue that not only adds both "breadth and depth" to their research but also triangulates the data.

3.4.3.3. Triangulating my research

As discussed, collecting information through different sources and using different methods can allow for the triangulation of the data and assist with achieving objectivity through enhancing the validity of the research data and findings and reliability of the results (Creswell & Creswell, 2018; Mertens, 2015; Morse, 1991; Yin, 2013; Zohrabi, 2013). Dhanapati (2016) also champions the use of triangulation techniques to assist with trustworthiness of a research study. In my research study, I used both data triangulation and methods triangulation to strengthen its reliability and validity. This is corroborated by Zohrabi (2013) who asserts that "[g]athering data through one technique can be questionable, biased and weak. However, collecting information from a variety of sources and with a variety of techniques can confirm findings" (p. 258). I used a questionnaire to gather information from different sources (different teacher mentors from different schools) for data triangulation. I also used more than one method to collect data on the same phenomenon being studied (experiences of mentoring pre-service teachers in the North Western Metropolitan region of Melbourne, Australia) and so undertook methods triangulation. Accordingly, a mixed methods approach, which includes using both quantitative and qualitative data – in my research study, it was a sequential explanatory research design– lends itself well to methods triangulation. I used a questionnaire, semi-structured interviews and analysis of artefacts to corroborate evidence "… to shed light on a theme or perspective" (Creswell & Poth, 2018, p. 260). The logic of triangulation meant I checked qualitative findings against quantitative results (Flick, 2011). So, by adopting a mixed methods case study design, I used a variety of sources of data and methods of data collection to enhance the integrity of the research study.

I will now examine details of the decisions made in relation to the data collection and data analysis in the ensuing sections of this chapter, including sampling strategies and reasons for sampling size. In particular, I focus on my decision to use the purposeful sampling strategy using criterion sampling (Patton, 2002).

3.5. Selection of research setting and participants

As mentioned previously, this study was conducted in the North Western Metropolitan region of Melbourne, Australia, specifically with teacher mentors situated in government and Catholic schools located in the northern eastern area (see Appendix A). RMIT University offered the Master of Teaching Practice (Primary Education) and Master of Teaching Practice (Secondary Education) in 2018, so I approached the principals of the 14 schools involved intaking pre-service teachers in these two programs. I asked the 14 principals to forward an email to teacher mentors who had mentored a RMIT pre-service teacher previously, requesting their participation in the study (see Appendix B). Of the 14 schools approached, principals were requested to forward the email about this research study to 105 teacher mentors. Fifty teacher mentors from six schools responded to the request to complete the questionnaire.

In accordance with the ethics requirements, I had constructed a Participant Information and Consent Form (PICF) to introduce myself, the research and the purpose of the study to the principals and teacher mentors involved in the research and to obtain their consent to be part of the research (see Appendix C). The information provided in the email to the teacher mentors clearly stipulated that there was no obligation for them to participate in this study. This was because the email was being forwarded by the principal so there may have been implicit undue expectations placed on the teacher mentors that they needed to participate. The text in the email invited teacher mentors from the schools to participate in the questionnaire and volunteer to be interviewed. The email stated clearly that participants could withdraw from the research study at any stage (see Appendix B). In addition, the email clearly stated there was no obligation to participate in the research study. The PICF was attached with the email to principals to forward to teacher mentors (see Appendix C).

As mentioned, responses to the questionnaire (see Appendix D for sample questions) were gathered from a sample size of 50 teacher mentors from six schools. A sample size is the count of individual samples in a statistical setting and so is an important feature to any empirical study. By selecting a sample size of 50 participants to complete the questionnaire, I was able to make inferences about the sample of the population of teacher mentors in the Northern Western Metropolitan region of Melbourne. The sample size was calculated by using the population size, confidence interval and confidence level (Curtis & Curtis, 2011; Denscombe, 2014, 2017). The population size of the number of teacher mentors in the 14 schools that offered the RMIT Master of Teaching Practice programs in North Western Region of Melbourne was estimated to be 105 teacher mentors. The confidence interval, or margin of error, was decided to be 10%, and confidence level was 95%. Applying these defined values, I used the Australian Bureau of Statistic online sample size calculator to determine the sample size for my research study to be 50 (Australian Bureau of Statistics, 2018). According to Hogg, Tanis, and Zimmerman (2015), a sample size of "greater than 25 or 30" is desirable to make inferences about the sample of the population group. The sample size of 50 was useful for gathering information for my research study as it was considered statistically sufficient (Hogg et al., 2015) and efficient to assist with identifying and examining contextual factors in regard to the main research question and the four research sub-questions.

I then purposefully selected four teacher mentors to be interviewed. As each teacher mentor had completed the questionnaire, I was able to identify those teacher mentors who had volunteered to be interviewed and used three factors of interest (i.e. type of classes taught; sex; and if mentoring training had been undertaken) to purposefully select the teacher mentors to participate in the interviews in order to gather a more detailed understanding of the research question and research sub-questions. That is, from those who volunteered to be interviewed, I initially identified those who taught primary classes and those who taught secondary classes; then I identified male and female teacher mentors from those who taught primary and secondary classes and then I identified those who had undertaken mentor training versus those who had not undertaken mentor training. Of the 18 teacher mentors who indicated that they would like to participate in the semi-structured interviews, I would have preferred to select to interview teacher mentors based on being representative of the teaching profession, yet this did not turn out to be the situation due to the small sample size of those teacher mentors who volunteered to be interviewed. This is discussed further in Chapter 5 'Qualitative interview findings'.

Therefore, the questionnaire was initially used as a far-reaching survey instrument so that I was able to generalise results to the group of teacher mentors being studied, and then the qualitative, open-ended semi-structured interviews were used to collect more thorough, in-depth views from participants in order to assist with explaining the initial quantitative data. I also gathered and analysed artefacts from each of the schools of the four teacher mentors who were interviewed to assist with explaining the quantitative data (see Appendix F for list of artefacts collected from each teacher mentor/school for analysis).

3.5.1. Purposeful sampling

Sampling is the process of selecting research participants relevant to the study and the research question/s under investigation. Research participants are often a subset from a larger group. Selecting RMIT University teaching practicum schools was a form of purposeful sampling (Patton, 2002). Purposeful (also known as purposive, judgmental, selective or subjective) sampling is a technique often used in qualitative research for the identification and selection of cases that will provide rich information for an in-depth study of the phenomenon of interest (Creswell & Plano Clark, 2007; Patton, 2002). This sampling method is intended to maximise efficiency by making the most effective use of limited resources (Patton, 2002). The participants in the research study were purposefully selected because the sample was chosen specifically for their unique characteristics and experiences, i.e. type of classes taught; sex; and whether mentor training was undertaken or not. As mentioned, I considered that each of the teacher mentors selected to be interviewed would be able to provide insightful, worthy data that addressed the research question/s. "Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term purposeful sampling" (Patton, 2002, p. 46). This type of sampling was advantageous to me as it enabled me to quickly reach a targeted sample of teacher mentors within these schools that were especially knowledgeable about the phenomenon of interest; I was able to set boundaries to define my cases and also create a frame to help me "uncover, confirm or qualify" the constructs of my research study (Miles & Huberman, 1994).

There are numerous purposeful sampling designs and "[t]here are several different strategies for purposefully selecting information-rich cases. The logic of each strategy serves a particular purpose" (Patton, 2002, p. 230). For my research study, there was an emphasis on similarity in relation to the selection of the teacher mentors, so "criterion sampling" (Patton, 2002) was chosen as a selection strategy. The intention of criterion sampling is to be certain to understand cases that are likely to be information-rich for the purposes of the research study (Creswell & Plano Clark, 2011). The reason I selected criterion sampling was that I planned to review and study teacher mentors in schools that met "some predetermined criterion of importance" (Patton, 2002), that is all cases selected were teacher mentors who were based in North Western Metropolitan region of Melbourne, Australia and had mentored a pre-service teacher previously. I was able to select multiple cases using certain pre-determined criterion characteristics for detailed qualitative analysis. According to Patton (2002) this is "a strategy common in quality assurance efforts" (p. 238). Miles and Huberman (1994) emphasises that multiple-case sampling improves confidence to the research study by reinforcing "… the precision, the validity and the stability of the findings" (p. 29). Yin (2003) refers to findings from multiple cases as "replications" to obtain support for emerging theory in a number of single cases within a multiple-case design; this approach is further accentuated by Eisenhardt and Graebner (2007) who assert that "each case serves as a distinct experiment that stands on its own as an analytical unit" (p. 25). That is, each case in a multiple-case design is examined individually rather than as a collective.

Although I selected teacher mentors from government and Catholic schools in the North Western Metropolitan region of Melbourne, Australia to be interviewed, I opted for maximum variability in the sample in terms of type of classes taught, sex, and whether they had undertaken mentor training or not. Nevertheless, case selection was ultimately limited to those who volunteered to participate in the interview. Albeit, this sampling frame for phase two of my research study enabled me to analyse the data and gain an understanding from different perspectives, as well as to confirm information by using more than one method of data collection (methods triangulation).

3.5.2. Sample size

As highlighted earlier, I conducted a sequential explanatory mixed methods approach, and one of its challenges is the unequal sample sizes for the quantitative and qualitative approaches to the study (Creswell & Creswell, 2018). Although there are no hard and fast rules about what is a suitable sample size for quantitative and qualitative research, "[p]erhaps nothing better captures the difference between quantitative and qualitative methods than the different logics that undergird sampling approaches" (Patton, 2002, p. 230). According to Patton (1990), "[n]ot only are the techniques for sampling different, but the very logic of each approach is unique because the purpose of each strategy is different" (p. 230). Quantitative research tends to use larger samples that are selected randomly and comply with statistical analysis requirements while qualitative research typically focuses on 'small' sample sizes, sometimes even single cases, which are purposefully selected.

I believed that the sample size of my research study, (i.e. 50 responses to the questionnaire and four interviews of teacher mentors and artefact analysis of the schools of the teacher mentors who were interviewed) was appropriate for me to gather detailed information to address the research question/s. "The validity, meaningfulness, and insights generated from qualitative inquiry have more to do with the information-richness of the cases selected and the observational/analytical capabilities of the researcher than with sample size" (Patton, 2002, p. 245). I considered that the small number of teacher mentors selected for my research study would provide comprehensive information to address the research question/s. The small sample size should only be judged according to the purpose and rationale of the purpose of the research study (Patton, 2002). In my research study, the main research question was 'What knowledge do teacher mentors need to support pre-service teachers to use ICT in teaching practicums?' and I considered that the purposeful sampling strategy supported attaining in-depth data from information-rich cases.

However, due to the small sample size, the results of my research study cannot readily be generalised to a larger teacher mentor cohort. Generalisability relies on the readers being able to see similarity to other situations from the information-rich descriptions provided in the research study. Yet, despite the limitations of a small sample size, the results are valuable because they provide useful insights in relation to the phenomenon under investigation. Patton (2002) asserts that there are no rules for sample size in qualitative research as it "… depends on what you want to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can be done with available time and resources" (p. 244). The results from this research study were also beneficial because it added new knowledge to the field of teacher education, teaching mentoring and ICT uptake in the classroom. In addition, the findings and interpretation of data were useful for further research.

I will now unpack my approach to the collection and analysis of data. I will discuss the factors that I took into consideration when collecting the data, and also discuss the data collection methods I used. Correspondingly, I will provide an overview of the advantages and disadvantages of each method and an explanation of why I selected each.

3.6. Data collection and analysis

I gathered data about each school settings from the My School website https://www.myschool.edu.au/ (ACARA, 2019a). Each of the schools where the teacher mentors taught was different in terms of student enrolments and Index of Community Socio-educational Advantage. The Index of Community Socio-educational Advantage is a scale that represents levels of educational advantage of all schools in Australia. It provides an indication of the socio-educational backgrounds of the students of the schools (based on parents' occupation and education, the school's geographical location and proportion of indigenous students). “The higher the … value, the higher the level of educational advantage of students who go to the school” (ACARA, 2019b).

3.6.1. Factors considered when collecting data

There are often numerous factors that need to be considered concerning the collection and analysis of data when using a mixed methods approach. These factors include “timing” (Creswell, 2009; Creswell & Plano Clark, 2007); “weight given to quantitative and qualitative research of a particular study” (Creswell, 2009, p. 206); “levels of interaction” (Creswell & Plano Clark, 2007) or mixing (or combining) of the data; and “functions of the research study” (Teddlie & Tashakkori, 2003).

The timing of collection and analysis of data refers to when the different types of datasets (quantitative and qualitative) are collected and analysed. This determines when data collection occurs and the type of triangulation. The data for this research study was collected sequentially – the data gathered by the questionnaire was analysed to inform the selection of participants to be interviewed, and subsequently the analysis of artefacts from their schools, and then both datasets were interpreted together. As discussed, this meant methods triangulation occurred with the collection and analysis of data.

“Priority” (Creswell & Plano Clark, 2007) refers to the “weighting” (Creswell, 2009), or emphasis given to the quantitative and qualitative research, that is the research could be more concerned with quantitative data than qualitative data; or the research could be more concerned with qualitative data than quantitative data; or quantitative data has the same status as qualitative data. Decisions regarding weighting occur at both the data collection and data analysis stages of the research design. Teddlie and Tashakkori (2003) refer to this as “priority of methodological approach” (p. 141). In my research study, data from the questionnaire related to research sub-question 1 and data from the interviews and analysis of artefacts related to research sub-questions 2–4. Equal status was given to each data set as understanding of the research question/s was improved by mixing both datasets. In addition, the limitations of one type of data were balanced by the strengths of the other. Therefore, quantitative and qualitative data were considered to be of the same importance and weighted equally in my research study.

The level of mixing of the data refers to the reliance on the quantitative and qualitative data. In my research study, the collection of the quantitative and qualitative data was dependent upon one another and collected in sequence but their analysis was undertaken separately. Using both data sets added breadth and depth to my research study.

The purpose for the mixing of my research approach was to use different types of data to corroborate and complement the analysis of my research question/s in order to identify the knowledge that teacher mentors needed to support pre-service teachers to use ICT in teaching practicums. "When" the mixing occurs might be at several stages in the research study, that is mixing may occur at the following stages: data collection; data analysis; interpretation; or at all three phases (Creswell, 2009). In my research study, I mixed the data at the analysis and interpretation stages. "How" I mixed the research data refers to whether the quantitative and qualitative data were "… merged at one end of the continuum, kept separate on the other end of the continuum, or combined in some way between these two extremes" (Creswell, 2009, p. 208). In my research study, I kept the two types of data separated but connected, that is I began with collecting and analysing quantitative data and its results were used to identify the teacher mentors, and subsequently their schools, for qualitative data collection in the second phase of my research study. According to Creswell (2009), "[c]onnected in mixed methods research means a mixing of the quantitative and qualitative research are connected between a data analysis of the first phase of research and data collection of the second phase of research" (p. 208). Therefore, even though the quantitative and qualitative data were collected in sequence and analysed separately, they were connected (or mixed) during the two phases of my research study because the collection of data was dependent upon each other. Correspondingly, both datasets were connected as they were mixed together at the interpretation stage in my research study.

The purpose of my research study was stated in the main research question and specifically spelt out in the research sub-questions. I used specific verbs to elicit the "how' and "why" questions to obtain a deep understanding of the knowledge needed by teacher mentors to support pre-service teachers to use ICT in teaching practicums. As identified earlier in this chapter, the data-gathering methods used to address my research study were a questionnaire, semi-structured interview questions and collection of artefacts.

3.6.2. Questionnaires

My discussion of data-gathering methods commences with the questionnaire. Zohrabi (2013) asserts that questionnaires are considered to have many advantages, such as being an efficient way to collect data on a larger scale in terms of time and cost: they can be sent to a considerable number of people at the same time and the researcher can gather data more easily in the field. Also, the anonymity of respondents enables them to more readily share information. The questionnaire was also selected as it helped to reduce my influence on the research study as the closed-ended questions enabled participants to have an "emic perspective", that is from the perspective of the participant rather than from the researcher (Creswell & Poth, 2018; Williamson, 2002a). Mertens (2015) also supports that researcher bias is minimised when questionnaires are able to be completed anonymously. In addition, another advantage of questionnaires is that individuals can complete them without supervision of the researcher, and so are useful for gathering data on non-contentious and comparatively uncomplicated topics (Moore, 2000). Likewise closed-ended questionnaires can be more efficient because of their straightforwardness in terms of analysis of data (Zohrabi, 2013).

However, both Zohrabi (2013) and Moore (2000) highlight disadvantages of using questionnaires, concluding that there can be a low rate of return, especially if using post or email, and the wording of questions may result in inaccurate or unrelated responses, particularly closed-ended questions that may not allow participants to give more details.

Despite these limitations, the advantages of questionnaires make them a useful tool to use for research. “Questionnaires are doubtless one of the primary sources of obtaining data in any research endeavor … As a matter of fact, closed-end questionnaires provided the inquirer with quantitative or numerical data” (Zohrabi, 2013, p. 254).

Teacher mentors in my research study were approached (via an email to principals), to complete a questionnaire that consisted of closed-ended questions (see Appendix D). The questionnaire had three sections: Section 1, which asked questions about the demographics of the teacher mentors including their age range, sex, type of classes taught, and years of teaching experience; Section 2 asked questions about previous experience of mentoring and any mentoring training undertaken; Section 3 asked questions about how comfortable the participant was with using ICT in their teaching practice, their beliefs about the importance of ICT for teaching, and about the digital tools that they used. The responses were collected via Google Form (Google, 2019a). Fifty responses were collected in my research study. Identification of individuals by the demographic data provided in the questionnaire was considered very unlikely. No names were recorded on the questionnaire, unless participants wished to provide their name so they could participate in the interviews.

3.6.2.1. Chi-square tests

A chi-square test (also referred to as a Pearson chi-square test, or just ‘chi-square’) was used to determine if there was a relationship between two variables in my questionnaire data. A chi-square test is a type of nonparametric test as it “makes no assumptions about population parameters or population characteristics for its use” (Grimm & Nesselroade, 2019, p. 636). A nonparametric test, such as a chi-square test, was required because my data was based on a nominal (or ordinal) scale. Data collected from the questionnaire was used to label (or categorise) variables without providing any quantitative value; the data was counted and divided into categories, including type of classes taught; sex; and type of schools, and so was not ordered or put into some type of quantitative scale, as the case for parametric or continuous data. Therefore, by using nominal data, I did not assume that the sampling distribution was normally distributed. In other words, it was not expected that "… the probability distribution of a random variable that is known to have certain properties … [would be] perfectly symmetrical (has a skew of 0), and … [have] a kurtosis of 0" (Field, 2013, p. 880). A chi-square test consequently does not use means or standard deviations to infer population parameters because no assumptions are made about the shape of a population distribution. As Urdan (2010) pertinently claims these "[p]opulations are sometimes skewed rather than normal" (p. 161). So, a chi-square test is a distribution-free tool designed to analyse differences in populations when the dependent variable is measured on a nominal scale.

A chi-square test is used to evaluate three kinds of comparison: goodness of fit; homogeneity; and independence (Field, 2013; Franke, Ho, & Christie, 2012; Grimm & Nesselroade, 2019). In my research study, I used the chi-square test to determine if there was a relationship between two categorical variables, and this is referred to explicitly as the chi-square test for association (or the chi-square test for independence) (Curtis & Youngquist, 2013). The chi-square test for association is intended to determine how probable it is that an observed distribution is due to chance. It reports on the association between the observed counts (frequencies) and expected counts in the two categories. Specifically, this chi-square test compares the observed count of responses to that of the expected count of responses to assess if the two variables are truly independent of each other. This chi-square test enables the researcher to determine whether the observed counts are significantly different to the expected counts, and therefore evaluates how probable the observations that are made would be, assuming the null hypothesis is true. A null hypothesis states that the prediction is incorrect and the predicted effect is non-existent (Field, 2013; Franke et al., 2012; Garner, 2005; Grimm & Nesselroade, 2019; McHugh, 2013; Urdan, 2010) because there is no difference between expected and observed frequency distributions. In other words, there is no relationship between the two variables being tested.

The purpose of the chi-square test for association is therefore to attempt to reject the null hypothesis that the data are independent. When I rejected a null hypothesis with a chi-square test, I was stating that there is a relationship between the two variables (Field, 2013; Franke et al., 2012; Garner, 2005; Grimm & Nesselroade, 2019; McHugh, 2013; Urdan, 2010).

The formula for a chi-square test (for goodness of fit; homogeneity; and association) is $\chi 2 = \sum \frac{(O-E)^2}{E}$, where O is the observed (actual) count, E is the expected count ;and $\sum$ is the sum of all cells in the table (Curtis & Youngquist, 2013; Field, 2013; Garner, 2005; Grimm & Nesselroade, 2019; Urdan, 2010). There are numerous assumptions of the chi-square test, which include the expected cell frequencies to be of sufficient size; that the sample is representative of the population of interest; the variables under study are categorical and the data is in the form of a frequency count; and each observation is independent of every other observation (Field, 2013; Franke et al., 2012; Garner, 2005; Grimm & Nesselroade, 2019; McHugh, 2013).

Chi-square tests are considered to be quite powerful even though they are nonparametric (Grimm & Nesselroade, 2019), and so I decided to conduct these tests with my questionnaire data, using a statistical analysis software package called Minitab (Minitab, 2019). To conduct the chi-square tests for my research study, I created a series of null hypothesis related to how the teacher mentors responded to specific questionnaire items. This allowed me to test whether there was a relationship between two variables and determine if the null hypothesis was rejected or not. The alternative hypothesis assumes that there is an association between the two variables. Yet, while a chi-square test allowed me to test whether there was a relationship between two variables, it did not tell me the direction or the size of the relationship (Field, 2013; Franke et al., 2012; Grimm & Nesselroade, 2019; McHugh, 2013).

I used *p*-values to make conclusions in significance testing. The *p*-values, allied with the chi-square test, express the probability of obtaining an effect at least as extreme as the one in the sample data, assuming the truth of the null hypothesis (Curtis & Youngquist, 2013). The *p*-values were used to help determine if results were significant or not in hypothesis testing. The significance level refers to the probability of rejecting the null hypothesis when it is true. In hypothesis testing you are asking the two following questions: 'What do the results tell me about the population?' and 'What is the strength of these results?' Although any value between 0 and 1 can be used for significant levels, I chose significance levels equal to 0.05 because it indicates a 5% risk of concluding that a difference exists when there is no actual difference. Consequently in my research study, when a *p*-value was less than or equal to the significance level of 0.05, I rejected the null hypothesis (Field, 2013).

The number of degrees of freedom (DF) also needs to be calculated with chi-square tests. According to Field (2013), the DF is "an impossible thing to define in a few pages, let alone a few lines. Essentially it is the number of 'entities' that are free to vary when estimating some kind of statistical parameter" (p. 873). The DF is calculated by multiplying the number of rows minus 1 by the number of columns minus 1 (i.e. DF = [rows-1] x [columns-1]). Therefore, for a 2 x 2 table, the DF is 1 because (2-1) x (2-1) = 1. As Garner (2005) explains "[i]n a 2 x 2 table … we have only one 'degree of freedom' – we can 'freely' select only one entry for the cells, and then all the rest are forced" (p. 196). As soon as one of the four cells is filled, the remaining three cells in such a table "… are forced, so that they will add up to the marginals across and down" (Garner, 2005, p. 196). There is a different chi-square distribution curve for each DF; the DF provide information about the mean of the associated curve. Consequently, as the DF increases, the closer the chi-square distribution approaches a normal distribution (Davila & Lynda.com, 2016).

3.6.3. Interviews

I now discuss my decision-making regarding using the interview technique to further examine the research question/s. My review of the relevant research literature suggested that interviews are one of the most critical sources of data when researching information for case study research (Burns, 1997; Stake, 1995; Yin, 2014). This is because case studies are very often about people and their activities, and "[t]he interview is the main road to multiple realities" (Stake, 1995, p. 64). My research study explored teacher mentors' knowledge to support pre-service teachers to use ICT in teaching practicums, therefore I wanted to hear the voices of the teacher mentors. Burns (1997) contends that this type of research needs to be described and considered through those being interviewed and that the participants of the research study may offer further understandings and identify sources of other evidence. The purpose of qualitative research interviews is to describe and provide meanings of the main themes related to the research question/s. Patton (2002) states that qualitative interviews provide "the depth" of information, that is specific themes are focused upon, augmented and/or explored to obtain rich and detailed data, as opposed to "the breadth", which is provided by quantitative questionnaires. The responses from a large number of participants can be gathered but not necessarily with profoundness. Kvale (1996) pertinently refers to qualitative research interviews as a "construction site of knowledge" (p. 2), and so the chief outcome when conducting interviews is to comprehend the meaning of what the participants have articulated. Merriam (1998) supports this by stating that qualitative research interviewing "… reflects an ontological position that is concerned with people's knowledge, understandings, interpretations, experiences and interactions" (p. 1021).

The advantages of the interview technique include the following: it can provide in-depth information; it can allow probing by the interviewer; it is good for collecting data to gauge attitudes and most content of interest; it permits good interpretative validity; and is useful for exploration and confirmation (Zohrabi, 2013). In particular, the benefit of conducting face-to-face interviews is being able to observe and record non-verbal body language as well as verbal behaviour. Patton (2002) aptly highlights that rapport with the interviewee should be upheld while displaying impartiality or detachment with the content. Disadvantages of the interview technique include data analysis can be time-consuming for open-ended items; can be expensive; and perceived anonymity can be considered low by respondents (Zohrabi, 2013).

There are several different types of interview. “The decision to choose one over another depends on the purpose of the research, the type of data, phenomenon under study …” (Zohrabi, 2013, p. 256). Merriam (1998) contends that the choice of the type of interview rests on “determining the amount of structure required” (p. 72).

3.6.3.1. Decision to use semi-structured interviews

The type of interview I conducted consisted of semi-structured questions and is referred to as a semi-structured interview (Burns, 1997; Cooper & Schindler, 2014; Flick, 2011; Merriam, 1998; Williamson, 2002b), or an interview guide (Patton, 2002). The “flexible and fluid structure” of the semi-structured interview is one of its main features (Mason, 2011, p. 1021). There is flexibility in using this style of interview as I can modify, delete or add supplementary questions depending on the responses provided by the interviewees, in this case the teacher mentors. “This form of interview is neither too rigid nor too open. It is a moderate form in which a great amount of data can be elicited from the interviewee” (Zohrabi, 2013, p. 256). Mason (2011) also endorses these benefits by asserting that “[t]his is so that the interview can be shaped by the interviewee’s own understandings as well as the researcher’s interests, and unexpected themes can emerge” (p. 1021).

As previously identified, four teacher mentors were selected from those who volunteered (identifying themselves on one of the questions in the questionnaire) to participate in one interview, with the option to complete a follow-up interview if required. It was emphasised that completion of the questionnaire and agreeing to participate in the interviews was totally voluntary. For analysis purposes, a pseudonym was then recorded for both teacher mentors and their schools. The smaller sample size for those being interviewed was considered “a good option” (Creswell & Plano Clark, 2018) as the intent of this research study was to use qualitative data to complement the information from the quantitative data and “to select participants that … [could] best provide this detail” (Creswell & Plano Clark, 2007, p. 122). The sample size also enabled an extensive and rigorous examination of the research question and research sub-questions as its intent was not to generalise but rather to explain the phenomenon. I collected this data sequentially as I had a subset of qualitative participants who self-identified to be part of the interview. The interviews were designed to gather in-depth information about the main research question: “What knowledge do teacher mentors need to support pre-service teachers to use ICT during teaching practicums?” and the following research sub-questions:

1. What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?

2. What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?

3. What are the teachers’ beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?

4. What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?

The semi-structured interviews were completed with a relatively open framework and allowed for a focused, conversational and shared communication type approach. The structure of my semi-structured interview was organised around an interview guide that contained questions, written under themes pre-determined from the research literature and the questionnaire (see Appendix E). For example, I ensured I had questions related to knowledge about mentoring, content, pedagogy and technology, as these were the types of knowledge that I had identified from the research literature that I needed to examine. For instance, I asked participants to tell me 'What knowledge did you need to assist the pre-service teacher to develop a lesson sequence that incorporated ICT?' with prompts that included 'What specific knowledge such as content, pedagogy, technology and/or mentoring was used?' and 'Do you think these types of knowledge would be the same as those required to assist with development of a lesson sequence without incorporating ICT?' I also ensured that I had questions related to finding out more about the participants' understanding of the AITSL teacher standards for graduates (AITSL, 2018b), which was related to questions in the questionnaire, such as 'Are you aware of the Australian Professional Standards for Teachers?', with the following prompt 'How do you use the Australian Professional Standards for Teachers when you are mentoring a pre-service teacher?'

The open-ended interview questions enabled me to gather insights from the teacher mentors that related to their understandings, opinions, beliefs, values and thoughts about using ICT in the classroom. The semi-structured interview questions permitted me to collect rich, detailed data and so "… focus … on the depth" of understanding (Patton, 2002). In semi-structured interviews, there is an interaction between the researcher and the participants, and data is seen as being constructed from this interaction. It is not simply about the participants providing answers or the researcher being a sponge and soaking up the information, but rather there is active construction of knowledge by both the researcher and participant/s (Myers & Newman, 2007). Mason (2011) states that "the logic of semistructured interviewing is to generate data interactively" (p. 1021) as the semi-structured interview enables reciprocity between the participant and the researcher.

As highlighted, I followed a flexible interview guide regarding the questioning, that is I still had the flexibility to modify the wording or to use prompts, or change the order of the questions, in order to obtain more in-depth insights and data from the participants. My flexible interview guide provided opportunities for the information from the participants to be reiterated, or reasons for their responses to be expanded upon. Therefore, my interview guide was not a scripted set of standardised questions as the aim was to ensure flexibility in how questions were asked of each of the teacher mentors, and in the sequencing of questions that were asked; it also enabled me to determine if and how particular themes would be followed up with each participant. This meant I used pre-determined, open-ended questions, with probing questions to explore a response further, which I had spent time planning in terms of the questions and their order. I was able to include topical trajectories in the conversation when appropriate. For example, I ensured that I had probing questions to find out how much each participant knew about the AITSL teacher standards (AITSL, 2018b) as I wanted to determine if there was an understanding that ICT was explicitly stated in three of the teacher standards.

However, there are disadvantages to using semi-structured questions in that skills and time are required to analyse the data. The technique is time-consuming and resource-intensive in that each interview in my research study was undertaken individually and then transcribed. I also needed to ensure that I interviewed a sufficient number of teacher mentors in order to be confident about the patterns (or themes) drawn from the data as well as the credibility of my findings through data saturation (or satisfaction), that is I was satisfied that the sample size enabled adequate collection of data for a detailed analysis and would contribute to content validity (Fusch & Ness, 2015; Guest, Bunce, & Johnson, 2006; Moore, 2000; Morse, 1995).

These individual interviews of participants took between 30 and 40 minutes each (see Appendix E). According to Merriam (1998), the interview can be recorded in three ways (tape recorded; notes taken at the time; and/or notes taken immediately after the interview). I had specified in the consent form that I was also seeking permission for the interviews sessions to be digitally recorded to aid the researcher with constructing accurate transcripts for interpretation purposes. Therefore, I reminded participants who were selected to be interviewed that each session would be digitally recorded. In addition to digitally recording each interview, I wrote important points down during the interview process.

The interviews were held at a mutually suitable time and location. Informed consent from each of the participants was gathered and recorded as per RMIT University and National Health and Medical Research Council (NHMRC) ethical conduct in human research requirements (NHMRC, 2018). As mentioned, pseudonyms for the teachers participating in the interviews and their schools were used to protect the identity of the participants and schools.

Using semi-structured interview questions enabled "emic perspectives" (Creswell & Poth, 2018; Williamson, 2002a), or issues of those that belong to the teacher mentors, to emerge throughout the research. "These are issues from the inside …" (Stake, 1995, p. 20), and were fundamental to me hearing their voices and understanding their issues. This emic (or insider) perspective allowed me to get an understanding of the teacher mentors' points of view about the issues being explored. This approach to empower participants to enable their voices to be heard assisted with minimising the power relationship that often exists between the researcher and the participants (Creswell & Poth, 2018). So, I gathered data from the participants by recording their views as an emic perspective, and then I transcribed the data that I collected from each of the semi-structured interviews and reported some of this data in verbatim quotes.

3.6.3.2. Reaching data saturation

I now discuss data saturation, including describing the challenges with reaching it as well as my reasoning for believing I had reached data saturation. "Qualitative data … in the process of saturation, form patterns or themes and begin to make sense" (Morse, 1991, p. 147). Yet, data saturation is difficult to define (Fusch & Ness, 2015; Guest et al., 2006; Mason, 2010; Morse, 1995). However, it is agreed that data saturation occurs when there is "… no new information …" (Morse, 1995) or no new themes or codes that emerge (Guest et al., 2006).

Morse (1995) asserts that “[t]he tighter and more restrictive the sample and the narrower and more clearly delineated the domain, the faster saturation will be achieved” (p. 148). Nevertheless, there is no “one size fits all” approach to reach data saturation because each research design is different (Fusch & Ness, 2015).

With qualitative data collection, the frequency of a piece of data (or a code) is not particularly essential as “as one occurrence of the data is potentially as useful as many in understanding the process behind a topic … because qualitative research is concerned with meaning and not making generalised hypothesis statements” (Mason, 2010, para 1). The richness of the data is a result of the detailed description, rather than the number of times a theme is identified (Morse, 1995). So, frequency counts are not applicable to coding qualitative research (Mason, 2010; Morse, 1995).

Data saturation is therefore considered to be an “elastic concept” (Mason, 2010, para 60) as it is dependent upon the researcher, and how and when the researcher defines themes and ultimately how the researcher plans to present their data. I believed that data saturation had been achieved with the selection of the four teacher mentors for my research study because no new themes were emerging from the analysis of interview data. According to Guest et al. (2006), the themes identified by the researcher need to be able to be linked to the data, and they “… should be able to provide evidence of a given theme within the text being analyzed” (p. 77).

3.6.3.3. Member checks

I have previously identified that member checking was used to guarantee construct validity of my research study. Member checking refers to the participant reviewing the data collected and reported upon. According to Mertens (2015), member checking needs careful consideration by the researcher as to who to check with, and how and when to do it. I asked participants to check the transcriptions of their semi-structured interview to ensure validity and reliability of what was recorded from each of the participant’s perspectives. Therefore, in my research, the purpose of the member checks was to focus on accuracy. This check for accuracy was considered a useful strategy, and is considered by Cho and Trent (2006) to be a "technical member check". "In this way, the participants add credibility to the qualitative study by having a chance to react to both the data and the final narrative" (Creswell & Miller, 2000, p. 127). According to Creswell and Creswell (2018), "validity is one of the strengths of qualitative research and is based on determining whether the findings are accurate from the standpoint of the researcher, the participant, or the readers of an account" (p. 199).

According to Mertens (2015), "[m]ember checks can be formal and informal …" (p. 269). I conducted informal member checks at the end of each semi-structured interview when I summed up what had been said and asked if my records accurately reflected the participant's position in relation to the questions asked. I also undertook formal member checks when the transcribed responses to the semi-structured interview questions were sent back to the participants to confirm the accuracy of the content of what they had said during the interview process. "In this way the plausibility and truthfulness of the information can be recognized and supported" (Zohrabi, 2013, p. 258). It was through member checks that the transcribed data from the interviews were taken back to the participants to obtain verification with the data collected and analysed. Stake (1995) contends that often there is little feedback obtained from the participants, but it is a necessary process, especially as member checking helps to "triangulate the researcher's observations and interpretations" (Stake, 1995, p. 115). Like Stake (1995) suggests, I did not receive much feedback from the participants in this research study in regard to member checking interview transcripts.

Thus, member checking permitted collaboration between me, as the researcher, and the participants, by enabling participants to provide input into the data collection phase of the research study. According Creswell and Poth (2018) this also "further deemphasizes the power relationship" (Creswell & Poth, 2018, p. 45) that often exists between a researcher and the participants in a research study.

3.6.4. Content analysis

I now discuss the approach that I undertook to code the data that I collected. I first provide a reason for the selection of the coding approach and then I discuss and provide details of the process that was undertaken. Saldaña (2016) declares that "[t]o codify is to arrange things in a systematic order, to make something part of a system or classification, to categorise" (p. 9). Ryan and Bernard (2000) claim that coding is the "heart and soul" of quantitative analysis. Saldaña (2016) goes onto elaborate that a code is typically a word or a short expression that "symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute [to the data]" (p. 4). So simply, a code translates the data in a relevant, united manner.

It should be noted that "[c]oding is just one way of analysing qualitative data, not the way …" (Saldaña, 2016, p. 3). Similarly, there are various ways to code. Patton (2002) and Saldaña (2016) also claim that there are no precise terms to describe the variations and processes of analysing qualitative data. My approach to coding was to analyse text from the interview transcripts by recognising, matching and analysing patterns in the data, and subsequently identifying consistencies and meanings in the apparently random data. I arranged the data in a systematic manner and grouped things together to associate meaning. From the research literature, this approach to coding is referred to as conducting a content (or pattern or thematic) analysis of the data (Creswell, 2016; Creswell & Poth, 2018; Patton, 2002; Saldaña, 2009, 2016) and categorising "recurring words or themes" to make meaning of the various forms of data (Patton, 2002).

I decided to use content analysis to code as Saldaña (2016) cautions against using "descriptive coding … [or] topic coding" (p. 102) when writing case studies because this approach uses nouns as a basis for coding and does not disclose much understanding of the data. So using this advice, I decided to use the more inclusive approach of coding for patterns. Saldaña (2016) states that a pattern is repetitive, regular or consistent occurrences

… [in the] data that appear more than twice (p. 5). The data I collected from the interview transcripts was coded into patterns and then themes. Patton (2002) emphasises that "[t]here's no hard and fast distinction … [in regard to the difference between a pattern and a theme]. The term pattern usually refers to a description finding … while a theme takes a more categorical or topical form" (Patton, 2002, p. 453).

Pattern analysis occurs in two cycles (or stages). Saldaña (2009, 2016) refers to this approach as first cycle and second cycle coding, and so asserts that the goal of pattern analysis is to develop a thematic organisation from the initial coding, that is pattern analysis is a "second cycle coding method", which is a more advanced method of reorganising and reanalysing data to generate a smaller and more precise list of broader themes identified from the first cycle of the coding process (Saldaña, 2009, 2016).

After collecting and transcribing data, complex reasoning was required to review and make meaning of the data. Initially the data was analysed inductively from specific to more general perspectives. These general perspectives (or central meanings of the data) are also termed "codes, categories, themes, or dimensions" (Creswell & Poth, 2018, p. 52). I referred to them as 'themes' in my research study. Deductive thinking was then used to make meaning of the themes by continually checking them against all the data collected from the questionnaire, interviews and artefacts, that is I dissected the qualitative data to determine what it revealed before putting it back together in a meaningful manner (Creswell, 2016; Creswell & Poth, 2018).

Inductive analysis relates to finding patterns and themes in one's data. Patton (2002) states that inductive analysis is typical when initially analysing qualitative data, such as interview transcripts as the researcher is determining possible patterns and themes, which come from the circumstances of the research study. Strauss and Corbin (1998) refer to this process of searching for patterns or themes as "open coding" while Patton (2002) distinguishes each as "pattern analysis or theme analysis" respectively.

I coded the qualitative data by hand, using highlighters and pencils to mark up and annotate the text in the transcripts. I began coding by reading each interview transcript several times to become familiar with the data. I then highlighted terms that were repeated in the text as well as terms that were linked to the research study. I coloured-coded and annotated sections of text in order to categorise the data and related this to the research question/s and the literature review. I listed the patterns initially in the margins of the transcripts before creating a Word (Microsoft Corporation, 2019b) document and organising them in a table and allocating them meaningful labels that were linked to my research study. I then collapsed these patterns into themes such as ‘enablers’, ‘barriers’, ‘domains of knowledge’ etc. that were identified in the research study’s literature review. The colour-coding was used for retrieval and organisation and assisted in the development “a codebook” (Ryan & Bernard, 2000) that organised lists of themes in a hierarchy. These themes helped to refine my research study as when I read through the data again, I was able to use the themes to find patterns.

The coding of my data was influenced by my reading of the research literature and consideration of the data, and was an iterative process as I reflected and rewrote the themes. Saldaña (2016) highlights that coding involves the researcher wearing an “analytic lens” and that it is dependent upon “what type of filter covers that lens and from which angle you view the phenomenon” (pp. 7–8). I analysed the data by clarifying it through my etic (or outsider) perspective to develop an overall understanding of it (Creswell & Poth, 2018). Ryan and Bernard (2000) assert that “[c]oding forces the researcher to make judgements about the meanings of contiguous blocks of text” (p. 780). Therefore, one of the disadvantages of pattern analysis is that it is highly interpretative as “a code is a researcher-generated construct …” (Saldaña, 2016, p. 4) and so limited generalisations can be made.

I completed coding the data when data saturation was obtained, that is when adequate data was collected and coded (Fusch & Ness, 2015; Guest et al., 2006; Moore, 2000; Morse, 1995). Throughout the process, I was seeking connections between patterns and identifying themes and connections to the research question/s. My analysis of data meant that I developed a matrix of patterns and themes that related to the data collected, and therefore contributed to data reduction. The content analysis was about building the patterns and themes from the 'bottom up' as I inductively structured the data into progressively more abstract pieces of information (Creswell, 2014; Creswell & Creswell, 2018). The themes were not imposed by a framework but rather were constructed from all the data that was collected (questionnaire, interviews and artefacts). I had to work back and forth between the themes and the data until a complete set of themes was identified. As Ryan and Bernard (2000) emphasise, "[t]hemes are abstract (and often fuzzy) constructs" (p. 781).

After the establishment of patterns and themes, Patton (2002) also identifies "the final, confirmatory stage of qualitative analysis may be deductive in testing and affirming the authenticity and appropriateness of the inductive content analysis" (p. 454). Deductive analysis was therefore used by me as the researcher when I was building themes as these themes were constantly being checked against other data such as research literature, that is a 'top down' approach whereby an existing framework to analyse the data was referred to.

3.6.5. Collection of artefacts

Artefacts were also collected from each of the schools of the teacher mentors who were interviewed – these artefacts included My School website data, school website data, school ICT policies, eLearning plans, and information about technical infrastructure of schools. The selection of these artefacts was to add to the information provided by the interview participants. Information from the analysis of artefacts assisted with corroborating themes identified in the content analysis. For example, information about technical infrastructure was used to make an assessment about barriers and enablers in regard to teacher mentor access to specific ICT in the classroom (see Appendix F for a list of all the artefacts collected from each teacher mentor's school).

3.6.6. Ethical considerations

All research at RMIT involving human participants requires ethics approval in accordance with NHMRC guidelines (NHMRC, 2018). Ethics approval was obtained from both RMIT (Reference number: CHEAN A 0000019608–08/15) (see Appendix G) and the Victorian Department of Education and Training (Reference number: 2015__002879) (see Appendix H). My research outlined above was considered low risk as the only probable harm from participating in the research was discomfort. A number of processes were put into place to ensure that there was no potential harm or risks to the participants in this research study. These processes included making participation in the research study voluntary and ensuring participants knew about their right to withdraw at any time; gaining informed consent and ensuring anonymity through the use of pseudonyms and confidentiality of the information gathered.

As highlighted earlier, I constructed a Participant Information and Consent Form (PICF) to introduce the research and the purpose of the study to the principals and teacher mentors involved in the research and to obtain their consent to be part of the research in accordance with the ethics requirements (see Appendix C). As mentioned, I also specified in the consent form that I was seeking permission for the interviews sessions to be digitally recorded to aid the researcher with constructing accurate transcripts.

As the research involved government schools, a formal request was sent to the Victorian Department of Education and Training (DET) to seek approval to undertake the research. This request identified the purpose of the research and the methodology and data-gathering tools being employed. A courtesy letter was sent to the DET Victoria North Western Region Regional Director, where the schools involved in the research were located. As mentioned, the Victorian Department of Education and Training (DET) approved this study's proposal to conduct research in government schools (Reference number: 2015__002879) (see

Appendix H). I completed the following stages for the approval process as outlined by the Victorian Department of Education and Training:

- review of proposal: obtaining DET approval to approach the school principal of the site-based teaching practicum school involved
- consent of schools: obtaining the approval from the principal to conduct research in their school (see Appendix B for a copy of the email sent to principals).
- consent of participants: obtaining the agreement of teacher mentors for participation in the research.

Approval was also sought directly from the Catholic school principals.

Thus, I was mindful that different ethical considerations were particularly imperative at different stages throughout the research study. For example, I negotiated access to the field site of the research, that is schools; involved participants in the study; collected personal data that revealed about participants' mentoring knowledge and experiences; as well as asked participants to give considerable time to the research study.

3.7. Summary of research methodology

In summing up, a mixed methods approach (Creswell, 2009; Creswell & Poth, 2018; Teddlie & Tashakkori, 2003) framed by a pragmatic paradigm framework (Cherryholmes, 1992; Creswell & Plano Clark, 2007; Creswell & Poth, 2018; Teddlie & Tashakkori, 2003) enabled me to most effectively address the main research question and research sub-questions and find out what knowledge was needed by teacher mentors to support pre-service teachers to use ICT in teaching practicums. I used a sequential explanatory mixed methods approach (Creswell, 2009) to gather both qualitative and qualitative data, with each data set being separately collected and analysed; I also added case study methodology (Yin, 2003, 2014) to this basic mixed methods design to create the more complex mixed methods case study design (Creswell & Creswell, 2018), where the data from the explanatory sequential design was mixed at the interpretation stage and written up as case studies.

Research questions were used as an organising framework for the development of the questionnaire and semi-structured interview questions and collection of artefacts, and this provided a structure for the analysis and interpretation of the data, which is described in chapters 4 and 5 respectively. An overview of how I gained access to the teacher mentors and how I approached them via their principals was described, including ethics approval to undertake this low-risk research and recruitment of participants. A copy of the Participant Information Consent Form (PICF) used was also identified (see Appendix C).

The types of closed-ended questions asked in the questionnaire, and the types of open-ended questions asked in the semi-structured interviews and types of artefacts collected have been described. In addition, the selection of participants for the interviews and the sampling strategies have been detailed. How I used a questionnaire to collect quantitative data from 50 teacher mentors, and then used semi-structured interview questions and artefacts from schools to gather qualitative data from four teacher mentors have also been described. It was emphasised that the number of participants contributing to the questionnaire was different to those participating in semi-structured interviews, and how the use of the interviews was to gain more in-depth insights into their beliefs and practices related to mentoring pre-service teachers to use of ICT in teaching practicums. Timing, weighting, levels of interaction and functions of the research study have also been discussed.

Additional qualitative data was gathered from artefacts such as My School website data, school website data, school ICT policies, eLearning plans, and information about technical infrastructure of schools to add depth to the case studies. Each data set was collected and analysed separately before integrating (or mixing) all the data to make interpretations. In addition, I discussed how I used data triangulation and methods triangulation to ensure reliability and validity to the data collection and analysis. I also explained how I used content analysis, relying on both inductive and deductive approaches, to code the data. In the subsequent chapter, I report on the data findings of this research study.

4. Quantitative questionnaire findings

This chapter reports on the quantitative questionnaire findings of the research study, conducted with the teacher mentors from government and Catholic schools in the North Western Metropolitan region of Melbourne, Australia. These findings are presented in relation to the main research question: ‘What knowledge do teacher mentors need to support pre-service teachers to use ICT during teaching practicums?’ and the following research sub-questions:

1. What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?

2. What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?

3. What are the teachers’ beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?

4. What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?

As identified in chapter 3, the quantitative and qualitative findings were obtained using three different data-gathering instruments: a questionnaire administered to 50 teacher mentors; semi-structured interviews conducted with four teacher mentors; and analysis of artefacts gathered from the schools of the teacher mentors who were interviewed. The questionnaire data was analysed using percentages obtained on frequencies and chi-square tests for questionnaire items, and the qualitative data used content analysis and was written up as case studies. For ease of discussion, I report quantitative findings from the questionnaire separately to the qualitative findings collected from the interviews and analysis of artefacts. Then, in chapter 5, I report on the qualitative findings of the interviews and analysis of artefacts that are written up as four case studies, each one of a teacher mentor in a specific setting.

4.1. Questionnaire data findings

In this chapter I unpack the questionnaire responses from the teacher mentors in relation to their demographics. The chapter then documents the mentor training experiences of the teacher mentors. Finally, the chapter considers the teacher mentors' ICT beliefs and use of ICT tools in teaching practice.

4.1.1. Findings related to demographics of teacher mentors

In this section, I have presented the demographic data collected from the teacher mentors using the questionnaire, namely their sex; age range in years; the type of classes taught (i.e. primary and/or secondary); and the year levels of the classes taught. The data is shown as percentages obtained on frequencies for these questionnaire items (Questions 1–5) (Refer to Appendix D). The data provides a background to the participants in order to gain an understanding of the complexity of the issues being explored in this research study and contribute to building deep, detailed and information-rich case studies. This section is framed by the first research sub-question 'What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?'

Table 3 documents that the majority (70%) of the research study participants were female teacher mentors with the remaining 30% of participants being male teacher mentors. Correspondingly, Table 3 identifies that the majority (66%) of teacher mentors taught secondary school classes while the remaining 34% of teacher mentors taught primary school classes. Table 3 also documents that the majority (82.4%) of the teacher mentors who taught primary classes were female with the remaining 17.6% of this cohort being male. In addition, Table 3 illustrates that majority (63.6%) of the teacher mentors who taught secondary classes were female with the remaining 36.4% of this cohort being male.

Table 3: Sex of teacher mentors according to type of classes taught

	Primary classes (n = 17)		Secondary classes (n = 33)		Total (N = 50)	
Female	82.4%	(14)	63.6%	(21)	70%	(35)
Male	17.6%	(3)	36.4%	(12)	30%	(15)
Total	34%		66%		100%	

Table 4 documents that 58% of teacher mentors had 10 or more years of teaching experience, with 26% of teacher mentors having 7–9 years of teaching experience. The data therefore shows that 84% (58% + 26%) of teacher mentors had seven or more years of teaching experience. Only 12% of teacher mentors had 4–6 years teaching experience and 4% of teacher mentors had 3 years or less teaching experience.

Table 4: Teaching experience in years of teacher mentors

Teaching experience (years)	Percentage (N = 50)
0–3	4% (2)
4–6	12% (6)
7–9	26% (13)
Greater than 10	58% (29)

Therefore, the cohort of teacher mentors who completed the questionnaire was mostly female secondary teachers who had more than seven years teaching experience. The next section presents the data related to mentoring experiences of the teacher mentors and focuses on the previous experiences of this cohort with mentoring. It also documents data about any training related to mentoring by the teacher mentors as well as the types of mentor training undertaken.

4.1.2. Findings related to mentoring experiences of teacher mentors

This section is framed by the first research sub-question 'What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?' as well as the third research sub-question 'What are teachers' beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?' and fourth research sub-question 'What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?'

For the most part, the teacher mentors who completed the questionnaire had not undertaken any training, with 76% indicating no training had been undertaken (see Table 5). Of the 24% of teacher mentors who undertook training, there were a small number (6%) of teacher mentors who undertook two training programs (see Table 6). A closer analysis of the training undertaken by the teacher mentors indicated that of those who did training, it was the 'Victorian Institute of Teaching (VIT) Teacher mentoring training' that was most common (see Table 7). Although, this sample size of teacher mentors was small, there was some indication that secondary female teacher mentors were more likely to undertake mentor training.

Table 5: Mentor training undertaken

Mentoring training undertaken	Percentage (N = 50)
Undertook mentor training	24% (12)
Undertook no mentor training	76% (38)

Table 6: Number of mentor training programs undertaken

Number of types of training programs undertaken	Teacher mentors who undertook training				
	Teacher mentors (N = 50)	Type of classes taught		Sex	
		Primary	Secondary	Female	Male
None	76% (38)	30% (15)	46% (23)	54% (27)	22% (11)
One	18% (9)	4% (2)	14% (7)	10% (5)	8% (4)
Two	6% (3)	0% (0)	6% (3)	6% (3)	0% (0)

Table 7: Types of mentor training programs undertaken

Types of mentor training programs undertaken	Number of teacher mentors undertook mentor training (N = 50)* *More than one training program could be selected
Australian Institute of Teaching and School Leadership (AITSL) Supervising pre-service teachers program	2
Victorian Department of Education (DET) Teacher mentor support program	1
Victorian Institute of Teaching (VIT) Teacher mentoring training	7
Victorian Principals Association - Graduate and Grow program	1
School-based in-service mentoring program	1
University-led mentor training	3
None	38

Table 8 indicates that all teacher mentors had previously mentored, with 56% of teacher mentors indicating that they had previously mentored five times or more; 26% of teacher mentors indicating that they had previously mentored 3–4 times; and 18% of teacher mentors indicating that they had previously mentored 1–2 times. Therefore, the majority (82% = 56% + 26%) of teacher mentors had previously mentored a pre-service teacher at least three times.

Table 8: Previous experience with mentoring

Number of times previously mentored	Percentage (N = 50)
1–2	18% (9)
3–4	26% (13)
5 times or more	56% (28)

I now report on a set of chi-square tests for specific questionnaire items related to the training of teacher mentors. For the first set of chi-square tests, I focused on the variable of whether teacher mentors had undertaken mentor training or not. The purpose was to inform me about whether or not there was a statistically significant difference between how the teacher mentors responded to specific questionnaire items, depending on whether they had undertaken mentor training or not. That is, the purpose of conducting chi-square tests was to compare whether undertaking mentor training was influenced by sex, teaching experience, type of classes taught and beliefs about level of importance to use ICT in the classroom. Minitab (Minitab, 2019) automated these calculations for the chi-square tests including *p*-values (see Table 9). I then compared the *p*-value to the significance level of 0.05 to draw conclusions about each test. If the *p*-value was equal to or lower than the significance level of 0.05, I rejected the null hypothesis (i.e. there was an association between the two variables). If the *p*-value was higher than the significance level of 0.05, I failed to reject the null hypothesis (i.e. there was no statistically significant association between the two variables).

Table 9: Results of chi-square tests according to whether teacher mentors had undertaken mentor training with different variables

Variable	Chi-square	DF	*p*-value
Sex	0.084	1	0.773
Type of classes taught	2.114	1	0.146
Teaching experience	0.005	1	0.942
Age range	0.844	3	0.839
Beliefs about level of importance to use ICT in teaching	7.420	2	0.024

A chi-square test for association was conducted between mentoring training and beliefs about the level of importance to use ICT in the teacher mentor's teaching practice. There were three cells with expected counts less than five (see Appendix I, Table I6). There was a statistically significant association between mentoring training and teacher mentors' beliefs about level of importance to use ICT in teaching practice, χ^2 (2, N = 50) = 7.420, $p = 0.024$ (see Table 9). The null hypothesis was rejected. However, it needs to be noted as previously stated, the chi-square test results did not provide any further information about this association.

4.1.3. Findings related to experiences of ICT in teaching practice of teacher mentors

This final section now turns to the analysis of the questionnaire data focusing on the experiences of teacher mentors with using ICT in their teaching practice. It also documents the types of ICT tools used according to comfort level of teacher mentors as well as their beliefs about the level of importance to use ICT in the classroom. This section is framed by the first research sub-question 'What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?' In addition, this section reports on the findings of a series of chi-square tests that were conducted to determine if there was a relationship between the level of comfort of using ICT acknowledged by the teacher mentors and the following variables: age range of teacher mentors; teaching experience; type of classes taught; and beliefs about the level of importance to use ICT in the classroom. Another series of chi-square tests was conducted to determine if there was a relationship between the beliefs about the level of importance to use ICT in teaching identified by the teacher mentors and the following variables: sex; age range; teaching experience; type of classes taught; and mentoring experience. This section is framed by the second research sub-question 'What are the challenges to mentoring pre-service teachers in regard to supporting their use of ICT by pre-service teachers during teaching practicums?' and the third research sub-question 'What are teachers' beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?'

The teacher mentors identified a range of ICT tools that were used in the classroom, with 100% indicating that they used digital devices; 94% listing that they used software such as Word, Excel, PowerPoint and Publisher; and 92% stating that they used ICT to undertake internet searches. Only 36% indicated that they used web 2.0 tools and 14% identified that they used robotics in the classroom (see Table 10).

Table 10: Types of ICT tools identified by teacher mentors

Number of times previously mentored	Percentage (N = 50)
Digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard (IWB), smartphone, digital camera	100% (50)
School intranet and/or learning management system such as Schoology, Moodle, Compass	90% (45)
Web 2.0 tools such as blog, wiki, social media, surveys and polls, comic creator etc.	36% (18)
Online searching using the internet	92% (46)
Digital resources from Scootle, FUSE, ABC Splash	52% (26)
Software such as PowerPoint, Excel, Word, Publisher	94% (47)
Applications (apps) or widgets	74% (37)
Robotics such as Bee-Bots, drones, Pro-Bots	14% (7)

Table 11 shows the use of ICT tools according to the comfort level of the teacher mentors and indicates that teacher mentors who reported very comfortable levels with using ICT also identified that they used all the listed ICT tools. Teacher mentors who identified they were somewhat comfortable with using ICT identified use of all the ICT tools, with the exception of robotics. Teacher mentors who identified they were not comfortable with using ICT did not identify that they used the following ICT tools: web 2.0 tools, digital resources and robotics.

Table 11: Use of ICT tools according to comfort level of teacher mentors

ICT tools	Very comfortable (n = 30)	Somewhat comfortable (n = 15)	Not comfortable (n = 5)
Digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard (IWB), smartphone, digital camera	72% (36)	26% (13)	2% (1)
School intranet and/or learning management system such as Schoology, Moodle, Compass	68% (34)	20% (10)	2% (1)
Web 2.0 tools such as blog, wiki, social media, surveys and polls, comic creator	30% (15)	6% (3)	0% (0)
Online searching using the internet	68% (34)	22% (11)	2% (1)
Digital resources from Scootle, FUSE, ABC Splash	40% (20)	12% (6)	0% (0)
Software such as PowerPoint, Excel, Word, Publisher	70% (35)	10% (5)	2% (1)
Applications (apps) or widgets	62% (31)	0% (0)	2% (1)
Robotics such as Bee-Bots, drones, Pro-Bots	14% (7)	0% (0)	0% (0)

Table 12 documents that the teacher mentors who considered the use of ICT for teaching as very important were more likely to use the following ICT tools: digital devices (60%); school intranet and/or learning management system (58%); online searching using the internet (56%); and software (56%).

Table 12: Use of ICT tools according to beliefs about level of importance to use ICT for teaching

ICT tools	Very important (n = 30)	Somewhat important (n = 15)	Not important (n = 5)
Digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard (IWB), smartphone, digital camera	60% (30)	30% (15)	10% (5)
School intranet and/or learning management system such as Schoology, Moodle, Compass	58% (29)	24% (12)	8% (4)
Web 2.0 tools such as blog, wiki, social media, surveys and polls, comic creator	30% (15)	18% (9)	4% (2)
Online searching using the internet	56% (28)	26% (13)	10% (5)
Digital resources from Scootle, FUSE, ABC Splash	24% (12)	12% (6)	6% (3)
Software such as PowerPoint, Excel, Word, Publisher	56% (28)	28% (14)	10% (5)
Applications (apps) or widgets	48% (24)	22% (11)	4% (2)
Robotics such as Bee-Bots, drones, Pro-Bots	6% (3)	6% (3)	2% (1)

I now discuss the chi-square tests conducted for the variable related to level of comfort with using ICT with other variables associated to specific questionnaire items. I conducted these chi-square tests to investigate whether or not there was a statistically significant difference between how the teacher mentors responded to the relevant questionnaire item, depending on their level of comfort with using ICT in the classroom. Minitab (Minitab, 2019) automated the calculations for the chi-square tests including *p*-values (see Table 13). As previously mentioned, I then compared the *p*-value to the significance level of 0.05 to draw conclusions about each hypothesis.

Table 13: Results of chi-square tests according to level of comfort with using ICT in the classroom of teacher mentor with different variables

Variable	Chi-square	DF	*p*-value
Age range	2.387	3	0.496
Teaching experience	0.966	1	0.326
Type of classes taught	4.766	1	0.029
Level of importance to use ICT	6.162	2	0.046

A chi-square test for association was conducted between the comfort level with using ICT and type of classes taught by teacher mentors. Only responses to 'very comfortable' and 'somewhat comfortable' were included to meet the assumptions (refer to previous discussion in Chapter 3 about assumptions of chi-square tests, under the heading '3.6.2.1. Chi-square tests'). There was one cell with expected counts less than five (See Appendix I, Table I9). The null hypothesis was rejected. There was a statistically significant association between mentoring training and type of classes taught by teacher mentors, χ^2 (1) = 4.766, p = 0.029 (see Table 13). That is, a statistically significant association existed between mentoring training and teacher mentors who taught secondary classes.

A chi-square test for association was calculated comparing comfort level with using ICT and beliefs about level of importance to use ICT in teaching. Only responses to 'very comfortable' and 'somewhat comfortable' were included to meet assumptions (refer to previous discussion in Chapter 3 about assumptions of chi-square tests, under the heading '3.6.2.1. Chi-square tests'). There were three cells with expected counts less than five (See Appendix I, Table I10). The null hypothesis was rejected. There was a statistically significant association between mentoring training and beliefs about level of importance to use ICT in teaching, χ^2 (2) = 6.162, p = 0.046 (see Table 13).

I was unable to determine if the level of comfort with using ICT in the classroom was influenced by the sex of teacher mentors as the data did not meet the assumptions for the chi-square test. A larger sample size with more male teacher mentors would be useful for future research.

I then created another series of chi-square tests, with the purpose to determine whether or not there was a statistically significant difference between how the teacher mentors responded to the relevant questionnaire item, depending on whether their beliefs about the level of importance to use ICT in the classroom. As highlighted previously, Minitab (Minitab, 2019) automated the calculations for the chi-square tests, including *p*-values (see Table 14) that were compared to the significance level of 0.05 to draw conclusions about each hypothesis.

Table 14: Results of chi-square tests according to beliefs about level of importance to use ICT in the classroom of teacher mentor with different variables

Variable	Chi-square	DF	*p*-value
Sex	1.587	2	0.452
Age range	2.787	2	0.248
Teaching experience	5.528	2	0.063
Type of classes taught	0.501	2	0.778
Mentoring experience	8.032	1	0.005

A chi-square test for association was conducted between beliefs about level of importance to use ICT in teaching and mentoring experience of teacher mentors. The categories for mentoring experiences were collapsed into two categories (‘1–4 years’ and ‘5 times or more’) to meet assumptions (refer to previous discussion in chapter 3 about assumptions of chi-square tests, under the heading ‘3.6.2.1. Chi-square tests’). There was one cell with expected counts less than five (see Appendix I, Table I13). The null hypothesis was rejected. There was a statistically significant association between the beliefs about level of importance to use ICT in teaching and mentoring experience of teacher mentors, χ^2 (1, N = 45) = 8.032, p = 0.005 (see Appendix I15).

4.2. Summary of questionnaire findings

This chapter has reported on the quantitative data for this research study using the questionnaire responses, and so in summing up, I recap some of the findings identified from the questionnaire. The majority of teacher mentors in this research study were female, secondary teachers, with more than seven years teaching experience. Six types of pre-service teacher mentor training were identified by 24% of teacher mentors who had undertaken training, with the 'Victorian Institute of Teaching teacher mentor training' indicated most frequently, representing 14% of the teacher mentors. Six per cent of all teacher mentors undertook two different types of training with the remaining 18% undertaking one type of training. All teacher mentors who undertook two different types of mentor training were female and taught secondary classes. Chi-square tests were used to determine if there was a statistically significant relationship between teacher mentors who had or had not undertaken mentoring training and seven variables: sex, age range in years, type of classes taught, year levels of classes taught, mentor training, comfort level with using ICT and beliefs about importance of using ICT in teaching. There was a statistically significant association between undertaking mentor training and the following three variables: teacher mentors' beliefs about the level of importance to use ICT in teaching practice; mentoring experiences; and type of classes taught. These results about mentor training therefore point to some directions for future research regarding policy and training of teacher mentors.

Of the teacher mentors who completed the questionnaire, the majority (72%) of teacher mentors indicated that they were very comfortable with using ICT and 26% indicated that they were somewhat comfortable with using ICT. Only 2% of teacher mentors indicated that they were not comfortable with using ICT. Of the teacher mentors who indicated that they were comfortable with using ICT, 26% were male and 46% were female while 56% were secondary teacher mentors and 16% were primary teacher mentors. Teacher mentors who indicated they were very comfortable or somewhat comfortable with using ICT were found across all age ranges, were of both sexes, and taught both secondary and primary classes; teacher mentors who indicated that they were not comfortable with using ICT were found in the 45–49 years age range; female; and taught primary classes. Of the digital tools listed, all teacher mentors used digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard, smartphone, digital camera etc. Chi-square tests were also used to determine if there was a statistically significant relationship between the level of comfort with using ICT by teacher mentors and a range of variables as well as between the level of importance to use ICT for teaching and a range of variables. There was an association between mentoring training and beliefs about the level of importance to use ICT in teaching. In addition, there was an association between level of comfort and age of teacher mentors as well as level of comfort and teaching experience of teacher mentor. Yet, these chi-square test results did not provide any further evidence about these associations. All in all, this quantitative data was used as a means of providing detailed and rich background for the qualitative case studies which follow on in this sequential explanatory research design study in chapter 5.

5. Qualitative findings of interviews and artefact analysis

5.1. Introduction to qualitative findings

Discussion now turns to reporting on the qualitative interview findings in this chapter, written as four case studies of teacher mentors. Each study is organised around a case, with the information presented in three parts: introducing the school context; background to the teacher mentor; and discussion of the key themes identified from the data collection. The themes identified, as discussed in chapter 3, are barriers and enablers to using ICT; mentoring knowledge; and TPACK, and are discussed in relation to each case study. This discussion provides an opportunity to highlight connections through "[using case studies to provide] … insight, discovery and interpretation [to the research question/s] …" (Merriam, 1998, p. 10).

As previously mentioned, four teacher mentors were purposefully selected from those teacher mentors who both completed the questionnaire and volunteered to be interviewed. Details of the purposeful sampling strategy used in this research study are discussed in the ensuing paragraphs. Of the 50 teacher mentors who completed the questionnaire, 18 teacher mentors volunteered to participate in semi-structured interviews with 83.3% (n = 15) being female and the remaining 16.7% (n = 3) being male. This representation of the sexes of teacher mentors who volunteered to be interviewed was not dissimilar to the proportion of female to male teachers in the Australian workforce in 2016. According to the Australian Bureau of Statistics (2016), 70.9% of all school teachers, (i.e. primary and secondary) were female and 29.1% were male in 2016 (see Appendix J for a breakdown of Australian primary and secondary teachers according to sex and sector).

However, representation by type of classes (i.e. primary and secondary) in this research study was not consistent with Australian teaching workforce data. Female representation was similar, with 40% in primary schools and 60% in secondary schools and was reflective of the Australian national data of 43.83% to 56.17% respectively (Australian Bureau of Statistics, 2016). Male representation, however, was underrepresented according to the Australian national data of 20.48% in primary schools and 79.52% in secondary schools (Australian Bureau of Statistics, 2016). It was disappointing that no primary male teacher mentors volunteered to be interviewed as part of this research study.

5.1.1. Purposeful selection of each case

I used the purposeful sampling strategy criterion (Patton, 2002), where there was an emphasis on similarity to select four teacher mentors. I purposefully chose the four teacher mentors from the 18 participants who volunteered to be interviewed (15 females and three males) by applying, as discussed in chapter 3, the following set of selection criteria to: type of classes taught (i.e. primary or secondary); sex; and whether mentor training had been undertaken or not. The selection of these three criteria of interest were characteristics of teacher mentors identified from the literature in chapter 2. I considered that an exploration of these criteria would allow me to gather information that would provide both depth and breadth to enable me to address my research question/s.

The process I used to purposefully select the four mentors was a pragmatic approach whereby I initially allocated each teacher mentor who volunteered to be interviewed a number from one to 18 and then grouped them according to those teacher mentors who taught primary or secondary classes; then from these two groupings, I categorised the teacher mentors according to their sex; using the resultant four groupings, the third and final categorisation was according to whether these teacher mentors had undertaken mentor training or not. From the final groupings, I identified four teacher mentors by applying the set of pre-determined selection criteria (see Appendix K). Some of the categories in the final groupings did not contain teacher mentors who had volunteered to be interviewed due to the small sample size. For example, there were no primary female or male teacher mentors who undertook mentor training (see Appendix K). The sample of teacher mentors purposefully selected to be studied (see Table 15) was not representative of the total teacher mentor population but rather the teacher mentors were selected because their features were of interest to me as a researcher and had been identified in previous research studies.

It was important that I judiciously chose the teacher mentors to be interviewed because carefully selected, purposeful samples ensured quality data to be analysed (Guest et al., 2006). The four teacher mentors purposefully selected best represented the three factors that I considered met the pre-determined criteria of importance from the 18 teacher mentors who volunteered to be interviewed. I specifically chose three female teacher mentors and one male teacher mentor as I considered that they possessed characteristics that would allow me to gather information that would provide both depth and breadth to enable me to address my research question/s. That is, I decided each case would be worthy of in-depth study because they would offer detailed, information-rich insights. These four teachers were purposefully chosen because of their characteristics – they were not regarded "[a]s single data points, but detailed stories that elaborate on experience" (Emmel, 2013, p. 138). Accordingly, each teacher mentor became a case that I studied in detail. As mentioned in chapter 3, pseudonyms were used for both the names of each school and each teacher mentor to protect the identities of the research participants.

Table 15: Criteria used to purposefully select teacher mentors to be interviewed

Teacher mentor who volunteered to be interviewed	Type of classes taught	Sex	Mentor training undertaken	Selected or not selected
1	Primary	F	No	✗
2 (Sarah)	**Secondary**	**F**	**Yes**	✓
3	Primary	F	No	✗
4	Secondary	F	Yes	✗
5 (Charles)	**Secondary**	**M**	**No**	✓
6	Primary	F	No	✗
7	Primary	F	No	✗
8	Primary	F	No	✗
9 (Annie)	**Primary**	**F**	**No**	✓
10	Primary	F	No	✗
11	Primary	F	No	✗
12	Secondary	M	No	✗
13 (Rose)	**Primary**	**F**	**No**	✓
14	Primary	F	No	✗
15	Secondary	F	Yes	✗
16	Primary	F	No	✗
17	Secondary	M	No	✗
18	Primary	F	No	✗

The details of the four teacher mentors selected to be interviewed, along with the criteria used for selection and of interest to me as a researcher are detailed in Table 16.

Table 16: Key features of the teacher mentors who were interviewed

Case study number	Interviewee pseudonym	School pseudonym	Criteria of interest
1	Sarah	Rusden P–12 College Government sector	• Secondary school teacher • Female • Previously undertaken mentor training
2	Charles	Ebden College Catholic sector	• Secondary school teacher • Male • No prior mentor training
3	Annie	Nepean North Primary School Government sector	• Primary school teacher • Female • No prior mentor training
4	Rose	Cochrane Primary School Government sector	• Primary school teacher • Female • No prior mentor training

5.1.2. Introducing the cases

I now present each case – Sarah, Charles, Annie and Rose – who I interviewed and studied in-depth. These four teacher mentors each became a case study, which has been written up in three sections. The first part of each case study provides a description of the school where the teacher mentor taught to provide insights into the teaching context of each teacher mentor. The second part presents information about the background of each case study that includes their teaching experiences, confidence with using ICT; and beliefs about level of importance to use ICT in teaching practice. The third part reports on the three broad themes that were identified from the analysis of the artefacts and interview transcript of each of the teacher mentors: views on barriers and enablers to using ICT; views on mentoring knowledge; and views on TPACK. As discussed in chapter 3, these themes were classified by identifying the data, and then grouped, categorised and re-categorised, as I analytically reflected on this data. Pertinent quotations from each of the teacher mentors were chosen to illustrate the themes in each case study. Reference has been made to these quotations by identifying the lines in each transcript of each of the cases, for example '(S 35)' indicates that the quote came from the 35th line in the transcript of the teacher mentor, Sarah, and '(C 124–126)' indicates the quote came from the 124th to 126th line in the transcript of the teacher mentor Charles. The letter 'A' indicates the quote came from the transcript of teacher mentor Annie and 'R' indicates that the quote comes from the transcript of teacher mentor Rose. These findings of the interviews were framed by the four research sub-questions:

1. What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?
2. What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?
3. What are the teachers' beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?
4. What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?

5.1.3. Case study 1: Sarah

5.1.3.1. About Rusden P–12 College

The first case study reports on data from Sarah's interview and analysis of artefacts from her school. Sarah was a teacher mentor who taught at Rusden P–12 College, a government school that was established for both primary and secondary students almost twenty years ago in one of Melbourne's rapid growth corridors. The school is situated on almost 14 hectares of land, approximately 25 kilometres north-west from the centre of Melbourne. In 2018, the College had a student enrolment population of over 2100 students, 166 full-time equivalent staff and 50 full-time equivalent non-teaching staff. Over 60% of students came from a language background other than English and one per cent were from Aboriginal or Torres Strait Islander peoples. The College's Index of Community Socio-educational

Advantage value was 967 and is below the average value of 1000 for Australian schools (ACARA, 2019b), and indicated that the students at Rusden P–12 College had a lower level of educational advantage than other Australian students.

The College consists of four mini-schools: Early years from Prep to Year 4; Junior years from Years 5 to 7; Middle years from Years 8 to 9; and Senior years from Years 10 to 12. It offered the following curriculums: Victorian Curriculum F–10 (VCAA, 2015b); Victorian Certificate of Education (VCE) studies (VCAA, 2019g); Vocational Education and Training (VET) (VCAA, 2019l); and Victorian Certificate of Applied Learning (VCAL) (VCAA, 2019f). The College is located adjacent to the local council's Maternal and Child Health Services, Child and Family Centre and recreational facilities, indicating that the school operated collaboratively within its community.

Rusden P–12 College is well-serviced by a range of facilities including a music studio, indoor gymnasium, computer laboratories, commercial kitchen and cafe and a language and professional learning centre, as well as with a range of different types of outdoor sporting facilities. The College also has a select-entry academic program whereby the school developed its own approaches to extending the learning of students within the classroom and other school environments (Victorian Department of Education and Training, 2019k), and also offers an elite sports program that is intended to develop both the academic and sporting achievements of students from Years 8–12 (see Appendix L for further information about Rusden P–12 College's select entry academic program and elite sports program). Therefore, Rusden P–12 College endeavours to offer a range of opportunities for its students.

Between 2012 and 2018, the College had a series of policies for the type of digital devices that students could use in the classroom, in line with state government initiatives (Victorian Department of Education and Training, 2019i). As discussed in chapter 2, the Victorian Department of Education and Training provides all government schools with technical infrastructure that includes a standard operating environment, which delivers its schools with key services such as the internet, network access, operating systems, and security and school administration software. But the Victorian Department of Education and Training "… does not stipulate that a school must have a 1-to-1 learning program, nor … mandate a preferred provisioning model (Victorian Department of Education and Training, 2019i).

Rusden P–12 College introduced a 'Bring your own device (BYOD)' initiative to the school policy in 2012, where students were encouraged to bring personally-owned digital devices, such as laptops and/or tablet devices (iPads) to school in order to access the internet to support their classroom learning activities. The College subsequently limited the BYOD policy to be just iPads in 2013, "which they [the College] found did not have a really good take-up [by students]" (S 144–145). The College then updated the policy to include smartphones in 2015. As Sarah reflected, "[t]hey were having issues with tablets [iPads] so that is when they moved to encouraging and promoting the positive use of phones" (S 145–146). Perhaps this suggested the school was open to providing a range of options for students to access and use ICT, especially as indicated earlier, its student population was from a lower socio-economic background.

In addition, the College had originally purchased iPads for students to use as part of their teaching and learning programs in 2013 but began transitioning to purchasing laptops in 2016. Teachers could book these school-owned iPads or laptops for classroom use. At the time of this research study in 2018, there were approximately ten laptop trolleys that were distributed across most buildings of the school as well as approximately seven banks of iPads allocated across all key learning areas in the Junior, Middle and Senior years, as well as additional iPads in the Early years. This seemed to indicate that the College was interested in providing ICT access for most of its students.

Interestingly, all school buildings had a trolley with a class set of laptops, except for the building that Sarah mainly taught in, and so she and her classes did not have access to a laptop trolley. “The school policy is that if you book a laptop trolley, you are only allowed to use it within that building” (S 151-152). All school buildings had access to a bank of iPads that were allocated to each key learning area. However, as Sarah commented, the internet access was not always reliable, and this made using the iPads “quite problematic” (S 156). So, while the school had endeavoured to ensure access, there were still technical infrastructure issues including poor internet connection that hindered access to ICT.

The school employed an eLearning Teacher in a Leading Teacher position. Leading teachers are highly-skilled practitioners, who have leadership and management roles within a school to improve the skills, knowledge and performance of its teachers (Victorian Department of Education and Training, 2019f). Typically, an eLearning teacher in a Leading Teacher position would have the responsibility to work with classroom teachers to support the pedagogical use of ICT in teaching and learning programs. This suggested that the school valued ICT and considered that teachers, including teacher mentors, required ongoing pedagogical support to use ICT for the delivery of curriculum. In addition, the College had information technology (IT) technicians that supported teachers with technical issues, which was similar to all the other schools in this research study. Sarah used the IT technicians as a resource but did comment that they were “busy”, suggesting that there were possible tensions in obtaining the timely support she desired. Arguably then, this affected her ability to use ICT in her teaching practice and subsequently to support the pre-service teacher to use ICT during the teaching practicum.

5.1.3.2. Introducing Sarah

Sarah graduated in 2010 and had taught secondary school classes in a small rural school in Victoria prior to taking up a position at Rusden P–12 College in 2014. At the time of data collection in 2018, Sarah was predominantly teaching senior secondary classes in the area of VCE Food Studies (VCAA, 2019b) and also some VET Hospitality Studies (VCAA, 2019e). She also held the role of Year 12 Team Leader (or Year 12 Coordinator) in 2018.

Sarah had previously undertaken teacher mentor training, completing both the ‘AITSL supervising pre-service teachers-–online program’ (AITSL, 2019b) and a school-based general in-service teacher mentor training program. As discussed in chapter 2, mentor training was often not undertaken by teachers so Sarah was an exception in undertaking two types of mentor training. Sarah had previously mentored a couple of pre-service teachers, primarily in the areas of VCE Food Studies (VCAA, 2019b) and Health Education (VCAA, 2019i). In 2018, her pre-service teacher’s major methods were Home Economics and Art. Sarah considered herself very competent with using ICT in the classroom and identified that she believed ICT was very important to teaching.

Sarah had a school-issued laptop computer in line with state government policy (Victorian Department of Education and Training, 2019j), and identified that she used the following ICT tools in her classroom:

- digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard (IWB), smartphone, digital camera
- web 2.0 tools such as blog, wiki, social media, surveys and polls, comic creator
- school intranet and/or learning management system such as Schoology, Moodle, Compass
- online searching using the internet
- digital resources from repositories such as Scootle, FUSE, ABC Splash
- software such as PowerPoint, Excel, Word, Publisher
- applications (apps) or widgets.

According to the transcript of her interview, Sarah demonstrated a strong knowledge of most of the ICT tools she had identified. She reported using a range of digital devices and confidently spoke about how she used iPads, laptops and smartphones in the classroom. However, Sarah did highlight that access for her students to each of these devices was problematic due to the building where she taught, which lacked access to both laptop trolleys and quality internet. These barriers are discussed later in this section under the heading ‘5.1.3.3. Sarah’s views on barriers and enablers to using ICT’. Yet despite these barriers she encountered, Sarah was positive when explaining how she endeavoured to use these digital tools as part of her teaching program. She also spoke about how she supported the pre-service teacher to use some of these ICT tools (digital devices, applications (apps), software and the internet) during teaching practicum.

Sarah stated that she generally did not use the ubiquitous software presentation tool, PowerPoint (Microsoft Corporation, 2016), to present information to students because "the students do not engage with it [PowerPoint presentations] as much" (S 137). According to Sarah, this software was commonly used by most teachers, including teacher mentors, within the school to deliver content to students and so suggested that perhaps it was overused and maybe supported a teacher-directed, didactic pedagogical approach. Sarah emphasised that she preferred to use particular "apps" to teach content to provide variety in her pedagogical approaches and because the students were more likely to have access to iPads in her classroom. All of the apps Sarah identified, which she used on the iPad for classroom instruction, were free, and included PicCollage (Cardinal Blue, 2018), which edits photos and video to make collages; Easy Diet Diary (Xyris Software, 2017), which counts kilojoules and tracks diets based on Australian foods; iMovie (Apple Inc., 2019b), which edits videos and photos by adding titles, themes, music and other effects; and FoodSwitch (The George Institute for Global Health, 2019), which provides easy-to-understand information about packaged food products and rates each food product using a colour-coded 'traffic light' labelling system and offers healthier options. The use of the Easy Diet Diary (Xyris Software, 2017) and FoodSwitch (The George Institute for Global Health, 2019) apps indicated that Sarah had an understanding of technological content knowledge by selecting ICT to deliver content. Sarah also stated she used web 2.0 tools such as online polls and quizzes to gather formative assessment from students, perhaps highlighting technological pedagogical knowledge. That is, the online quizzes were used primarily for her "… to determine what students know and what content I still need to teach them" (S 180–181). In addition, Sarah referred to using the school's learning management system for administration and reporting, and also stated that she used the Victorian Department of Education and Training's digital resources repository, FUSE (Victorian Department of Education and Training, 2019d) “to access digital content like videos … interactives … and websites to teach curriculum related to topics such as healthy eating, sustainability, Australian Guide [to Healthy Eating] and … food-related issues” (S 170–171). Thus, Sarah was mindful of using ICT to support student learning and said that she chose to use apps that were related to the curriculum (or content knowledge) she was teaching, thereby demonstrating understanding of technological content knowledge.

5.1.3.3. Sarah’s views on barriers and enablers to using ICT

Sarah’s interview transcript revealed that she considered that the potential of ICT was not being harnessed in her teaching practice due to the various barriers she encountered. Although Sarah identified confidence as an enabler to using ICT in her teaching practice and acknowledged that she believed in the importance of ICT, she also discussed how her strong desire to use ICT with her classes, and to support the pre-service teacher to use ICT during teaching practicum, was hampered by a lack of access to digital devices, a lack of school technical infrastructure; and a lack of support from school leadership. While not explicitly stated, Sarah suggested her competence and confidence were enablers to attempting to use ICT in the classroom. However, she did identify a lack of confidence as a barrier for the pre-service teacher to use ICT.

When discussing the challenges to using ICT in her teaching practice, Sarah emphatically stated “[l]ack of access was a barrier” (S 132). Sarah believed that using ICT was a vital part of the classroom, yet she consistently expressed a high level of frustration with accessing and using ICT for teaching, and therefore in supporting the pre-service teacher’s ICT uptake during teaching practicum. Sarah explicitly identified that lack of access was linked to lack of leadership support. She reported that her school had “iPads and … laptops and … some computer rooms, [yet] … some computer rooms [had been] … turned into classrooms for [greater classroom] space and there are now more laptop trolleys [as a result of losing access to computer rooms]" (S 142–144). However, not all of these options to access ICT were available to Sarah nor the pre-service teacher during teaching practicum. As previously stated, Sarah was timetabled in classrooms in a building that did not have a laptop trolley for her to access, so she was limited with the types of ICT that she, and consequently her pre-service teacher, could use.

> In the Food [Studies] area, you are not allowed to [access a laptop trolley as], the policy is that when you book a laptop trolley, you are only allowed to use it within that building. The building where Food [Studies] is [taught], there are no laptop trolleys in the building, so we are not able to book any trolleys and take them to the … [classroom]. We would have to book a different space. (S150–153)

Sarah also commented that even access to the laptop trolleys was problematic for other teachers that taught in buildings, in which there was access to laptop trolleys. "You have to book it [the laptop trolley]. With 2000 kids at the school, we probably have about ten laptop trolleys or something like that, [so] it is no doubt a big challenge" (S149–150). Thus, it seems that Sarah's school had challenges in meeting the ever-increasing demand for ICT, and this could reflect leadership issues – these leadership issues are raised later in this discussion.

Sarah went on to describe how she had to book her classes into a computer room, located in a different building to where she usually taught her classes, to enable her students to have access to laptops. This was also the situation for the pre-service teacher during the teaching practicum. Sarah, and therefore the pre-service teacher, were required to move the students from their regular classrooms to computer rooms, and as the availability of the computer rooms was dependent upon the timetable, forward planning and teacher judgement that students would be ready to complete the ICT tasks when the room was booked. This too created disruptions as students were required to move from one classroom to another and the "settling in of the students [to the new classroom environment] … often stole time [from teaching and learning]" (S 153). So, Sarah, and subsequently the pre-service teacher, knew the decision to use ICT impacted on time to teach the students, and these frustrations with access led Sarah to question the use of ICT due to its detrimental impact on teaching time. It suggests that even though traditional barriers to ICT use throughout school have dissipated, there were newer or different challenges related to accessing and using ICT.

As suggested previously, Sarah expressed some concerns with the school leadership. She declared that she had approached the school leadership personnel to discuss the lack of access to digital devices in the building where she taught. However, the response was that there was insufficient budget to purchase any laptops for the students to use in that building. "Each year we have pushed to have either a few laptops … They [the school leadership personnel] keep coming back with 'we have not got enough money'" (S 162–163). Yet, while Sarah highlighted that her persistence with requesting access to laptops in her building did pay off, it was short-lived. "[T]his year, we did have four computers … and then they [the school leadership personnel] took them away so we do not have any access to technology [ICT] in our space" (S 163–165). Consequently, this led to feelings of frustration.

Sarah also emphasised that the technical infrastructure at the school, namely the school's wifi network and to a lesser extent access to the IT technicians, were obstacles to using ICT in the classroom. Sarah acknowledged that she was able to book class sets of school-owned iPads to use in the building where she taught. However, Sarah reported that the reliability and robustness of the wifi in the classroom was problematic when using iPads. She described how the school's leadership personnel said they would resolve it next year, even though Sarah stated it was a current issue for her and her students. Sarah asserted "I have organised [class sets of] iPads quite a few times but the wifi is pretty bad in the [classroom] … They [the school leadership personnel] are looking at fixing that too next year. (S 153–155). Sarah went on to discuss how the type of digital tools available for her to use in the classroom was challenging as these digital tools relied on dependable and robust wifi connections. Therefore, the issues related to access to digital devices and school procedures regarding these digital devices impacted on Sarah's decision-making, leading to her to recall one particular time when she booked the school-owned iPads but her students were unable to access to the wifi and complete the set task. “The time that I have got class sets (*sic*) of iPads, about three quarters of the students could not get on to the network because of the poor connection” (S 155–156). This had similar ramifications for supporting the pre-service teacher to use ICT during the teaching practicum as well.

Sarah also advised that to address the challenges of access to school-owned iPads and laptops, the school introduced a ‘Bring your own device (BYOD)’ policy in 2012. However, according to Sarah, this did not overcome the barrier of access because it did not guarantee that all students had access to a digital device. “[S]ome students bring their own [digital device] but it makes it difficult because the majority do not have anything [digital devices] to be able to do anything that relies heavily on any form of IT application” (S 149). Sarah also asserted that despite having access to a digital device, it was still challenging to use ICT because the school did not provide a quality internet connection; this meant that during classes, student had to use their own data allocations to access the internet, and often students did not have any data allocation to use.

> The [student-owned] phones do work in the classroom but the student uses their own data [allocations] to complete their work. So, their phones are better [than having access to no digital device] but then you still have got half the students that have got no data [allocation]. It’s tricky. (S 158–159)

Sarah commented that one of the classrooms she typically used for her VCE Food Studies (VCAA, 2019b) classes did have some ICT in the form of a TV screen that projected content from a laptop or iPad for students to see. However, she stressed that this ICT did not always work.

> We have got a screen in our … classroom, that was also a barrier at that particular point [of the pre-service teacher's teaching practicum] because the TV screen played up in the first couple of weeks. So, she [the pre-service teacher] did actually plan and then the TV screen did not work. The majority of [the pre-service teacher's use of ICT] … were PowerPoint-based … [so] she had no way of using the presentations when the screen did not work. (S 136–140)

Sarah discussed how she was not able to resolve the issue due to lack of immediate availability of the IT technician. She identified that she endeavoured to help the pre-service teacher troubleshoot the issue, but they needed to wait until the IT technician was able to fix the screen because "the IT technician was busy" (S 166). Sarah implied that lack of timely access to technical support impacted on her decisions when supporting the pre-service teacher to using ICT in the classroom. The barriers that Sarah experienced as a teacher mentor were consequently also barriers for the pre-service teacher.

Sarah spoke in some detail about the importance of ICT confidence and some of the consequences that a lack of confidence had on her pre-service teacher. She said the pre-service teacher had concerns around her competence to use ICT, and that this influenced the pre-service teacher's decisions to use it. Sarah commented that the pre-service teacher felt overwhelmed by the complexity in teaching itself, and the need to understand so many elements, including classroom management.

> I kept encouraging other forms of ICT and showing other types of apps on iPads but it comes down to how that pre-service teacher feels about their confidence about managing the class amongst everything else … and understanding the curriculum, what she had to teach, the content. (S 8–11)

Sarah contended that the pre-service teacher saw some control in the classroom being lost through using ICT, stating that "it's about developing confidence that the pre-service teacher might have as a classroom teacher as well as [developing her] confidence when delivering [content with] ICT … and learning how to deal with technical issues" (S 8–10). Therefore, the technical issues impacted on the pre-service teacher's confidence to use ICT in the classroom. It could be also construed that Sarah believed that her role as teacher mentor was to develop the pre-service teacher in many aspects related to teaching and using ICT in the pre-service teacher's teaching practice was perceived as only one element among many that needed to be considered.

According to Sarah, the lack of pedagogical content knowledge of the pre-service teacher, which is discussed in more detail later in this case study, was due to lack of confidence about her understanding of content.

> I explained to her [the pre-service teacher] different aspects … [of] sustainability [the content to be taught in VCE Food Studies] … [I said] 'You could get the students to do this and this, or it could be a worksheet or it could be getting them to go onto this website' … I gave her lots of information about how she might take it [content related to aspects of sustainability] and as I said before, she was really leaning on me for how she should do every part [of the lesson]. I was like, 'Look at the theme, and do what you think would be best for you because I would be working differently'. I was trying to develop her, to develop that confidence. (S 114–119)

As Sarah explained, "for the theory [curriculum] … I kept coaching her [the pre-service teacher] through that [the theory/curriculum] to develop understanding and ideas … through the process, she started to become more confident. Part of that as well is that … it feeds into teacher practice with managing classrooms" (S 52–55). Therefore, Sarah highlighted that during the teaching practicum, the pre-service teacher tended to use ICT to support the management of the class, rather than for learning.

> Confidence was the biggest thing … I guess at times it's easier to have them [the students] in the classroom and quite structured, whereas once you bring iPads in you lose the sense of … control**.** Quite early on in her placement … she [the pre-service teacher] observed me … [and] I included … some form of ICT so she could see how it could be structured, and how as a teacher you build in and embed that expectation for the use and the purpose of the ICT to that particular session. (S 121–127)

Consequently, low-level (or teacher-directed) uses of ICT were employed by the pre-service teacher to build her teaching confidence by ensuring control in the classroom and assisting with delivering content. Sarah considered that the potential of ICT was not easily harnessed with the resources available to her, and this impacted on the decision-making when supporting the pre-service teacher to use ICT during teaching practicum.

5.1.3.4. Sarah's views on mentoring knowledge

As a relatively new teacher, Sarah had not had much mentoring experience. Sarah stated she was given the responsibility of mentoring a pre-service teacher for the first time in 2016. According to Sarah, "[w]e are allocated [a pre-service teacher] according to what the teaching methods of the pre-service teacher are" (S 168), confirming, as described in chapter 2, that the selection of mentors tended to be based on convenience and alignment to teaching methods rather than mentoring knowledge and skills of the teacher.

Although Sarah was nominated to supervise a pre-service teacher by the school leadership personnel, this was a role that she wanted to undertake successfully. This can be illustrated by the fact that Sarah voluntarily chose to complete the 'AITSL supervising pre-service teachers-–online program' (AITSL, 2019b) to help her understand mentoring. According to Sarah, she believed that the mentor training course would enhance her ability to be a teacher mentor.

> I did the training [AITSL supervising pre-service teachers – online program] off my own bat because I had not been a mentor before. Because I like to be prepared and I like to be able to make sure that I am doing the best thing for the pre-service teacher. (S 77–78)

Sarah indicated that she needed more than the knowledge and experience of teaching to be a teacher mentor. Sarah stated "I just did some research and found the AITSL one [mentoring program] and did that" (S 78–79), indicating that she was proactive in searching for professional learning to assist her with obtaining a better understanding of the requirements to be a teacher mentor to a pre-service teacher. Consistent with the research literature in chapter 2, Sarah suggested that there were no expectations from the school for her to undertake mentor training, and consequently no support provided from the school in terms of time release from teaching to complete the online course. Therefore, Sarah used her initiative to complete the training in her own time. Sarah also emphasised that her personal experiences as a pre-service teacher were “fantastic” (S 41) and “amazing” (S 79). Sarah asserted that “[I] always keep that [the personal experiences of being mentored] in the back of my mind when I am talking about mentoring pre-service teachers” (S 41–43), insinuating that knowledge of mentoring is unique and different to the knowledge of teaching. Perhaps Sarah recognised during her time as a pre-service teacher that her teacher mentors had knowledge and skills beyond that of being an experienced teacher, which contributed to her experiences during teaching practicum, and so Sarah realised she needed to undertake specific training to be a teacher mentor to obtain this capacity.

Sarah claimed that because she had undertaken mentor training that she had “got that background knowledge [to enable the pre-service teacher] … to have a rewarding time [when on teaching practicum]” (S 43–44). Thus, Sarah’s decision to undertake mentor training did suggest that she thought that her teaching experience was not all that was required to mentor a pre-service teacher.

5.1.3.5. Sarah’s views on TPACK

Sarah discussed the importance of content knowledge, pedagogical knowledge, pedagogical content knowledge, technological pedagogical knowledge and consequently TPACK to support the pre-service teachers to use ICT during teaching practicum. Specifically, the transcript of Sarah’s interview revealed that she believed that content knowledge had a greater role to play than either pedagogical knowledge or technological knowledge when using ICT. She asserted that “if you are not really clear on content knowledge, it makes it really hard to understand how you might teach that in an engaging way that could include technology" (S73–75). Therefore, indicating that technological content knowledge and technological pedagogical knowledge were also impacted.

As mentioned, Sarah thought that content knowledge was vital for the pre-service teacher being able to use ICT in the teaching practicum. She stated that "content is what guides you to work out what to teach and how to teach it … so you need to know the theory first" (S 172–173). She also commented that the pre-service teacher did not have a strong understanding of the theoretical underpinnings of content related to VCE Food Studies (VCAA, 2019b), which therefore impacted on her ICT uptake. As Sarah explained, "for the theory, she [the pre-service teacher] really wanted to rely heavily upon me" (S 52). Sarah stressed that the focus of their discussions was primarily on content, highlighting that understanding content knowledge was a priority for the pre-service teacher. She asserted that learning knowledge about curriculum took precedence over the pre-service teacher developing pedagogical approaches that would include the use of ICT to teach content during the teaching practicum. Therefore, the development of the pre-service teacher's technological content knowledge and technological pedagogical knowledge was not considered a priority.

Sarah further elaborated that the pre-service teacher sometimes found the content "quite overwhelming" (S 111) when planning lessons, and that teaching with ICT meant she had "less control … [which was] quite daunting for her [the pre-service teacher]" (S 112). Sarah stated that the pre-service teacher used PowerPoint (Microsoft Corporation, 2016) presentations and YouTube (YouTube, 2019) video clips at a "basic level" (S 134) and described "that is what she [the pre-service teacher] is comfortable with and I understand that … when you are learning how to be a teacher, if you have got that [content] up on the screen, you then remember what you have to do next … it is like the typed up lesson plan" (S 137–140). Sarah highlighted that because the pre-service teacher was learning about how to teach the curriculum, she wanted to organise her lesson so that she felt in control and did not want to have her position of authority in the classroom challenged. Sarah implied that bringing in ICT to teach content contributed to the pre-service teacher being forced to let go of some of that control. Thus, Sarah discussed that the pre-service teacher used ICT as a tool to structure or guide her lesson and therefore scaffold how the content was delivered in a didactic manner during teaching practicum. It could be suggested that ICT was used as a prop to support the pre-service teacher when learning to become a teacher. It could also be interpreted that there were limited opportunities for technological pedagogical knowledge because ICT was just being used in a teacher-directed manner. It could also be suggested that there were no opportunities to develop technological content knowledge because the pre-service teacher did not have adequate content knowledge to consider content-related ICT tools to use. Consequently, there was no development of TPACK.

Similarly, Sarah said the preservice teacher lacked pedagogical knowledge, which she considered was important to teaching, but to a lesser extent than content knowledge, and specifically remarked "I wanted to push her to take ownership of those classes and making it (*sic*) hers … with her own [pedagogical] approaches" (S 111–112). Sarah also commented that she wanted to support the pre-service teacher to use ICT in the teaching practicum (i.e. support the pre-service teacher's technological pedagogical knowledge), as she believed that it was an important tool for learning. Sarah said that because of the lack of knowledge of content as well as pedagogy, and therefore a lack of pedagogical content knowledge, the pre-service teacher tended to only think about using 'low end' ICT applications. She said that she had discussed with the pre-service teacher "how she [the pre-service teacher] could get that lower-level entry with PowerPoint and YouTube" (S 30–31) so that the pre-service teacher could meet the relevant AITSL teacher standards related to standard 2 'Know the content and how to teach it' (AITSL, 2018b) (see Table 1). Sarah suggested that the pre-service teacher was somewhat reluctant to use ICT, arguably because she felt overwhelmed by teaching itself and was prioritising learning content knowledge. Therefore, it could be construed that the pre-service teacher also had limited opportunities to develop other domains of knowledge such as pedagogical content knowledge, technological pedagogical knowledge and technological content knowledge as the pre-service teacher's focus was on developing content knowledge. Perhaps this aligned more with Pierson's model (1999, 2001) described in chapter 2 where the ellipses of types of knowledge were not similarly sized, and the circle depicting technological knowledge is smaller in size and so represents less emphasis than the other knowledge domains (see Figure 5).

Therefore, Sarah highlighted that content knowledge took priority, and so hindered the pre-service teacher's pedagogical knowledge, pedagogical content knowledge, technological content knowledge and technological pedagogical knowledge and consequently TPACK. Sarah emphasised that the pre-service teacher was reluctant to give students too much flexibility or freedom as the pre-service teacher was learning how to structure and control a class. As previously mentioned, introducing ICT was considered to decrease this classroom control of the pre-service teacher. Perhaps this suggests that Sarah understood that basic use of ICT was required to support the pre-service teacher meet the appropriate ICT standards at a graduate level (AITSL, 2018b), and the pre-service teacher needed to continue to develop her demonstration of teacher standards throughout her teaching career.

5.1.4. Case study 2: Charles

5.1.4.1. About Ebden College

The second case study documents Charles who taught at Ebden College, a large secondary Catholic school for boys located on two campuses in two locations in the northern suburbs of Melbourne. Ebden College had an enrolment of just under 1900 students from Years 7 to 12, with 160 full-time equivalent academic staff and 55 full-time equivalent support staff in 2018. Twenty-six per cent of students were from a language background other than English and one per cent were from Aboriginal or Torres Strait Islander peoples. The College's Index of Community Socio-educational Advantage value of 1052 was above the average value of 1000 for Australian schools (ACARA, 2019b), and indicated that the students at Ebden

College had a higher level of educational advantage than other Australian students. This value was much higher than Rusden P–12 College, where Sarah (first case study) taught.

The College offered the Victorian Curriculum F–10 (VCAA, 2018a), with content from the Digital Technologies learning area (VCAA, 2015c) being explicitly taught as a standalone subject in Years 7 and 9. In addition, according to Charles, there was an expectation that teachers would use ICT throughout their teaching and learning program but he suggested that perhaps this was not evident at Ebden College. Charles felt that many teachers at Ebden College chose not to use ICT, or only chose limited applications to add to their teaching practice. There was also a variety of pathways for senior students through a comprehensive range of VCE studies (VCAA, 2019g) as well as VET (VCAA, 2019l) and VCAL (VCAA, 2019f) offered at Ebden College.

Ebden College consisted of generally older-style buildings that were built in the late 1960s. Ebden College also recently had a new eLearning Centre constructed in 2017; this building consisted of two dedicated classrooms with state-of-the-art technology including "top-end computers" (C 84) and individual projectors and screens at each cluster of tables. These classrooms were used for activities in senior Media classes, such as very fast rendering, and activities in Music classes, such as creating music using software on the computers. According to Charles, there was an expectation that virtual reality [VR] experiences would also be undertaken in these rooms. "[T]he next step will be for VR [experiences] as well because they [virtual reality software] can run faster here than on our older computers" (C 86). Charles proudly claimed that "we have lots of great things occurring around here [in the new classrooms] (C 404). He also declared "[w]e have wifi … for the whole school and that is getting better and better" (C 359–360). Charles firmly believed the new classrooms would assist teachers, and subsequently teacher mentors, to change their approaches to teaching. His comments suggested that perhaps he considered ICT as being simple to use if teachers, and therefore teacher mentors, were provided with the tools and spaces to use them.

> [The new classrooms are] … a really nice space to be in. Some teachers just like the space … [and I say] 'feel free to teach how you want in this space, you can do your usual thing, you can do something crazy, the space is there to help you use it [ICT]'. (407–409)

Charles' excitement for the new teaching spaces was very conspicuous, and his belief that these new teaching spaces could change how teachers and teacher mentors taught will be discussed further, under the heading '5.1.4.5. Charles' views on TPACK'.

In 2018, Ebden College was in its final year of transitioning from an iPad to a Microsoft (Microsoft Corporation, 2019a) school. Students in Years 9 and 12 were the two final year levels that leased iPads; the students in the remaining year levels leased Microsoft laptops. It was planned that in 2019, all students would have access to laptops, with students in Years 7–9 having a less powerful device than those in Years 10–12. This had implications for Charles when supporting the pre-service teacher to use ICT in the teaching practicum as there were different types of devices being used by students according to their year levels. Therefore, Charles needed to assist the pre-service teacher to make decisions regarding the most appropriate types of ICT to be used based on digital devices being utilised by students.

5.1.4.2. Introducing Charles

Charles was a male secondary school teacher who was relatively new to teaching as he had only been teaching six years, since the beginning of 2012, and only at his current school. He had mainly been teaching secondary Science curriculum throughout this time. Charles had previously mentored three to four pre-service teachers but had not undertaken any training to be a teacher mentor, unlike Sarah (first case study). Similar to Sarah, Charles considered himself very competent in using ICT in the classroom and believed that the use of ICT was very important to teaching. Charles was enthusiastic about using ICT and appeared to have a great interest in using ICT in his personal life and for classroom instruction. He stated emphatically that "I am a big user of digital solutions for things…I use lots of them in my classroom" (C 47-48).

In 2018, Charles taught Year 9 Victorian Curriculum F–10: Science (VCAA, 2019j) and Year 12 VCE Biology (VCAA, 2019a) as well as having held the responsibility position of eLearning Coordinator. The eLearning coordination role required Charles to work with other classroom teachers to support the pedagogical use of ICT in teaching and learning programs, and was a similar role to that of an eLearning coach or eLearning teacher. Charles' eagerness to use ICT and to support colleagues to do similarly in their classrooms was reflected in his comments throughout the interview such as "… being able to have seamless, invisible tech is really important for everyone" (C133) and "… the world is too rich with technology to ignore it" (C 347–348). Charles also stated that he was very "passionate" about using ICT and said it was his job as a teacher to "make a difference with using ICT" (C 336). He implied that this was the job of the pre-service teacher as well.

Charles demonstrated a high awareness of ICT tools by indicating he used the following ICT tools in his teaching practice:

- digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard (IWB), smartphone, digital camera
- school intranet and/or learning management system such as Schoology, Moodle, Compass
- web 2.0 tools such as blog, wiki, social media, surveys and polls, comic creator
- online searching using the internet
- digital resources from Scootle, FUSE, ABC Splash
- software such as PowerPoint, Excel, Word, Publisher
- applications or widgets.
- robotics such as Bee-Bot, drones, Pro-Bots.

Interestingly, while Charles identified several ICT tools in his interview, he only discussed two in detail in relation to his use of ICT in the classroom: OneNote (Microsoft Corporation, 2003), a note-taking tool that includes text, tables, pictures, and drawings that is used for collecting, organising and sharing information online; and virtual reality (VR) software, which simulates three-dimensional images or environments that can be interacted with using special electronic equipment. This suggested a bit of a mismatch between what he said and what he did. Charles identified that he was responsible for ensuring his teaching colleagues used OneNote (Microsoft Corporation, 2003) because of his role as the eLearning Coordinator. He claimed “it was kind of my goal to really push OneNote in our school because we are a Microsoft school” (C 69–70), suggesting that the use of OneNote was being promoted because of the school’s affiliation with Microsoft and OneNote’s availability to teachers, and perhaps not being driven by a curriculum or pedagogical need. Charles went on to assert “… it’s kind of the way it works in a school” (C 70), implying that the teachers were expected to use ICT tools that have been provided by the school leadership.

Charles also discussed his interest in using virtual reality software and hardware and the ways in which it could be used in his school. He was eager to supervise pre-service teachers as he assumed that they would come with this knowledge. Charles enthusiastically disclosed that his goal to have virtual reality experiences in the classroom would most likely be achieved because the pre-service teacher had arrived at the school with knowledge and skills in this area. Charles claimed “[t]hat’s how we are dealing with VR [virtual reality] at the moment. It is really serendipitous. Someone [the pre-service teacher] coming into it already having interest in it [virtual reality] and we having an interest in it and it worked really well” (C 74 75). This suggested that Charles had an open and ‘can do’ attitude to using new ICT tools when opportunities to do so arose. It also appeared that Charles was waiting for someone to come in and use virtual reality software and hardware, and this was the impetus to have virtual reality experiences, rather than a pedagogical reason. This will be discussed in more detail later, under the headings ‘5.1.4.3. Charles’ views on mentoring’ and ‘5.1.4.5. Charles’ views on TPACK’.

5.1.4.3. Charles’ views on barriers and enablers to using ICT

Key themes related to barriers and enablers to using ICT that emerged from Charles’ interview are now discussed. Unlike Sarah (first case study) who mainly spoke about access issues, Charles focused on personal (or human factors) such as time and knowledge and skills as challenges to mentoring pre-service teachers to use ICT during the teaching practicum.

According to Charles, time was a barrier in three main areas: in terms of time for the teacher mentor to develop knowledge and skills about how to use specific ICT tools (i.e. time to develop technological knowledge, and how this would enable the subsequent development of technological pedagogical knowledge, technological content knowledge and TPACK); time available for the teacher mentors to work with pre-service teachers to develop their technological pedagogical knowledge, technological content knowledge and TPACK; and finally time to embed ICT into school culture. He also identified that knowledge and skills of the pre-service teachers as an enabler to using ICT, along with identifying access to ICT, technical infrastructure, leadership support, teacher beliefs and age of pre-service teachers as other enablers to using ICT. Charles was so enthusiastic about using ICT that he tended to downplay any possible complexities in its use in the classroom.

As mentioned, time was accentuated by Charles as a significant barrier in three ways. First, Charles identified that it took time for teacher mentors to learn knowledge and skills to use ICT. His responses throughout the interview assumed mentoring pre-service teachers would naturally include supporting the use of ICT in the teaching practicum, and so implied that time was only required for the teacher mentor to develop technological knowledge and this would naturally contribute to the development of technological pedagogical knowledge, technological content knowledge and therefore TPACK. This suggested that Charles believed that not all teachers had the capacity to use ICT in teaching practice even though they were selected to be teacher mentors. Charles declared "… you need to learn the possibilities of it [ICT] … in order to ensure teacher mentors support pre-service teachers [to use ICT in the classroom]" (C 63). As mentioned earlier, he believed that pre-service teachers came with technological knowledge so time was not required by them to develop this knowledge domain.

Charles emphasised that his role as eLearning Coordinator provided opportunities to support teacher mentors to develop technological knowledge and subsequently technological pedagogical knowledge, technological content knowledge and TPACK. However, Charles suggested that teacher mentors lacked time to learn ICT knowledge and skills and consider ways to incorporate it into their lessons because they prioritised other aspects of teaching. He discussed how time was “precious” and teacher mentors may find it “challenging to find time to support the pre-service teachers to use ICT [if the teacher mentors had not developed ICT knowledge and skills themselves]” (C 335). Charles implied that using ICT was not necessarily part and parcel of teaching practice, and identified that technological knowledge needed to be learnt by the teacher mentors so they could assist pre-service teachers to use ICT during teaching practicum. He believed that the age of teacher mentors was an influence on ICT uptake in the classroom, and emphatically declared “[t]he only people I know who are less willing, not against it *(sic)*, are older staff members, and that is because it is a lack of experience of it” (C245–246).

Interestingly, Charles also believed ICT uptake would then easily occur once technical skills were evident, and made assumptions that other knowledge domains of TPACK would also occur. While he considered that time was important, somewhat paradoxically, he was also quite dismissive when discussing time as a barrier as he believed competence to use ICT could be quickly accomplished. Although he identified that teacher mentors needed time to learn about ICT tools, he also indicated that it was a simple process for teacher mentors to understand how to use ICT tools in the classroom once they were shown. “[M]y experiences of the staff here, those who are not very [ICT] savvy, [those that] are not technical, but once you show them what … [the ICT tools] can do, they are more than willing to pick it up and give it a go” (C 350–351). This perhaps suggested that Charles had a narrow view about the complexity of teaching with ICT and assumed that teacher mentors would be able to intuitively use digital tools in teaching practice, thereby demonstrating technological knowledge, technological pedagogical knowledge, technological content knowledge and subsequently TPACK, if shown by him.

> We are kind of having dedicated subjects to it [teaching the Victorian Curriculum F–10: Digital Technologies content]. I really wish that people would realise that you can do all that stuff in all of the subjects, but we will get there, it just takes time … what we are understanding that it will take time to best understand how to implement that stuff [ICT in the subjects]. (C 93–96)

Secondly, Charles identified time for the teacher mentor to support the pre-service teacher to use ICT and asserted that "[w]e are so rushed off our feet …" (C 62), signifying that teachers are busy "… grappling with other aspects" (C 324) of school life such as faculty meetings, report writing, lesson planning and so forth, and so "[i]t can be challenging to find time to do things outside of the typical tasks of a teacher … [such as undertaking teacher mentoring roles]" (C 325). He also assumed that the pre-service teachers brought technological knowledge with them because of their age, so generally Charles' discussion referred to time for the teacher mentor to support the development of technological pedagogical knowledge, technological content knowledge and TPACK of the pre-service teacher. "With the pre-service teachers that we have, we basically ask all the same question which is 'What do you want to do with ICT?'" (C 312–313). This is further discussed later under the heading '5.1.4.5. Charles' views on TPACK'.

Remarkably, while Charles identified time was a concern for other teacher mentors at his school, he claimed that because he had the role of eLearning Coordinator, unlike these teacher mentors, he had time to dedicate to assist pre-service teachers to use ICT in the classroom, and so develop their technological pedagogical knowledge, technological content knowledge and TPACK. "Myself who looks after this [new technology] building has time to dedicate to this [supporting pre-service teachers to use ICT]" (C 326). He stated that his role as an eLearning Coordinator was to ensure that both the pre-service teachers and teacher mentors would use ICT during teaching practicums.

> I would say that if I did not see them [the pre-service teachers] using some type of technology [ICT] in the classroom I would have a chat to them [the teacher mentor]. You would have to have a conversation and say that it is part of the [AITSL teacher] standards and it is also good practice as a teacher [mentor] that you need to engage with them [the pre-service teacher] on a number of different platforms [using ICT]. (C 344–347)

Thus, Charles' considered his role provided him the opportunity to support pre-service teachers to use ICT whereas other teacher mentors may not have this time.

Thirdly, Charles identified that pre-service teachers needed time to "learn about the school context" (C 296) and commended the RMIT-approach to teaching practicums, whereby pre-service teachers had the opportunity to learn about the school context for several weeks prior to their teaching practicum. Charles identified that pre-service teachers were provided with time to learn the school context, which he regarded as an enabler to using ICT during teaching practicum.

> I think [it is] a more holistic way of having a placement; they [the pre-service teachers] spend the first four weeks I guess preparing, doing research into the actual school and getting a real embedded experience of the school and then … come … [later] and actually implement a very specific and tailored program. (C11-14)

Charles acknowledged that "[i]t takes time for it [use of ICT] to be embedded into a school" (C 97) and reinforced how important it was for the pre-service teacher to understand the school context.

> [T]hat has been one of the advantages of this type of placement is that they [pre-service teachers] have had time so part of what they need to do is learn about the school, learn about what we do here, giving them that time, and concentrating more on the practices of the school rather than just getting up and teaching about the content. So, I think time is a really important thing. (C 238–243)

Consequently, Charles believed that time to learn about the school context was required to know how to incorporate ICT into one's skillsets, subjects and school practice. However, the complexity of using ICT within his school context was perhaps overlooked by Charles, especially as he repeatedly spoke about providing access to digital tools to facilitate the pre-service teacher's use of ICT and conceivably discounted the intricate factors that intertwine to support the use of ICT during teaching practicum. Possibly Charles also revealed his understanding of the school context was rather limited by only referring to discussing resources available for the pre-service teacher to use.

> So, allowing that time to better understand the context of the school. Schools have different levels of access, some schools may not have the facilities for students to easily access whatever it is and we are really fortunate here that we have pretty good access and if we don't we can always ask IT [technicians] 'can you please sort this out for us' and other schools may not have as you were saying before, it depends on the context of the school massively. (C 305–309)

Charles' views on time to learn the school context perhaps contradicted his earlier comments regarding the provision of space and knowledge about ICT tools being enough motivation for the teacher mentors and pre-service teachers to use ICT. Therefore, although Charles identified time to be involved in the mentoring relationship was relevant to learn technical skills for the teacher mentors, time also had implications for the pre-service teacher, especially in regard to learning the potential pedagogical uses of ICT tools and understanding the school culture.

Charles identified access to ICT as a factor in supporting teacher mentors to use ICT, and considered it was the most important factor influencing use of ICT in the classroom. He believed that the availability of ICT at Ebden College was enough incentive for teacher mentors to use it, and in particular highlighted the construction of the new classrooms as being an enabler. Charles' comments throughout the interview suggested that he believed this access would overcome any other barriers to using ICT. "There are endless possibilities for all teacher mentors [to use ICT] in this space, no excuses for anyone not to give it a go" (C409–410). However, despite Charles' comments indicating that he was delighted with the availability of ICT resources at Ebden College, he also lamented that the school did not have access to all available ICT resources.

> So, it is a pretty technology-rich school, and a lot of other schools are too, and I have been to … [these schools that] are doing it better as they have lots of resources, a lot more than we have because technology [ICT] can be expensive. (C 386–387)

His comments implied that the more ICT tools that teacher mentors had access to, the better the use of ICT would be. Charles also implied that money was required to access ICT resources, and hinted that teacher mentors at better funded, 'more fortunate' schools were able to do better things with ICT because these schools could afford to purchase ICT tools.

Like Sarah, Charles thought having a good technical infrastructure in the school was important to ensuring access to the internet and therefore ICT uptake. He stated that obtaining reliable access to the internet had been "technically challenging" (C359) for Ebden College and "took several years to achieve" (C 360) because of the school's older buildings and also because the internet goes through both the Catholic Education Office's and school's filters. Charles reflected that providing quality technical infrastructure would be an ongoing concern for the school, especially as the school continued to grow. As he commented "we are a big school, big place, lots of uses of it [ICT] at the same time. [He questioned] 'How do we keep up?' [and] 'How do we meet the demand?'" (C 361). However, his later comment that "everything has [now] been teed up so that access is really good … we have really nailed it" (C 363–364) confirmed that perhaps the speed of this technical infrastructure roll out had been too slow, and quite possibly that there has been a lack of policy and implementation planning. Charles may have believed that having an adequate technical infrastructure alone would be sufficient to support ICT uptake, which as previously discussed, contributed to providing access to teacher mentors to support pre-service teachers to use ICT during teaching practicum. As mentioned earlier, possibly Charles was overlooking the complexity of issues identified in regard to the uptake of ICT in teaching practice.

Charles was very complimentary about the school leadership at Ebden College. He identified being in a leadership position himself and that having supportive and like-minded colleagues in leadership was instrumental in championing him and other teachers, including teacher mentors, to use ICT. “[W]e have had people in leadership positions and we have been able to do great things because we are in leadership positions. We can make those calls so there is one less level of bureaucracy to deal with” (C 328–329). Charles also identified that he and these teaching colleagues in leadership positions were “of similar mind sets” (C 332). Therefore, he considered leadership support as very important for ICT uptake.

While having ICT knowledge and skills was seen by Charles as an important enabler, he also strongly believed that a positive mindset and self-efficacy in using ICT was vital. As he commented, “it is just the mindset of the staff and that the mentality … to be really receptive of [ICT] stuff … they need to know, to believe in themselves that they can use it” (C 274–276). Charles also asserted that “[p]re-service teachers are all relatively savvy with [ICT] …” (C 343) and “[t]hey have a belief it [ICT] should be used and definitely they have discipline and confidence” (C 354). Charles eagerly declared that “definitely being passionate, it makes a difference as a teacher [mentor], as a student [pre-service teacher] … [to use ICT]” (C 336). Charles repeatedly spoke about “passion” (C 384) as an influential factor. He declared that “you get up [to present] about things you are passionate about like using ICT in the classroom … That’s a really good opportunity to get it out there” (C 288–290).

5.1.4.4. Charles’ views on knowledge of mentoring

Charles stated that teachers at his school either volunteered or were asked to be teacher mentors. Charles’ reasons for the selection of teacher mentors are consistent with the discussion in chapter 2. According to Charles, most teacher mentors “put their hands up … [and] are excited about it and really like the idea of it” (C 261–262) implying that enthusiasm was a useful characteristic for a teacher mentor. Charles also claimed that Ebden College had “a long tradition of it [mentoring pre-service teachers]” (C 263) and so suggested mentoring was considered part of the responsibility of being a teacher.

Charles was quite adamant in his views that his main role as a teacher mentor was to provide “direction and expertise [to the pre-service teacher]” (C 175). Furthermore, it seems that this direction was related to confidence to deliver instructional support, that is technical know-how, to be able to use particular ICT tools in the classroom (a similar to view to that of the first case study, Sarah). Charles’ comments tended to infer that he had a ‘master/apprenticeship’ view of mentoring.

> I think it is important that the pre-service teacher gets to observe me using ICT a lot first … They [the pre-service teacher] will see how I am using this [ICT tool] in my classroom or this is a great thing or I know something that is better than that. Giving them time to observe is a really important thing to do. (C 295–298)

Charles emphasised the ‘instructional coach’ approach to mentoring as he firmly believed that there would be a transference of knowledge and skills and did not consider any other knowledge, besides technological knowledge, specifically technical skills, would be necessary for the pre-service teacher to use ICT in the classroom. Charles believed that providing ideas of ways to use ICT in the classroom would be enough direction for pre-service teachers to develop technological pedagogical knowledge to understand how to use ICT in teaching practicums. He stated “[y]ou need to learn the possibilities of it [ICT]” (C 63); Charles believed that his leadership role as eLearning Coordinator provided the guidance to pre-service teachers to incorporate ICT into their lessons. “I really pushed them [pre-service teachers] to think outside the box when it comes to ICT” (C 47).

> I have been mentoring student teachers [pre-service teachers] for many years and they have all been willing to try things and have been really positive towards it. They have not come in with any pre-conceived ideas apart from being really excited by it. ‘Oh, I did not know that was even possible that we could do that in the classroom, I should really do this’. (C 250–253)

Charles believed that the pre-service teacher only required technological knowledge to use ICT in the classroom. He did not consider that the pre-service teacher needed to have an understanding of content knowledge or pedagogical knowledge, let alone technological pedagogical knowledge, technological content knowledge or TPACK to use ICT in the teaching practicum. He acknowledged that "everyone's technical ability is different" (C342) but insisted that once the pre-service teachers are shown what the ICT tool can do, they would willingly use it in the classroom. He claimed that "[y]ou just have to put it [ICT] out there and wait for it to come back to you. When they [the pre-service teachers] are ready for it" (C 72). This limited view of mentoring also overlooked other roles of the teacher mentor in supporting the pre-service teacher to use ICT, such as providing emotional support and being a socialising agent that were described in chapter 2. Charles also disregarded any reciprocity between the teacher mentor and pre-service teacher as he considered the teacher mentor would be the 'master' in a master/apprentice-style relationship, providing all the support and that the pre-service teacher would not contribute to the relationship at all.

Charles also seemed to have a somewhat limited view of how ICT could be used in teaching practice, and this became more evident when he discussed the AITSL teacher standards (AITSL, 2018b). As discussed in chapter 2, there are three teacher standards relating specifically to ICT (refer to Table 1). While Charles commented that he had a good understanding of these teacher standards, his discussion tended to only recount teacher standards relating to ICT collectively – he did not delineate between them, suggesting that he possibly only considered technical skills generally as the means to demonstrate these standards. This is discussed further in the ensuing paragraphs, under the heading '5.1.4.5. Charles' views on TPACK'.

However, Charles' enthusiasm for using ICT cannot be underestimated. Charles believed that he needed to provide support to enable the pre-service teacher to use ICT in the teaching practicum. This was reinforced earlier when Charles asserted that the pre-service teacher had the knowledge and skills to use ICT because of his age so Charles believed that pre-service teacher just needed his guidance to use ICT in different ways in the classroom. Charles claimed that he was, as a teacher mentor, "… willing to listen, offer support and all that kind of stuff" (C275) to enable the pre-service teacher to use ICT in the classroom.

> They [the pre-service teachers] come into a school and get thrown in the deep end straight away, which I think is fine as in many cases. You pick up things despite, you need that experience but also the time of learning a bit about it and knowing what is appropriate. (C 301–303)

Charles was genuinely excited by the highly-developed technical skills of the pre-service teacher, especially in regard to virtual reality. "That's what we are looking for and this takes time. For someone [like the pre-service teacher with ICT skills in virtual reality] to come in and say I can dedicate my time to do this" (C 62). Charles believed in the importance of technological knowledge and his interview transcript revealed that he believed pre-service teachers would be comfortable and confident with using ICT – that the pre-service teacher would inherently have technological knowledge. "It is an assumption now that everything [ICT such as interactive whiteboards or data projectors] will be there now and so they [pre-service teachers] are very comfortable in those types of spaces" (C 104–105).

As previously stated, Charles believed the pre-service teachers had the competence and confidence with using ICT and so his role was to provide ideas for different types of digital tools to use as the pre-service teacher had technological knowledge. He had a limited view of technological knowledge as he only considered technical skills. Charles perhaps underestimated the importance of technological pedagogical knowledge in supporting the pre-service teacher to use ICT in the classroom and this is also discussed further in the next section.

5.1.4.5. Charles' views on TPACK

Charles' interview transcripts revealed several points of view about the knowledge domains of TPACK. In particular, Charles' interview transcript revealed that he placed a huge importance on technological knowledge and downplayed the value of other domains of the TPACK framework, such as content knowledge, technological pedagogical knowledge, technological content knowledge and subsequently TPACK.

Charles emphasised the importance of technological knowledge (albeit a narrow view, focusing on the dimension of technical skills only), demonstrating a strong conviction in the use of ICT to support student learning. He identified that understanding about ICT tools and what these tools do was important for both the teacher mentor and the pre-service teacher. Charles was confident in his technological knowledge throughout the interview. He highlighted that he used ICT a lot in his teaching and asserted that he was "… very, very adept with ICT" (C 254–255) and "technical skills are important …" (C 201–202). He also assumed the pre-service teacher would naturally have high technological knowledge by virtue of their age.

> I know it [using ICT] is difficult, especially if you are a pre-service teacher who is more a mature-aged student and you are not as embedded into that, it is a lot easier for the pre-service teacher who has recently graduated [from secondary college]. I think it is a lot easier for them to go 'This makes a lot more sense as it is something that I use … It is something that I visit, or this is something that I do'. I think it is a lot easier and I think sharing that knowledge is really important. (C 210–215)

It also was apparent from the interview transcript that Charles' description of technological knowledge was teacher-directed where control of the use of ICT in the classroom was very much in his hands. He discussed the reasons for the school moving from an iPad to Microsoft platform was related to controlling student use of ICT. "[You] lack control [when students use iPads], you cannot monitor them and lots of kids are on games and that kind of stuff ... I want students to do what I tell them to do [when using ICT]" (C 163–166).

Charles also discussed using OneNote (Microsoft Corporation, 2003) for monitoring students, which he found was "… an excellent solution to giving feedback to students …" (C 50). However, he then discussed how virtual reality experiences could be used in the future for him to create a model of a cell "so the experience of teaching content related to cells would be done in a new way" (C 61–62), thus, suggesting an understanding of technological content knowledge and possibly TPACK.

Although Charles identified that he used many ICT tools in his classroom, he tended to emphasise the use of OneNote (Microsoft Corporation, 2003) and virtual reality experiences only, perhaps indicating that this practice did not match his perception. This was also reflected in the questionnaire results when Charles self-reported that he was aware of all the listed types of ICT in the classroom, demonstrating a strong awareness of a range of ICT tools. Yet from his interview transcript, this awareness did not translate into use in Charles' classroom. For example, as mentioned previously, when Charles discussed what ICT was used in his classroom, his dialogue mainly focused on using OneNote (Microsoft Corporation, 2003) and to a lesser extent what he was going to do with virtual reality software and hardware. He did mention other ICT tools, such as Quizlet (Sutherland, 2005), a memorisation tool to assist with recalling information; Minecraft (Microsoft Corporation, 2009), an educational video game series; Arduinos, open-source microcontrollers that include a processor, memory and input/output peripherals on a single chip; and a learning management system called SIMON (SIMON Web Based Solutions, 2017). However, these ICT tools were not discussed in any detail nor did he indicate how he used these tools in his teaching practice. While he was perhaps aware of many types of ICT tools, Charles was insightful about his use of ICT and identified that he now considers that he is more selective about the ICT tools that he uses in his teaching practice.

> When I first started teaching, I used technology [ICT] a lot and mostly as a crutch … because I was new to the profession. Basically, I used it as a back-up, whether I knew all the content or not … to kind of cover for my lack of experience essentially. As I have taught more, I kind of have realised that actually I do not need … [to use ICT] and rather than that being all that I do … it is a tool that you use selectively. (C 179–184)

This perhaps indicates that Charles was more reflective about his technological pedagogical knowledge and possibly technological content knowledge. It could also be proposed that perhaps Charles was developing a more robust view of the interconnectedness of the domains of knowledge and consequently TPACK.

In addition, Charles highlighted how the ever-changing nature of ICT was often problematic for teacher mentors to keep up-to-date and remain knowledgeable about specific types of ICT and how to use them. This also suggested Charles was referring to technological pedagogical knowledge being challenging due to the dynamic nature of ICT.

> [S]ome things [ICT tools] are in fashion for a while, you learn it and it gets superseded with something else or gets replaced and they go 'I've just finished learning this thing and now I have to learn this thing'. I think it is happening less and less these days as technology [ICT] does move so rapidly and it does adapt a lot easier than it used to. (C 246–249)

Although Charles discussed technological pedagogical knowledge, at times, his understanding seemed simplistic by suggesting it was easily achieved. Charles commented that there were opportunities to use ICT in ways that were "new possibilities" (C 64) and another way of teaching content. He asserted that using ICT as a teaching strategy is about "simply getting over … the 'tech hurdle' of understanding that this [using ICT] is not a scary thing ... [and getting] the aim out there" (C 65–67). Charles believed he only had to provide teachers, including teacher mentors, with the ICT tools for the next step to be made in regard to ICT uptake. He said "[s]o here's some programs that you can use and here's some guidelines that you can have and perhaps a rubric [for assessment] to go with that and then you modify it for your subject. That is, the next step for us, that's kind of what we are looking at when trying to apply it to every subject" (C 56–60).

Charles was very excited about the new learning management system that the school was beginning to implement. He commented that this system would enable staff to disseminate information, and that this could then free up time. He declared "we have changed our whole [faculty] meeting structure this year to give more opportunity [to issues related to teaching and learning because of the new learning management system]" (C 281–282). These comments reinforce earlier discussion where Charles made assumptions that teachers and teacher mentors just needed to be familiar with what ICT tools were available to be able to easily use them in their classrooms. That is, awareness of ICT tools and being shown how to use them was enough impetus for teachers and teacher mentors to use ICT and thereby demonstrate technological pedagogical knowledge and possibly technological content knowledge and TPACK. Charles downplayed the other knowledge domains such as content and pedagogy and suggested that technological pedagogical knowledge and possibly technological content knowledge and TPACK occurred through being exposed to ICT tools. This was a recurring theme throughout the interview with Charles, and was reflected in his comments regarding the lunchtime coding club where students learnt from one another to code.

> I bought a bunch of Arduinos so kids come in [at lunchtime] and they code … I get the kids that are experts at it [coding] and they run tutorials for other students. We have lots of STEM [Science, Technologies, Engineering, Mathematics] and science-based challenges throughout the year. It is mostly in our lunchtime club thing … and it frees up time to excel these students to use their passion and all that kind of stuff. (C 375-384)

Charles was perhaps also indicating that students would naturally learn to use ICT if they were provided with the opportunity and they were passionate about learning. Similarly, he consistently made assumptions throughout the interview that pre-service teachers would also use ICT because they utilise it in their personal lives and come with knowledge and skills to use ICT. Charles also implied that pre-service teachers would use ICT if they were shown ways to use it.

> I can imagine myself having the conversation and saying 'how can we support you?' Let's sit down … and let's show the great things we can do'. In many cases, they [pre-service teachers] are normally really wowed by it … they get just as excited as me. (C 348–352)

Yet while largely exposing the relative ease in using ICT in teaching practice, Charles was concerned that teaching colleagues at his school may not take advantage of the new Victorian Curriculum: Digital Technologies curriculum (VCAA, 2015c). This does tend to suggest a contracted view of ICT as he referred to it in a very narrow way. As Charles went on to explain, he was enthusiastic about the curriculum, believing that ICT would eventually be incorporated across all subjects (or curriculum areas) at his school, although he recognised his school was currently teaching ICT knowledge and skills in a dedicated subject. He was, perhaps, hopeful that some of the content from the Victorian Curriculum F–10: Digital Technologies curriculum area (VCAA, 2015c) could be explicitly taught in other subjects and also that ICT would be integrated throughout all subjects. However, he also thought that for some teachers it was "extremely shocking" (C 192) to entertain that they would use ICT in their subjects.

> I am someone who really believes it [ICT] is better throughout every subject. We do not necessarily have total integration in subjects, which I would love to see in the future, but we do have dedicated subjects to it [ICT]. I really wish that people would realise that you can do all that stuff in all of the subjects but we will get there. (C 190–195)

Charles maintained that technological knowledge (albeit a narrow view that focused on technical skills) was most important and his enthusiasm for using ICT cannot be underrated. He considered that the pre-service teacher would also confidently and competently use ICT in the teaching practicum purely by being shown ICT tools. While he considered time was important, Charles believed that TPACK would naturally occur because the pre-service teacher inherently had technological knowledge and that was the main domain of knowledge needed for ICT uptake during the teaching practicum.

5.1.5. Case study 2: Annie

5.1.5.1. About Nepean North Primary School

The third case study documents Annie who taught at Nepean North Primary School, which is a relatively new government school that was built in the emerging growth corridor of northern Melbourne in 2008. Nepean North Primary School had a population of just over 1000 students, 65 full-time equivalent teaching staff and 17 full-time equivalent non-teaching staff in 2018. The College's Index of Community Socio-educational Advantage value was 1035 and above the average value of 1000 for Australian schools (ACARA, 2019b), and indicated that the students at Nepean North Primary School had a higher level of educational advantage than other Australian students. This value was similar to Ebden College where Charles taught and much lower than Rusden P–12 College, where Sarah taught.

While not a teacher at Nepean North Primary School in the first year of its operation, Annie commented that during her time at the school, she has witnessed "a lot of growth" (A 12) and had observed that the "demographics have changed" (A. 13). As she explained, "[i]nitially we [the school] had a predominantly white Anglosaxon background and now it is more multicultural, represented by 44 different cultures … with a lot of students from support housing …" (A 13–14), leading Annie to comment "we have a very broad spectrum of student needs and family backgrounds" (A 16). Annie also spoke about how the school "… wanted to highlight what we thought would be the most emerging culture and most significant culture to influence the student" (A 18–19). So, the school had developed a teaching and learning program involving the study of the Chinese language through including the use of online programs and support from an assistant teacher of Chinese.

Nepean North Primary School's extensive facilities comprised six modern buildings including ten open-plan general purpose classrooms with ICT facilities; 15 open-plan relocatable classrooms; a fully-equipped STEM (Science, Technologies, Engineering, Mathematics) Centre; and an arts centre that accommodated resources for music and visual arts curriculums; as well as a school television studio. The school had an extensive range of ICT hardware including Apple televisions (Apple Inc., 2019a), digital cameras, laptops and a 1-to-1 iPad program. Unlike Sarah and Charles, Annie's school used the Apple platform (rather than the Windows platform), meaning that ICT infrastructure, namely computer and operating systems were different in Annie's school to that of the other teacher mentors who were interviewed. However, all teacher mentors had access to similar resources in terms of laptops, iPads, interactive whiteboards, software and the internet.

Annie commented that the teachers at her school all had an Apple MacBook laptops as part of the Victorian Education Department of Education and Training's 'Teacher and Principal Notebook Program' (Victorian Department of Education and Training, 2019b, 2019j) (see Appendix M for further information about the program). The teachers at Nepean North Primary School had access to Apple MacBook laptops by a special arrangement as these laptops were acquired by the school choosing an alternate provision allowance offered by the Victorian Department of Education and Training (Victorian Department of Education and Training, 2019b, 2019j). Nepean North Primary School was able to receive a grant equal to the value of the Windows laptops allocation for all eligible teachers and fund the required additional cost of Apple MacBook laptops (Victorian Department of Education and Training, 2019j). Such an arrangement for the provision of Apple MacBook laptops is atypical as the Victorian Department of Education and Training encourages the provision of Windows laptops.

Annie stated that every teacher at Nepean North Primary School had an Apple MacBook laptop because "… the school pays the difference to ensure that every teacher has a MacBook" (A 30). When queried why the school decided to go with the Apple MacBook platform, Annie was flummoxed by the question but eventually said "[w]e wanted to use the apps, the programs that come with the Macs [Apple MacBooks] … the Apple TVs [televisions]" (A 48–49). It could be construed that the Apple MacBook platform was selected more for the technology it afforded, rather than for educational benefits. Curiously later in the interview, Annie deliberated whether the benefits of the Apple televisions (Apple Inc., 2019a) were perhaps inferior to that of the interactive whiteboards, which the Apple television had replaced. Further discussion regarding this occurs later in this chapter, under the heading '5.1.5.3. Annie's views on barriers and enablers to using ICT'.

Annie also commented that the school had a 1-to-1 program (Victorian Department of Education and Training, 2019i) that enabled all students to have access to a digital device. The 1-to-1 program adopted by Nepean North Primary School was that each student purchased an iPad and specific apps depending on their year level, as determined by the school. Each iPad was owned by a student and they would take it home as well as use it in the classroom, which was dissimilar to other case studies in this research study where digital devices were leased from the school rather than owned by the student. (Although Rusden P–12 College had a BYOD program, in which students owned digital devices, it was not coordinated by the school and lacked consistency of devices like the program at Nepean North Primary School). However, Nepean North Primary School had changed its policy in 2017 so that now only students from Years 3 to 6 were part of the 1-to-1 program. Annie explained that the students from Prep to Year 2 now had access to a school-owned iPad in the classroom. She did not elaborate on the details of this school policy but the reasoning for changing the 1-to-1 program is discussed later in this section. Therefore, the school had a two-pronged approach to access of ICT – students in Prep to Year 2 had access to a school-owned device that was accessed only in the classrooms, and students in Years 3–6 were expected to buy their own iPad, which was "… deem[ed] as important for their educational growth" (A 38–39) and was able to be used both in the classroom and at home.

According to Annie, parents and students were required to sign an ICT user agreement, which clearly stipulated expectations around the safe and responsible use of ICT and specific apps required to be purchased for use in the classroom. Students were also able to purchase their additional apps but they were not allowed to use these apps "… if it impacts on the data usage of the school …" (A 39). Students in Years 3–6 also had access to a bank of school-owned Windows laptops. Annie's comments around student access to digital devices indicated that the school had a strong and supportive approach to use of ICT in the classroom and provided some understanding of the school context that the pre-service teacher experienced.

As mentioned, when discussing the school's 1-to-1 program, Annie revealed that the school had reviewed and revised the school's 1-to-1 policy and decided that students in Prep–Year 2 did not need to be part of the school's 1-to-1 program. The reasons provided by Annie centred around the teachers of these year levels reporting that students were not using the apps that had been selected for them and so there was no need for the students in these year levels to have iPads. Annie explained that the selected apps were different for each year level and that "… each [app] is selected for their educational value" (A 176–177). As she elaborated, teachers in Prep–Year 2 felt that they did not find the apps suitable for the educational purposes in these year levels as they were able to teach the curriculum without using iPads. Annie specifically highlighted content related to literacy was seen as a priority for these year levels and this was taught without using the iPads. She also emphasised that there were health and safety issues that the school had identified with young students carrying expensive devices to and from school as well as ergonomic issues arising from the extra weight in the students' backpacks. Although these were contributing reasons for the change in policy for students in Prep–Year 2, the main reason provided by Annie related to the apps on the iPads not being used in the classroom. It might also be suggested that a lack of appropriate professional learning concerning use of ICT in lower primary school was one barrier to using ICT in the classroom for these teachers at Nepean North Primary

School. Also perhaps the focus on the literacy strategy of the Victorian Department of Education (Victorian Department of Education and Training, 2018b) did not allow for learning opportunities related to ICT at Nepean North Primary School. This barrier is examined in more detail in the following section, under the heading '5.1.5.3. Annie's views of barriers and enablers to using ICT'. Accordingly, it would seem that the school valued new and emerging technologies and was prepared to fund them. Consequently, teachers and students at Nepean North Primary School had reasonably good access to high-level ICT and a modern technical infrastructure.

5.1.5.2. Introducing Annie

Annie was a highly-experienced female teacher, who taught at Nepean North Primary School. She had taught for over 18 years at two primary schools across all year levels from Prep to Year 6; she had been a generalist as well as a specialist teacher. Annie had previously taught at another nearby large primary school before coming to Nepean North Primary School in 2011. She had mentored pre-service teachers over five times previously and like Charles, had never undertaken any training related to mentoring pre-service teachers. Annie's interview transcript implied that teaching experience provided her with the training needed to mentor pre-service teachers.

In 2018, Annie taught Prep to Year 3 in a specialist role, supporting the teaching of the Victorian Curriculum F–10: Personal and Social Capability (VCAA, 2018c). She had a substantive Leading Teacher role (Victorian Department of Education and Training, 2019f) within the school and had considerable experience as a Teaching and Learning Coach; specifically she was responsible for "some elements of classroom practice and teaching … [and also for] directly coaching staff on pedagogy or content … depending on what the needs are" (A 3–4). As she then elaborated, these needs align "… with the [school's] strategic plan and … goals" (A 4–5). As a Teaching and Learning Coach, Annie commented that she had the responsibility to support teachers to understand the curriculum and build teacher capacity to use this curriculum to differentiate classroom instruction and design appropriate assessment. The school had a well-developed coaching program for staff.

Annie considered herself a very competent user of ICT and listed the following digital tools that she has used in her classroom:

- digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard (IWB), smartphone, digital camera
- school intranet and/or learning management system such as Schoology, Moodle, Compass
- online searching using the internet
- digital resources from Scootle, FUSE, ABC Splash
- software such as PowerPoint, Excel, Word, Publisher
- applications or widgets.

Annie identified a high awareness of ICT tools, and specifically identified apps such as Skype (Skype Communications, 2003), which enables video chat and voice calls between digital devices), and Google Hangouts (Google, 2015), which is a communication platform that includes messaging, video chat, and Voice over Internet Protocol [VOIP] features, as digital tools that she used to conduct live chats with students in schools overseas. Annie's identification of these communication apps suggested that Annie placed emphasis on providing students with opportunities to interact with other students as part of the school's "… heavy internationalising focus" (A19).

Annie also reported that she considered ICT as very important for teaching in the classroom. Underpinning Annie's use of ICT in the classrooms were solid beliefs about its relevance to "2lst century skills … [and] future employability skills" (A 175). She asserted that "students today need to know how to use technology … it is part of the world they are moving into beyond school" (A 174–175), emphasising that the knowledge of ICT was imperative for the future. Like Charles, Annie believed that use of ICT was critical for the future employability skills of young people.

5.1.5.3. Annie's views on barriers and enablers to using ICT

In her interview, Annie identified lack of leadership and lack of professional learning as well as lack of school technical infrastructure, namely lack of technical support, as barriers; and access to ICT, teacher confidence and age of pre-service teachers, as enablers, to using ICT in the classroom. Many of these barriers and enablers were similar to what was identified by Sarah and Charles, the two other case studies discussed earlier in this research study.

As mentioned, Annie stated that most of the interactive whiteboards in the classrooms "… have become obsolete because of the MacBook uptake and now we [the school] have moved to almost every room having an Apple TV [television]" (A 44–45). She exclaimed that she "… did love SmartBoards [interactive whiteboards] as you can annotate … [and give] feedback [to students]. That is rich" (A 163 –164), and went on to elaborate that her "absolute favourite thing to do" (A 164) was to make notes on a student's piece of work so that the class was "… editing the work and giving feedback directly [to the student]" (A 165–166). She highlighted that she could not annotate student work using the new Apple TVs, which replaced the interactive whiteboards. Annie commented that the school leadership personnel, who had advocated for these newer televisions were unaware that their functionality was inferior to the interactive whiteboards. Therefore, Annie indicated possible uninformed decision-making by the school leadership personnel in regard to procurement of ICT devices at Nepean North Primary School. Thus, school leadership personnel were considered as a critical factor, and one of the many stakeholders involved, in ensuring the effective use of ICT in the school's practice.

Also, of concern to Annie, was that the school leadership personnel had not provided professional learning opportunities to ensure that staff could effectively use the new devices. As she commented, "they [other teachers, including teacher mentors, at her school] did not know all the capabilities [of the interactive whiteboards] as they did not have enough professional learning" (A 169–170). Annie explained that other teachers, including teacher mentors, at her school would give students a worksheet and get them to complete it on an iPad individually, rather than use the interactive whiteboard to complete the worksheet as a class. She suggested that these teaching colleagues did not know the potential of using the interactive whiteboard as they were not trained in understanding of all the capabilities of this particular ICT tool. This has implications for the support provided to the pre-service teacher as they may not be encouraged to use the full functionality of the interactive whiteboard either. Thereby contributing to lack of technological pedagogical knowledge and possibly TPACK, which is discussed later in this section. It appears that the school endeavoured to have the most modern forms of ICT available to teachers. It could be construed that perhaps the teaching potential of interactive whiteboards in most classes at Annie's school was not able to optimised due to lack of teacher professional learning about its functionality, and so negatively influencing the potential of these teachers to demonstrate some domains of knowledge including TPACK.

Annie also spoke about "… teething problems with technology …" (A 86) that impacted on her use of ICT in the classroom, and that she was "always troubleshooting every aspect [of ICT]" (A 87), indicating that the school technical infrastructure was a barrier to using ICT in the classroom. Annie implied that it was expected that using ICT in teaching practice would be problematic due to factors outside of her control. When questioned about the use of IT technicians to assist with technical 'teething issues', Annie responded that it was her responsibility to resolve technical issues, and that she also used her students in the classroom to assist with this. Perhaps, as discussed in chapter 2, Annie did not have the social awareness to work collaboratively with other members of the school community to ensure ICT uptake as she expected that the 'teething problems' were a natural part of using ICT; she believed that it was her responsibility to overcome them, rather than knowing where to seek help with other colleagues such as the IT technicians. Annie therefore considered access to ICT was often met with issues related to reliability.

Annie believed that the pre-service teacher would have technological knowledge because they were younger. She commented that “[i]t is … a generational thing … they [the pre-service teachers] are very good with technology [ICT]” (A 98–99), and that “… all [pre-service teachers] are all ICT competent” (A 130) and “happy to use technology [ICT]” (A 139). Annie stated pre-service teachers had a familiarity with using ICT and advised that pre-service teachers “do not need any encouragement to use ICT” (A 43) as “the default is always the technology [for pre-service teachers]” (A 106). Specifically, Annie thought that pre-service teachers were “familiar with apps … and have that experience [with using smartphones]” (A33), and as a result believed that they would be “very quick to pick up [ICT] … and to have the technological uptake” (A 31–34). This also suggested that she believed that prior personal experience with using ICT gave the pre-service teacher confidence and capacity to use ICT tools recommended by Annie during the teaching practicum.

Annie also highlighted that when using ICT as a teacher mentor, she needed to be “confident and competent” (A 145) as she considered the pre-service teachers to be “quite tech savvy, generally being a young generation” (A 145–146). Annie voiced her concerns for teacher mentors by assuming a pre-service teacher would be more superior with the use of ICT because of their age. Annie declared “I would not want the mentor teacher to feel inferior or less confident because someone who is younger coming in” (A 145–147). There appeared to be a belief by Annie that the teacher mentor would feel second-rate because pre-service teachers would naturally have ICT knowledge and skills because of their age.

Equally, Annie considered that access to ICT devices and confidence of both the teacher mentor and the pre-service teacher as enablers with using ICT. As discussed earlier, Annie had good access to a range of ICT tools and a modern technical infrastructure at school that enabled both her and the pre-service teacher to use ICT in the teaching practicum. In addition, Annie identified that she had the confidence to teach with ICT, and identified her own confidence as an enabler for pre-service teachers to use ICT.

> I do not want to sound boastful … I am quite tech savvy so there would have been teachers in a mentor position that would not have encouraged the teacher to go down that path [to use ICT]; they would not have had the confidence to deliver and ensure its success. (A 111–113)

Annie highlighted the complexity of factors that affect ICT uptake by discussing lack of leadership and professional learning as barriers and the beliefs about age and technological knowledge and confidence as enablers. Her discussion about ICT uptake centred on possessing technical skills and reinforced a techno-centric approach to using ICT in the classroom.

5.1.5.4. Annie's views on mentoring knowledge

Annie had mentored over five times previously, and like other teacher mentors at Nepean North Primary School, was not encouraged to undertake any training related to mentoring pre-service teachers. Annie commented "[t]here is nothing explicitly taught" (A 54) implying that teaching experience provided her with the training needed to mentor pre-service teachers. Annie elaborated that the role of the Student Placement Coordinator at the school, who oversaw the teacher mentors, was purely administrative. She stated that "typically … we have tried to give the students [pre-service teachers] to someone with a little bit more [teaching] experience" (A 59–60), highlighting that teaching experience was regarded as an important factor for mentoring. In addition, Annie stated that the more experienced teachers were allocated to pre-service teachers who were in the third or fourth year, rather than in the first or second year of their university teaching courses. Therefore, paradoxically the less experienced pre-service teachers were allocated the less experienced teacher mentors while the more experienced pre-service teachers were allocated the more experienced teacher mentors. Perhaps this highlighted that it was only when the pre-service teacher was nearing graduation that it was considered vital to provide the pre-service teacher with an experienced teacher, who was considered by the school as ‘best’ for mentoring. However, Annie also lamented that “due to the nature of our school … [having] a lot of [teacher] graduates … [the school] cannot always match the [pre-service teacher] … with experience” (A 63–64). She reinforced this by elaborating that in her first year at Nepean North Primary School, the school had a lot of graduate teachers by stating that the school “employed 16 new teachers” (A 64) and so would have been unable to match all pre-service teachers with experienced teachers due to the high number of graduates. Clearly, Annie considered teaching experience as an important consideration when mentoring pre-service teachers. As mentioned, this is consistent with discussion in chapter 2.

It would seem that Annie thought that teaching experience was what was needed to mentor pre-service teachers and tended to discount mentoring knowledge per se. As she commented “[w]e are all allocated a person and then it is really left to each individual teacher, who is the mentor, to guide the student [pre-service teacher] (A 52–53). She also claimed that teachers at her school either “get told [to be a teacher mentor] … [or] individual teachers can volunteer to mentor the students [pre-service teacher]” (A 56–59). During the interview, Annie did not question that mentoring knowledge was something to consider when supporting pre-service teachers, and so it is likely that she did not regard mentoring knowledge as important nor as a different type of knowledge to knowing how to teach.

Annie seemed to view mentoring as a ‘master/apprenticeship’ relationship, as demonstrated by her discussion of content knowledge. As Annie commented, the content from the curriculum that was taught was set at the start of the year, and so pre-service teachers had little control over what was taught during the teaching practicum, and relied upon the guidance of the teacher mentor. So, although Annie stated that the pre-service teachers came with technological knowledge, she demonstrated a controlling attitude about how the curriculum (or content knowledge) would be delivered. Similar to Charles (second case study), this approach seemed very much like an ‘apprentice/master’ model where the ‘apprentice’ (or pre-service teacher) does what the ‘master’ (or teacher mentor) tells them to do. That is, the teacher mentor develops the pre-service teacher, who learns from and models the teacher mentor. According to Annie, the curriculum (or content knowledge) was regarded as the priority for the pre-service teacher to understand. Although Annie believed that the pre-service teachers came with technological knowledge, there was a dictating attitude about content knowledge i.e. the curriculum at the school was the most important factor to consider.

5.1.5.5. Annie's views on TPACK

Annie identified content knowledge, technological knowledge, technological pedagogical knowledge and perhaps pedagogical content knowledge when discussing how she supported the pre-service teacher to use ICT. Annie considered that she was responsible for the content knowledge and that the pre-service teacher brought technological knowledge, so these beliefs suggest the development of TPACK was hindered.

As highlighted previously, the pre-service teacher at Nepean North Primary School had little capacity to provide input into the design of the delivery of the curriculum. Annie specifically considered that her role as teacher mentor was to provide the content knowledge. She talked in detail about the teaching and learning program at Nepean North Primary School being designed to "… tick off the curriculum" (A 79). When asked to talk about how she operated with the pre-service teacher, Annie matter-of-factly said that it was her responsibility to plan the content to be taught, and so she gave little scope for the pre-service teacher to design and devise a lesson themselves. As she commented "[a] lot of our planning is quite thorough and prescriptive so by the time the [pre-service teacher] … gets it, they do not have a lot of choice" (A 67–68). Annie described how the pre-service teacher had some scope with input into how the curriculum was taught (i.e. opportunities to demonstrate pedagogical knowledge and pedagogical content knowledge), but emphasised that the content knowledge had been mapped out by her as the teacher mentor.

> A lot of student teachers [pre-service teachers] are not able to do that much with, say literacy and numeracy; they are guided very much by what we have, because we have mapped out obviously the whole year and the curriculum area we want to tick off. They might have scope in being able to choose some picture story books and prompts but not deviate too much so they are limited by what we have given them. (A 80–84)

There was a tension or a contradiction between 'ticking off' the content of the curriculum and allowing the pre-service teacher to scope their teaching pathway. Annie tended to have a controlling view of the curriculum delivery and so gave limited opportunity for the pre-service teacher to develop understanding of content knowledge. So, this possibly suggested that Annie acted as a gatekeeper to the content knowledge when mentoring the pre-service teacher. It was quite revealing that Annie tended to have a lot of direction and control over how pre-service teachers taught the curriculum, and so limited the development of TPACK of pre-service teachers.

As previously mentioned, Annie made assumptions that the pre-service teachers would come with technological knowledge and so did not place emphasis on this knowledge being important or needing development. Annie declared that pre-service teachers "… are very competent with being able to use technology [ICT] so the students will intrinsically learn because they are enjoying it" (A 90–91). This belief about ICT being the motivator to enable students to learn was also a narrow view of learning in that it emphasised that learning was about enjoyment and engagement. It suggested that it was intuitive for students to learn if provided with ICT, and so perhaps discounted the role of the teacher mentor and subsequently that of the pre-service teacher. Annie further reinforced this narrow viewpoint when she commented that she was "blown away" (A 94) by the Prep students at Nepean North Primary School using the Prezi app (Prezi Inc., 2009), a presentation software that features a map-like overview to enable the user to pan between themes and zoom in and out on content to reveal on details and context of themes. In her previous school, only the Year 6 students had used the Prezi app, and therefore Annie associated the use of Prezi with making the students in Prep at Nepean North Primary School appear to be 'smarter'. Thus, Annie tended to associate the use of Prezi, or the 'bells and whistles' and 'floss and gloss' with using Prezi with learning, rather than identifying the value of the tool for learning (i.e. the value of its technological pedagogical knowledge). This has implications in that perhaps Annie regarded just using ICT as sufficient, and did not consider developing other dimensions of technological knowledge, such as including ways of thinking and cybersafety – let alone developing technological pedagogical knowledge or TPACK.

However, perhaps inconsistently, Annie also asserted pre-service teachers "are very good with technology [ICT], but it was the how to use it [ICT] that is most important … My role [as a teacher mentor] is to ensure ICT has an educative purpose" (A 98–100). She emphasised that she had to provide the "understanding [about] the why behind technology [ICT] being introduced" (A 104), hinting that technological pedagogical knowledge was important for the pre-service teacher to learn during the teaching practicum. Annie implied that her role was as an instructional coach to provide the knowledge to the pre-service teacher about the strategies related to using the affordances of the ICT tools. Thus, Annie considered that technological knowledge was intuitive for the pre-service teacher because the pre-service teacher used ICT in her personal life, and so only considered that her role as teacher mentor was to develop the technological pedagogical knowledge of the pre-service teacher.

However, Annie explicitly cautioned that pre-service teacher needed to ensure that not all their classroom activities were dependent on ICT. Annie asserted that the teacher mentor was responsible for ensuring the pre-service teacher was not "reliant on it [ICT] so it replaces [other teaching strategies]" (A 40). Annie insisted that it was important for a student in the classroom to use "pen and paper …" (A140) and to have "[real-life] face-to-face contact [with a hardcopy picture storybook] when being read a story" (A 142). It could be construed that Annie was suggested that the teacher mentors were responsible for developing pedagogical content knowledge of the pre-service teachers as she considered that the pre-service teacher would need support to implement teaching strategies to teach content if it was not reliant on using ICT. It could also be inferred that this view restricted the development of a pre-service teacher's TPACK if pre-service teachers were constrained in their use of technological pedagogical knowledge. It may also be inferred that Annie considered that the use of ICT was not always conducive to learning.

In her questionnaire response, Annie identified a range of ICT tools that she used in the classroom. However, interestingly in the interview, Annie did not talk about using many of the same tools in her classroom. Annie did discuss the use of digital devices by identifying interactive whiteboards, iPads and, to a lesser extent, laptops. She also discussed the use of apps and identified five specific apps: Skype (Skype Communications, 2003); Google Hangouts (Google, 2015); Prezi (Prezi Inc., 2009); Explain Everything (Explain Everything Inc., 2019), a design and screencasting tool that allows the user to annotate, animate and narrate; and Popplet (Notion Inc., 2013), a tool to gather and organise ideas visually. Annie declared that the Explain Everything app was her "absolute favourite … [because it was] really powerful …" (A 160–162) in that it permitted students to record annotations of their work to enable their thinking to be visualised. Interestingly, all five apps identified by Annie were not tailored to be used with particular content knowledge, but rather were generic and able to be used across a range of content so it did not indicate a development of specific technological content knowledge. Although outside the scope of this study, it would be interesting to further research reasons for the selection of these specific ICT tools. Annie was unable to identify specific websites when asked about websites she used in the classroom. For example, Annie responded "I cannot remember the name of the program but it was a fantastic program that she [the pre-service teacher] used, an IT platform, a website where she plotted things on the website so the kids could navigate through it like a map" (A 70–72). It is possible Annie identified ICT tools that she was aware of but perhaps did not use regularly or at all.

Thus, there were limited opportunities for pre-service teachers to use ICT to teach as the teaching and learning program at Nepean North Primary School was closely controlled by

Annie as the teacher mentor. There was no indication by Annie about what, if any, content knowledge or technological knowledge could be developed by the pre-service teacher during the teaching practicum. There was some limited discussion about pedagogical content knowledge and technological pedagogical knowledge. Overall this highlights that perhaps the TPACK of the pre-service teacher was hampered.

5.1.6. Case study 4: Rose

5.1.6.1. About Cochrane Primary School

The fourth and final case study documents the interview data from Rose who taught at Cochrane Primary College, a government primary school that had an enrolment of just over 300 students, with a full-time equivalent teaching staff of 20.7 teachers and 8 non-teaching staff in 2018. The school had three per cent indigenous students and three per cent of students from a language background other than English. The Index of Community Socio-educational Advantage was 966, which was below the average of 1000 for Australian schools (ACARA, 2019b) and indicated that the students at Cochrane Primary School had a lower level of educational advantage than other Australian students. This value was similar to Rusden P–12 College where Sarah (first case study) taught and much lower than Ebden College and Nepean North Primary School, where Charles and Annie (second and third case studies) respectively taught. Cochrane Primary School had had major building and refurbishments projects since 2012, with a recent upgrade of its buildings to provide modernised, spacious learning environments being completed in 2017. A new sporting stadium had also recently been built and was used by both the school and the wider community.

The school offered a 1-to-1 netbook program for students in Years 5 and 6, where the laptops were leased from the school and students were able to take these devices home. This was similar access to the Years 5 and 6 students at Nepean North Primary School; however, the laptops at Cochrane Primary School were school-owned whereas those at

Nepean North Primary School were student-owned. Students in other year levels at Cochrane Primary School had access to laptops in the classroom but there was no 1-to-1 ratio like students in the same year levels at Nepean North Primary School (where Annie, the third case study, taught and as described earlier in this chapter), nor were the devices taken home by the students. Students in Prep–Year 4 typically had access to a bank of six laptops and six iPads in each classroom. There was also an interactive whiteboard or television screen and data projector in each of the classrooms. The school had video conferencing facilities, and had a tradition of using blogs in some of the classrooms. The school also used the Skoolbag app (Skoolbag Pty Ltd, 2019) as a form of communication. It enabled information about school activities to be 'pushed' (or delivered) to parents, i.e. there was no need for parents to log in and access the information from the school website as information was disseminated to the smartphone of parents. In addition, the app was used by parents to schedule times for parent–teacher evenings, pay schools fees and volunteer for excursions.

The ICT facilities were similar to that of the other schools of the teacher mentors who were interviewed in this research study. However, it appears that there was less 1-to-1 access for students than those in Ebden College and Nepean North Primary School and conceivably Rusden P–12 College. Interesting, this was the only school that identified that it used ICT to communicate directly with its parent community.

5.1.6.2. Introducing Rose

Rose was a very experienced female primary teacher who had taught in a variety of government schools throughout her 30-year teaching career and had been teaching in her current school since 1995. She was aged between 50–54 years and had taught across a range of year levels from Prep to Year 6. Rose had mentored over five times previously, stating that she had "lost count of the number of students [pre-service teachers] that I have mentored" (R 180). She had had no prior training to be a teacher mentor, claiming "I just learnt on the job" (R 182), which is consistent with the discussion in chapter 2. Rose described herself as somewhat comfortable with using ICT in the classroom and was somewhat confident in her beliefs that using ICT in the classroom was important to teaching. This self-assessment contrasted with those of the other case studies in this research study (i.e. Sarah, Charles and Rose), who all rated their competence to use ICT as very high and their beliefs about the importance of ICT for teaching as very high too.

In 2018, Rose taught a composite class of Years 1 and 2 students, as part of a team with two other teachers. Rose and her colleagues also worked closely with the Prep teacher. Each classroom in the Years 1 and 2 department at Cochrane Primary School, either had an interactive whiteboard or a TV screen and projector. Rose's classroom had access to a TV screen and data projector.

While most of Rose's teaching career had been as a classroom teacher, she had also held various roles in the school including eLearning Coordinator in 2012 as well as having worked in the then Directorate of School Education's regional office in the mid-1990s for approximately nine months to run professional learning related to thinking strategies and so had a well-developed understanding of pedagogical knowledge. Rose's main responsibilities when an eLearning Coordinator at the school was to obtain eSmart accreditation (Alannah and Madeline Foundation, 2018) for the school (see Appendix N for further information about the eSmart accreditation), as well as work with classroom teachers to support the pedagogical use of ICT (i.e. their technological pedagogical knowledge) in teaching and learning programs. An eLearning teacher was typically found in most schools as evident by the responses of all teacher mentors interviewed in this research study. Despite Rose's self-assessment as 'somewhat comfortable with using ICT', she had used blogs extensively in her classes and assisted other teachers to use blogs within their classrooms for a couple of years prior to being appointed to the role of eLearning Coordinator. "I used class blogs a lot … parents and children like to see their work [online] … I like doing class blogs … they are easy you know" (R 142–147). So Rose was given the responsibility and time to work with other teachers within the school to assist them with establishing their own class blogs as well as provide "… ideas for a range of online, digital resources like [those from] FUSE [Victorian Department of Education and Training's digital content repository] … [and] website links" (R 148) when she held the eLearning Co-ordinator role.

In addition to using web 2.0 tools such as blogs, Rose indicated that she used the following digital tools in her teaching practice:

- digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard (IWB), smartphone, digital camera
- school intranet and/or learning management system such as Schoology, Moodle, Compass
- online searching using the internet
- digital resources from Scootle, FUSE, ABC Splash
- software such as PowerPoint, Excel, Word, Publisher.

It is important to highlight that in 2012, Rose had been involved with trialling the primary teaching resources for the digitisation of the Animalia program (Australian Children's Television Foundation, 2019) (see Appendix O for further information about the Animalia program). Rose and a teaching colleague were also responsible for providing curriculum advice for this online resource (i.e. technological content knowledge) (Victorian Department of Education and Training, 2019e) that was published on the Victorian Department of Education's digital content repository FUSE (Victorian Department of Education and Training, 2019d) in 2012.

5.1.6.3. Rose's views on barriers and enablers to using ICT

The analysis of Rose's interview transcript revealed both barriers and enablers to using ICT in the classroom. Inadequate technical support was identified as a barrier that emerged – this was a recurring theme, and consistent with the findings in the schools of Sarah and Annie (first and third case studies). Rose also identified lack of time to learn ICT tools; lack of technical infrastructure; namely technical support; lack of leadership support and appropriate decision-making for the use of ICT in the classroom; and lack of access to suitable resources as barriers as well. Rose was the only teacher mentor who identified lack of personal confidence to use ICT, however both Sarah and Annie commented on this being a barrier for pre-service teachers. Like Charles (second case study) and Annie (third case study), Rose also identified confidence and age of pre-service teachers as enablers to using ICT during the teaching practicum. Generally overall, these barriers and enablers were consistent with those identified by Sarah, Charles and Annie, the three other case studies in this research.

Rose considered that she needed more time than the pre-service teacher to develop her technological knowledge, which aligned with Charles' comments about time being an enabler to using ICT. Rose commented that technical skills came more easily to the pre-service teacher, and the use of ICT tools was intuitive to the pre-service teacher when she stated that "[t]hey are just all over ICT naturally …" (R 116).

Rose thought it was difficult for her to get technical support as the IT technician was more likely to be supporting teachers and students in the other classrooms that were located closer to the IT technician's office. She also identified that access to technical support was problematic because the technician only worked part-time. Rose stated quite matter-of-factly that the IT technician "comes on request … [but] it often is not as soon as I need him" (R 32–33), identifying an issue with obtaining timely ICT support. Rose explained that technical issues often arose in her classroom and "I cannot just leave my students to find him [the IT technician] … [as] he's often not available when I need him" (R 29). Rose's class had access to a bank of six laptops and six iPads. Rose laughingly commented "I often contact him [IT technician] for technical support [but] … [h]e is not a fan of iPads … so not much of a support if you have iPad questions" (R 31–33), indicating that she did not find it easy to get technical support and even more challenging to get technical support for iPad-related issues. She commented that she had to "… make do" (R 29) when there was no support available.

She asserted that “I learnt to have tricks up my sleeve to come up with alternatives ways to teach [the content]” (R 30), insinuating that she could use her pedagogical content knowledge to overcome the technical issues. This is discussed in more detail later in this chapter, under the heading ‘5.1.6.5. Rose’s views on TPACK’. Unlike Annie, Rose considered the iPads could be used for teaching and learning by the students in Years 1 and 2, yet like Annie, Rose suggested that technical issues were ‘par for the course’ when using ICT and these issues were not within her control.

> Things just go wrong, things happen that I cannot plan for … I try to make it work beforehand but glitches always happen all the time so I need to get him [the IT support technician] … or come up with another plan … That’s the way it is around here. (R 164–166)

Rose mentioned that she had recently had her school-owned laptop upgraded but still experienced difficulties in getting access to particular software programs that had been purchased for use and downloaded onto her previous laptop.

> I just want to turn on my [new] laptop and use the apps [software programs]. I shouldn’t have to be chasing the technician to fix things … It’s frustrating, annoying when apps [software programs] I use are not there … I seem to be always chasing the technician to get things fixed and it’s a new laptop so you would think it should work but … there are problems that I cannot fix … like missing apps [software programs]. (R 151–156)

She stated that the IT technician told her to go online to download software programs, but it was not possible as the software program that Rose wanted to access was only available on the CDs that the school had purchased (rather than being cloud-based), and the new laptops did not have CD or DVD drives. Rose explained that she accessed the software program using her laptop with the television screen and data projector in her classroom. Rose said that the other teachers at her school, who also had the same issue with their new laptops lacking this software program, were writing information on the whiteboard each day but she considered it was “… a waste of time [to do it in this alternative way]” (R 154). Rose said that she had to think of other ways to teach the content without using the software by claiming "I guess I could try and do it [teach the content] using PowerPoint" (R 147). This indicates that Rose did not have knowledge about how to troubleshoot the technical issue and relied on her technological content knowledge to come up with a solution. Rose also commented "I went up to the school over the weekend to check if I could fix it myself … [but] I am exhausted trying to work out how I can get access to it [the software program]" (R 153-155). This exemplifies, as discussed in chapter 2, how barriers to using ICT are complicated – despite Rose's efforts to work out a solution, she lacked appropriate guidance or support, professional learning, knowledge, or competence to overcome the issue with her laptop. For example, Rose did not ask if the school had a portable CD or DVD drive that she could borrow to access the content on the CDs. However, Rose did not believe she had the capacity to solve technical issues.

Paradoxically, Rose also regarded access to the technical support, specifically before the teaching practicum, as an enabler to using ICT in the classroom. Rose stated that all she had to do was submit a request and the IT technician would put the pre-service teacher on the school network so that the pre-service teacher was able to bring a personal digital device to use on Cochrane Primary School's network during the teaching practicum. Rose asserted that "[w]e are lucky these days …" (R 97) and went onto emphasise that "[the pre-service teachers'] lives [are] so much easier if they can get onto the network" (R 101–102). It could also be said that Rose knew she had to plan to get the pre-service teacher on the network and had the technological knowledge to know what to request the IT technician to do. Perhaps it could also be inferred that Rose considered having reliable technical support was one of the main requirements for a successful teaching practicum, and that Rose considered that once the pre-service teacher was on the school's network, then the pre-service teacher would be supported with their technological knowledge.

Rose also identified lack of leadership support as a barrier, and in particular highlighted that school priorities related to improving student results were seen as separate to using ICT.

> The boss [principal] does not really have an understanding of the issues in the classroom. She is more concerned about literacy and numeracy data … She does not want to hear about my issues with iPads or the network not working. She just wants to see [student] results improving. (R 169–171)

Like Annie, Rose also identified poor decision-making by the school leadership personnel in regard to allocating classroom budgets to cater for ICT resources when she discussed the use of free resources, such as those from YouTube (YouTube, 2019) and FUSE (Victorian Department of Education and Training, 2019d). Rose expressed disappointment that the StudyLadder website (Studyladder, 2019), which she used for literacy activities, was now no longer free and so she would not be able to use it with her students to teach writing as there was no budget allocation. Rose commented "… it's now gone down the path [of being subscriber site] … as you would expect for a great resource … The Years 1 and 2 department operates on a shoe-string budget so I cannot justify spending money on this … website each year. It is a clever site … I will now have to work out how to teach writing in a different way now that the website is not free' (R 20–22).

Even though Rose considered the website was a useful resource, she could not rationalise spending money on an annual subscription to use it. It appears that budgetary decisions were controlling Rose's access to the website and consequently her technological content knowledge. Rose indicated that the 2018 budget for Years 1 and 2 classes had already been allocated and "[w]hilst there is some flexibility within the budget, it's [purchasing a subscription] not a priority this year as we do not have enough [money] …" (R 20). Rose's comments perhaps suggest that she had a robust view of interconnectedness of the different domains of knowledge and was able to use her pedagogical content knowledge to teach the content despite not having access to specific ICT tools.

> I try to find free ones that are educational … and suitable for my needs … [and] my students … There is so much out there … I can find good ones to use … I come up with other teaching strategies that do not require me to pay money … We used to teach without these [ICT] resources and I can still do it if need be … but it would be good if the boss gave us more [money] as I would use it to buy more [ICT resources] … I prefer CDs not online resources. (R 174–177)

There appeared to be a lack of technological planning in Years 1 and 2 because of school budgetary decisions and limited financial resources being allotted to ICT resources. It could be assumed from Rose's interview transcript that she would only use ICT resources that were provided as part of the school allocation such as laptops, iPads and interactive whiteboards, as well as software provided by the Victorian Department of Education and Training through its eduSTAR platform (Victorian Department of Education and Training, 2019g, 2019h) and other free websites. Also, there was possibly a belief that tangible resources needed to be purchased. Rose did discuss a software program on CD for use in the Years 1 and 2 classrooms that had been purchased quite a few years previously – there was limited reference to other specific resources that were purchased solely for this age range by the school, and none in recent times, nor any cloud-based only resources. Like Sarah, Rose experienced issues related to using ICT due to budgetary constraints and hinted it was due to poor decision-making made by school leadership personnel about how the money was allocated.

Rose also highlighted enablers to using ICT in the classroom and one of these enablers was confidence of the pre-service teacher. She identified it was confidence with technological knowledge but not with content knowledge. "They [the pre-service teacher] have confidence; it is … an arrogance that they 'know it all'. It is an arrogance with probably the technology that they use, and not necessarily teaching and learning" (R 118–119).

Yet, Rose saw this enabler for the pre-service teacher as a barrier for her as a teacher mentor, remarking "I do not have this arrogance" (S 120). Curiously Rose believed that she was not ICT competent, even though she identified that she used a variety of types of ICT in her questionnaire responses, and discussed many of these types of ICT in her interview. When questioned about her rating as 'somewhat comfortable with using ICT' and use of these ICT tools, Rose exclaimed "I am the one who seems to be brilliant, but I look at myself and think I have a really poor [ICT] skill set … The younger teachers do better things than me" (R 131–132). According to Rose "[y]ounger teachers come in these days with a much greater skill set in regard to ICT than perhaps people of my age" (R 106–107). Rose also highlighted in her interview that "[d]igital stuff does not come naturally to me but I make myself use it" (R 137). It may be inferred that perhaps Rose found it challenging to learn technical skills and so did not think she was as proficient as she considered others learnt these skills more quickly than she did. Rose compared her use of ICT with that of other teachers and regarded any type of ICT that she did not use was "more sophisticated …" (R 163). Rose assumed that pre-service teachers would naturally be adept with ICT because of their age. These views are explored in more detail in ensuing paragraphs in the section, under the heading '5.1.6.5. Rose's views on TPACK'.

Underlying Rose's use of ICT in the classrooms were strong beliefs about its relevance to "the world of our students" (R 138–139) and "needing to equip [students with ICT skills]" (R 139). These beliefs were congruent with those of Charles and Annie (second and third case studies). Rose asserted it was "part of my role [as a teacher] … to make sure I am doing the best I can for them [the students] so I use ICT" (R 139–140). So, Rose stated that she was compelled to use ICT in the classroom to prepare students for the future. Rose, in particular, challenged herself to use ICT despite the various barriers she encountered because it could be assumed that she put the student at the forefront of her teaching.

5.1.6.4. Rose's views on mentoring knowledge

Rose had not undertaken any training to be a teacher mentor, stating "[w]e get told [to be a teacher mentor]" (R 157). Rose pointed out that she had been mentoring pre-service teachers for nearly three decades and had developed her knowledge and skills to mentor throughout this time, consistent with the discussion in chapter 2. Her interview responses indicated that she considered that her teaching experience was adequate to provide her with the knowledge to mentor a pre-service teacher, as her role was to "… facilitate the pre-service teacher in the classroom" (R 76). She remarked that the pre-service teacher was encouraged to contribute ideas as to how content could be taught but Rose regarded that her role as a teacher mentor was to provide guidance for the pre-service teacher. This suggests that Rose viewed her role as a teacher mentor primarily as that of an instructional coach. Rose did not consider in her response that it was the responsibility of a teacher mentor to perform other roles such as providing emotional support or to be a socialising agent. Also, interestingly, Rose did not consider that she needed to have an understanding about how to use ICT to mentor the pre-service teacher. Rose asserted that her knowledge about mentoring with ICT was not superior as she deemed the pre-service teachers to have better ICT knowledge and skills. This is discussed in the next section, under the heading '5.1.6.5. Rose's views on TPACK'.

Like Annie, Rose asserted her role as a teacher mentor was to help the pre-service teacher understand the curriculum, thereby emphasising that her expertise in the mentoring relationship lay in understanding content knowledge. She also identified that she supported the pre-service teacher to consider ideas for using ICT when teaching this content, despite the pre-service teacher possessing an "arrogance with technical knowledge but not with curriculum knowledge" (R 120). It could be construed that Rose believed she was able to support the pre-service teacher to develop technological content knowledge as Rose brought her expertise with content knowledge and the pre-service teacher brought their expertise with technological knowledge, and together they developed an understanding of technological content knowledge. As described in chapter 2, this could reasonably be interpreted as a demonstration of the reciprocity between the teacher mentor and the pre-service teacher as they negotiated development of technological content knowledge together. That is, both the teacher mentors and pre-service teacher benefited from the mentoring relationship.

Rose reinforced this reciprocal relationship when she stated, “I actually think when we get pre-service teachers these days, they are actually teaching us more than we are teaching them [about ICT]” (R 52–53). This viewpoint juxtaposed that of other teacher mentors interviewed in this research study such as Sarah, Charles and Annie (first, second and third case studies) who described quite a different relationship. Rose went on to state that she found it “quite confronting” (S 115) to mentor pre-service teachers as she felt that her own technological knowledge was not adequate. She claimed “[i]t can be difficult to be seen to be mentoring in [the Victorian Curriculum F–10:] Digital Technologies when you are not as good as what they are” (R 115–116). However, Rose did reflect that despite this confidence of the pre-service teacher or as she also emphasised that the pre-service teacher had “an air of authority [about the use of ICT]” (R 118), and that the pre-service teacher’s “… authority probably lies in how to use social media and a range of digital devices but it may not necessarily translate to her using them in the classroom to support the delivery of curriculum” (R 122–123). Thus, Rose reconciled that a reciprocal relationship was desirable, and possibly her questioning of this was due to her lack of mentor training as mistakenly she believed the default mentoring relationship should be more like a ‘master/apprenticeship’ one.

Rose also stated that she did not know much about the AITSL teacher standards (AITSL, 2018b) in relation to graduate teachers. When prompted that the teacher standards were what pre-service teachers needed to address for their application for Victorian Institute of Teaching (VIT) registration (Victorian Institute of Teaching, 2019), Rose declared that it now made sense to her why the graduate teachers at her school knew the teacher standards when staff were discussing which standards to address as part of the Victorian Department of Education and Training's teaching staff's performance and development plans (Victorian Department of Education and Training, 2019l). Rose stated that she had "… wondered 'how come they [the graduate teachers] are so good at knowing them [the teacher standards]?' … [I used to think is it] [j]ust because they [the graduate teachers] are so passionate about it [the performance and development plans] or just because they know it [the teacher standards]" (R 47–48). Rose also did not realise that she used the AITSL teacher standards (AITSL, 2018b) when she completed the teaching performance assessment for the pre-service teacher after the teaching practicum. Rose exclaimed "[w]ell blow me down. I didn't realise that this [assessment] was aligned to the [AITSL teacher] standards" (R 50). This is interesting as it perhaps implied that Rose was not aware that she was separately assessing the three teacher standards related to ICT. It possibly could also be interpreted that Rose's lack of mentor training may have contributed to this oversight regarding the AITSL teacher standards (AITSL, 2018b).

However, it is fascinating that Rose did not acknowledge that her work on developing Cochrane Primary School's eSmart strategy correlated with the AITSL teaching standard 4 'Create and maintain supportive and safe environments' (AITSL, 2018b) with a focus area related to using ICT safely, responsibly and ethically (see Table 1). Yet she did state "I would say that I am pretty good with … teaching students … about cybersafety, perhaps I have a better knowledge of that than perhaps some of the pre-service teachers" (R 110–111). There appeared to be a disconnect with Rose's classroom practice and her understanding of this specific AITSL teacher standard for graduates (AITSL, 2018b). Also as previously stated, Rose appears to have a limited understanding of all the dimensions of technological knowledge, and in fact, placed special importance on only using ICT tools to demonstrate teacher standards related to ICT.

Surprisingly, Rose believed that mentoring the pre-service teacher to use ICT did not require any different knowledge as she considered that "… the use of ICT was no longer standalone” (R 70) but rather the use of ICT permeated through “a whole range of areas [including] curriculum areas, welfare areas, school issues [and] discipline … [and so] ICT is just one small area of it [mentoring]” (R 67–66). This reinforces her views in an earlier discussion where Rose expected the pre-service teacher to use ICT in the classroom, yet she considered it was not her responsibility as a teacher mentor because she thought that the pre-service teacher was more proficient and so would be teaching her. Rose did not seem to consider when mentoring pre-service teachers that this mutually beneficial relationship was desirable and so was quite tough on herself regarding her lack of some technical skills. Rose stated that she focused on other areas of classroom practice when providing support to the pre-service teacher. She also asserted that it was difficult to mentor the pre-service teacher in the specific curriculum learning area Victorian Curriculum F–10: Digital Technologies (VCAA, 2015c) because she was not “as good [at using ICT] as they [the pre-service teachers] were” (R 116). This possibly related to Annie’s lack of knowledge about the AITSL teacher standards for graduates (AITSL, 2018b) and that she was responsible for ensuring the pre-service teacher met standard 2 ‘Know the content and how to teach it’ (AITSL, 2018b) (see Table 1). Further investigation on this point is outside the scope of this research study.

5.1.6.5. Rose’s views on TPACK

Like Charles and Annie, Rose emphasised that technological knowledge was important to using ICT in the classroom and appeared to place greater value on this knowledge rather than content knowledge or pedagogical knowledge. This is despite Rose stating it was important to have knowledge of content and pedagogy to understand how to teach the curriculum. Possibly Rose placed greater significance on technical skills and competence because she considered the use of ICT did not “come naturally …” to her (R 137) and so coveted this knowledge. It could be construed that Rose valued technological knowledge more as she believed it was less attainable for her.

Rose asserted the pre-service teacher she was mentoring was “very familiar with lots of [ICT] programs, social media and stuff like participating in webinars, I think a lot of their university classes are conducted online these days … She [the pre-service teacher] can use technology [ICT]” (R 114–116). Rose stated that pre-service teachers would come in “running rings around [her]” (R 112) in regard to knowing about and using ICT programs.

> [T]hey [the pre-service teachers] are … coming in with the skills and knowledge like how to do Photo Story [a free Microsoft application that allows students to create a digital visual story using photos, narration and music] and things like that, things that I have to work hard to do. They say, ‘I think we can do this’, which I think is a great thing for both of us though. I think it is important that … older teachers learn from their pre-service teachers as well. I think that is great as well. (R 56–58)

Rose suggested that technological pedagogical knowledge could be developed by herself and the pre-service teacher working together during teaching practicum. Yet as discussed, Rose did not consider that she could contribute technological knowledge, only content knowledge and vice versa in regard to the pre-service teacher.

As highlighted, Rose was quite dismissive about her technical skills with using ICT. Rose stated matter-of-factly “I got shown some blogs and the basics and then taught myself. I got lots of help initially, but I fumbled my way along and became the blog expert in our school” (R 144–145). She also stressed that she was not on social media, claiming she was “an old ‘old fogey’ [derogatory term to refer to someone who is older and out of touch with contemporary activities]” (R138) and that “[d]igital stuff does not come easily … but I make myself use it … I force myself [to use ICT]” (R 138–139). Again, when questioned about her rating as ‘somewhat comfortable with using ICT’ and her successful development of online teaching and learning materials for teachers to support Animalia (Australian Children's Television Foundation, 2019) (see Appendix O), Rose was bemused and perhaps bewildered, and modestly responded “[t]hat’s easier for me, it is not technical” (R 162). Rose did not appear to recognise that she demonstrated dimensions of technological knowledge or perhaps she did not value the dimensions of technological knowledge that she demonstrated. Rose appeared to lack the understanding that technological knowledge refers to more than just knowing how to use specific tools, and includes ways of thinking about using ICT so it can assist teaching practices and that it incorporates cybersafety practices (i.e. dimensions that Rose exhibited in her teaching practices). Rose tended not to value the technological knowledge she possessed in regard to blogging, using online digital resources and understanding of cybersafety. She possibly assumed that this knowledge was not special or unique. Perhaps Rose's technical knowledge and skills were sufficient despite her having articulted uncertainty about her ICT competence. She also perhaps undervalued her solid understanding of the interconnectedness of the different domains of knowledge needed to teach using ICT tools such as technological content knowledge with the development of online teaching and learning resources.

As mentioned, Rose rated herself 'somewhat comfortable' with using ICT in the classroom in the questionnaire, and consistently referred to possessing "limited technical skills and knowledge" (R 142) in her responses throughout the interview and claimed that she was "hopeless with [using] technology" (R 139). Yet remarkably, Rose had previously held the position of eLearning Coordinator within the school and was a regular blogger. Rose believed she was given the role of eLearning Coordinator because it was when the school was seeking eSmart accreditation (see Appendix N for further information). According to Rose. "[t]hat's the funny thing. I always look at myself and think that I am really down the technology way when using ICT in the classroom … but I am the person who did the digital licence for the Alannah and Madeleine Foundation" (R 129–130). Rose went on to claim that once the administrative tasks associated with obtaining the eSmart accreditation were achieved for the school, the responsibility of eLearning coordination was given to a younger member of staff at the school. Rose believed that this younger teacher would be better equipped with technical skills to implement the eSmart strategy.

> I think the eSmart [project] landed in my lap because I get off my bum and do the work that is required … to do it well. If there is a job that needs to be done, you will know that I [will] do it. I think once the 'tick off part', you know the requirements, were met … the school … thought we will now hand it onto her [the new young teacher] so she can continue on with it. (R. 132–135)

Rose's comments consistently throughout the interview reinforced that she did not have a comprehensive understanding of technological knowledge.

Like Sarah and Annie, content knowledge was also regarded as important by Rose, and it was the type of knowledge that she felt most comfortable using. When asked about content knowledge, she emphatically declared "[t]hat is my role" (A 139). Rose stated that while pre-service teachers would come in with "really great ideas" (R 65), she was responsible to ensure it related to the curriculum and would "say 'yes, but what does it relate to?'" (R 65) to assist pre-service teachers to understand about how to teach the curriculum. Rose stated "[t]he use of ICT or the use of computers is no longer a standalone, computer lesson. It is a curriculum area" (R 70–71). Remarkably, Rose indicated that she was comfortable with using ICT to integrate it throughout content she was familiar with, however considered teaching the Victoria Curriculum F–10: Digital Technologies (VCAA, 2015c) as a subject to be outside of her comfort zone.

Rose also discussed pedagogical knowledge by emphasising that ICT was often used as "an engagement tool" (R 36) by some teachers at her school.

> Kids these days expect bells and whistles in every lesson that you do … [ICT] is a way for teachers to get to some students' attention as we have some students that respond to that [use of ICT] than teacher talk … it can retain these students' interest. (R 35–36)

Rose identified that ICT assisted with teaching curriculum as it enabled content to be taught in different ways (i.e. recognising technological content knowledge). She stated that she would "find a [video] clip that gives better examples or a better explanation in a concise manner that you [as a teacher] can't perhaps do" (R 37–38). Rose emphasised that learning to use ICT tools did not come easily to her but she also pointed out that "I try to make sure it's useful, it's meaningful (R 140). So, perhaps Rose placed a great deal of emphasis on technological content knowledge when using ICT in the classroom to ensure it was beneficial and not just an add-on when teaching content. This revealed that Rose, like Annie, considered technological content knowledge was important.

Rose highlighted that content knowledge was most important and did identify supporting the pre-service teacher's pedagogical knowledge with the curriculum to develop pedagogical content knowledge. But Rose believed the pre-service teacher possessed technological knowledge so there was no discussion about developing this knowledge during teaching practicum. Rather Rose considered that the pre-service teacher contributed technological knowledge so together they could develop technological pedagogical knowledge. These beliefs possibly impacted on the development of the TPACK of pre-service teachers. Rose also overlooked examples of technological knowledge she possessed as well as examples of technological content knowledge.

5.2. Summary of findings of interviews and artefact analysis

This chapter has introduced and discussed the four teacher mentors – Sarah, Charles, Annie and Rose – that were each written up as a case study. Each case provided a description of the school context in which each teacher mentor taught and described the background of the teacher mentor. There was discussion under the three broad themes that emerged from the analysis of the datasets: Barriers and enablers with using ICT; Mentoring knowledge; and TPACK. It was evident that there are complicated and unique relationships between the barriers and enablers as identified by the four teacher mentors who were interviewed in this research study, as well as similarities in the challenges that these teacher mentors encountered when supporting pre-service teachers to use ICT during teaching practicums.

The first case study was Sarah, a relatively young teacher mentor, who was excited by the opportunity to mentor a preservice teacher, and readily initiated undertaking online training to support her to do so. She reported that she had confidence to use ICT and believed ICT was important for teaching, yet still made constrained use of ICT in the classroom because of various barriers. Sarah spent considerable time talking about access issues related to using ICT that she believed impacted on her decision-making to support the pre-service teacher. She identified difficulty in arranging access to ICT in the classroom and was particularly frustrated by a lack of robust and reliable wifi to use digital devices. Furthermore, Sarah identified lack of support from school leadership personnel and lack of access to timely technical support as additional barriers to using ICT. Sarah highlighted that these barriers to using ICT were often interrelated. Sarah also considered having confidence was an enabler for her as a teacher mentor and specified that having an understanding of the content to be taught enhanced her confidence to use ICT in the classroom. She identified that lack of confidence of the pre-service teacher in various aspects of teaching, such as curriculum and classroom management, as well as troubleshooting technical issues, hampered the use of ICT during the teaching practicum. It is most likely that the barriers experienced by Sarah were experienced by the pre-service teacher, and perhaps were escalated because of the pre-service teacher's lack of confidence in content knowledge. Sarah believed that having content knowledge was vital to teaching and therefore this knowledge was considered a priority when supporting the pre-service teacher to use ICT. Sarah was the only teacher mentor in this research study who identified that mentoring knowledge was needed to support the pre-service teacher's use of ICT during teaching practicums.

The second case study, Charles was an enthusiastic and confident user of ICT who believed in the importance of using ICT in teaching. His discussion concentrated mainly on enablers to support the pre-service teacher to use ICT during the teaching practicum, with a focus on access to ICT, technical infrastructure, leadership support, beliefs about ICT and age of the pre-service teacher. Charles' emphasis on enablers was perhaps quite a narrow view as there was an underlying assumption that these enablers would be sufficient for the pre-service teacher to use ICT for classroom instruction, and he perhaps disregarded the complexities of ICT uptake during the teaching practicum. He also had a lot to say about time and its influence on ICT uptake. Charles had a techno-focused view of using ICT, and this was transferred to how he described supporting the pre-service teacher to use ICT in the teaching practicum. He believed having only technological knowledge was sufficient to use ICT in the classroom, and ignored the interactions with other domains of knowledge to achieve TPACK. He also disregarded mentoring knowledge as important to supporting the pre-service teacher use of ICT during teaching practicums.

The third case study, Annie was a confident and competent user of ICT, and like Charles and Rose, considered that the pre-service teacher would bring technological knowledge to use in the teaching practicum, as this knowledge was inherent in the pre-service teacher's personal life. Annie considered that her role as teacher mentor was to develop the technological pedagogical knowledge, technological content knowledge and TPACK of the pre-service teacher. However, Annie's discussion indicated a tendency to provide limited opportunity for the pre-service teacher to demonstrate content knowledge and subsequently pedagogical content knowledge and technological content knowledge because the delivery of the curriculum was tightly regulated by Annie as the teacher mentor. Accordingly, there were restricted opportunities for the pre-service teacher to demonstrate TPACK because of the control over the delivery of the curriculum. Annie emphasised how lack of professional learning meant that teaching colleagues did not use the full functionality of ICT to optimise their teaching practices. In addition, she discussed how the decision-making of school leadership personnel influenced the procurement of ICT that possibly could be construed as inferior ICT for teaching and learning purposes to the ICT that was being replaced. She also considered that technical issues were inherent with using ICT, despite the school having a good technical infrastructure. Annie did not consider mentoring knowledge to be significant to supporting the pre-service teacher to use ICT during the teaching practicum.

The final case study was Rose who self-reported that she was ‘somewhat comfortable with using ICT’ and held beliefs that ICT was ‘somewhat important’ to teaching, and consequently viewed technological knowledge, and in particular technical skills with using ICT, as not being one of her strengths. Rose had a narrow view of technological knowledge as there were dimensions of this knowledge domain, such as ways of thinking and cybersafety, which she exhibited. Rose deemed that the pre-service teacher would bring technological knowledge from their personal life to use in the teaching practicum. She placed great emphasis on content knowledge and judged that she was best placed to advise the pre-service teacher in regard to this knowledge. Rose discussed how she and the pre-service teacher could support one another to develop technological content knowledge by relying on her expertise in curriculum and the pre-service teacher’s knowledge of ICT. Rose was the only case who suggested a reciprocal mentoring relationship between the herself as the teacher mentor and the pre-service teacher as she considered there were benefits to both of them in the relationship. Rose brought content knowledge and the pre-service teacher brought technological knowledge and together they could develop several knowledge domains including TPACK. Rose emphasised that she considered technological pedagogical knowledge when using ICT to ensure it was meaningful as well as implying that she possessed pedagogical content knowledge and technological pedagogical knowledge to overcome issues with using ICT. Rose did not consider mentoring knowledge was important to supporting the pre-service teacher use ICT during teaching practicums. Discussion now turns to the findings reported in chapter 4 and 5 in relation to the research question/s.

6. Discussion

This chapter discusses the findings reported in chapter 4 and 5. The quantitative and qualitative data were integrated, analysed and then synthesised to provide an insight into the domains of knowledge needed by teacher mentors to support pre-service teachers to use ICT in teaching practicums. This discussion is written in four parts, with the each of the four research sub-questions used to frame this discussion, beginning with backgrounds of teacher mentors, then challenges to mentoring pre-service teachers, followed by beliefs of the teacher mentors, and finally, technological, pedagogical, content and mentoring knowledge required to mentor.

The broad aim of this research study was to determine the knowledge needed by teacher mentors to support pre-service teachers to develop capabilities to use ICT during teaching practicums. It specifically examined the main research question: What knowledge do teacher mentors need to support pre-service teachers to use ICT during teaching practicums? Furthermore, the study investigated the following research sub-questions:

1. What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?

2. What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?

3. What are the teachers' beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?

4. What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?

6.1. Backgrounds of teacher mentors

This part of the chapter discusses the influence that teacher mentor backgrounds had on supporting pre-service teachers to use ICT in the teaching practicums. It includes a discussion about the sex, teaching experience and age as well as the school context of the teacher mentors.

6.1.1. Sex and ICT uptake

The research literature is divided around the influence of sex on the use of ICT. Some studies reported no significant difference in use of ICT according to sex of teachers (Adil, Masood, & Ahmed, 2013; Top et al., 2011; Verma & Dahiya, 2016). Other studies however reported that male teachers (or pre-service teachers) have greater confidence with using ICT (Jamieson-Proctor et al., 2010; Jordan, 2011; Topkaya, 2010), greater skills with using ICT (Ilomäki, 2011; Teo et al., 2015), and greater access to ICT (Mahdi & Al-Dera, 2013). This research study reflected this division in the research literature.

6.1.2. Teaching experience and ICT uptake

While the view of Prensky (2001) and other researchers (Cabero & Barroso, 2016; Krumsvik et al., 2016) assert that the younger generation of teachers (and pre-service teachers) are more *au fait* with using ICT because they have been raised to use it in their day-to-day practice, this view has largely been contradicted by other researchers (Alazam et al., 2012; Gil-Flores et al., 2017; Mahdi & Al-Dera, 2013; Prieto-Rodriguez, 2016). However, this view that younger teachers with less experience are more likely to be competent with using ICT in their teaching practice still permeates the research literature. Generally, it suggests that there is minimal correlation between ICT uptake and teaching experience (Alazam et al., 2012; Gil-Flores et al., 2017; Mahdi & Al-Dera, 2013; Prieto-Rodriguez, 2016). However, inconsistently other researchers have found that less teaching experience is associated with higher levels of ICT competence (Krumsvik et al., 2016); greater willingness to use ICT

(Baek et al., 2008); and greater levels of comfort with using ICT (Russell et al., 2003). This research study reflected the conclusion that there was no statistically significant association between level of comfort and beliefs about level of importance of ICT with teaching experience.

6.1.3. Age and ICT uptake

The research literature is also divided in regard to age of teacher (or pre-service teacher) and ICT uptake. As mentioned, the “digital native” view of Prensky (2001) still prevails in the research literature and while challenged by other researchers (Bennett et al., 2008; Bhati et al., 2009; Selwyn, 2009), it still is often touted as if fact. This view however tends to underpin much of ICT policy, wherein the younger generation, often pre-service teachers and students in the classroom, are portrayed as ready and willing to use ICT in their practice, as they indeed do in their personal lives. This view also tends to portray teachers, and subsequently teacher mentors, as being slower on their uptake with ICT. This implies that teachers, and therefore teacher mentors, are limiting student and pre-service teacher learning because they do not have the technical skills nor the confidence possessed by their students or younger counterparts. As Selwyn (2009) argues, this myth continues to underpins the research literature, that is teachers are not as confident as their younger counterparts when using ICT. Of concern is that teachers, and subsequently teacher mentors, are then positioned as lacking sufficient technological knowledge and skills to teach using ICT.

In this research study, teacher mentors tended to believe that pre-service teachers, because of their age, would naturally be more competent to use ICT in the teaching practicum. This view was generally regarded as *fait accompli*, with teacher mentors not interrogating it, but rather inclining to simply accept it as fact. The consequences of this view can be quite limiting in regard to supporting pre-service teachers’ TPACK development if one domain of knowledge is overlooked. Another consequence is that technological knowledge is perceived as a distinct knowledge domain and one that does not necessarily connect to the domains of content knowledge or pedagogical knowledge. This was evident in the way that three teacher mentors saw that their role was to concentrate on supporting the development of content knowledge of the pre-service teachers, as technological knowledge was taken as a given. There is general agreement in the research literature that technological knowledge is interconnected with other knowledge domains and that these domains are integrated in complex ways in teaching practice. While how this occurs is open to interpretation, with researchers presenting various models of how this functions, as described in chapter 2 in the works of Angeli and Valanides (2005); Mishra and Koehler (2006); Niess (2005, 2011); Pierson (2001); and Saad et al. (2012). However, there is agreement that simplistic views that focus only on the domain of technological knowledge are not useful for teachers, and subsequently teacher mentors, to support pre-service teachers to use ICT during teaching practicum. Indeed some researchers such as Harris, Phillips, Koehler, and Rosenberg (2017) suggest that the prevalence of this narrow view has led to value-adding tasks that do not optimise the use or delivery of ICT in the classroom, thus hindering ICT integration. Shulman (2007) emphasises the importance of "… wisdom of practice, which refers to the full of range of practical arguments engaged by … [teachers] …" (p. 560). That is, teachers, and subsequently teacher mentors, need to challenge existing teaching practices through explorations of pedagogical reasoning and action and examination of nuanced contexts. Harris et al. (2017) emphasises the importance of 'wisdom of practice' when using ICT and so expecting younger pre-service teachers to use ICT in teaching practicums solely based on their technological knowledge is problematic. Similarly, Selwyn et al. (2018) discusses that using ICT does not automatically lead to new or transformative approaches in teaching.

Given this mismatch between the research around technological knowledge (as complex and integrated with other knowledge domains) and the views of these teacher mentors, this research study suggested various implications for ICT policy, teacher professional learning programs and initial teacher education programs. Undeniably, more complex views of technological knowledge are needed so that teachers and teacher mentors can effectively integrate ICT into their practice. Without such a complex view of this knowledge, there is the danger that teachers, and subsequently teacher mentors, will continue to add ICT to their practice in simple and unconnected ways.

6.1.4. School context

Over the past thirty years, with the dominance of the technological determinist view of technology, the influence of context was downplayed or ignored. It was the ICT itself that was seen as determining impact – that it had innate capacities – and the role of the teacher was often seen as an accessory. ICT policy documents tended to assume that using ICT in teaching practice was a simple endeavour, and all that was needed were teachers possessing technological knowledge, explicitly technical skills. Arguably this contributed to the focus on 'technical skilling' in early professional learning offered by the Victorian Department of Education and Training, and the emphasis on getting the ICT in place as evidenced by the role of provisioning of the internet and computers in all schools, and support for 1-to-1 devices and BYOD initiatives.

As well, there has been a tendency to not draw explicit attention to context in the research literature. Contextual knowledge can be seen as implicit, but its role in impacting the use of ICT has perhaps been disregarded. For example, Mishra and Koehler (2006) in their initial construction of the TPACK framework did not explicitly conceptualise the role of context. However, this has since changed in subsequent iterations of the framework, as Koehler and Mishra (2008, 2009) later added 'contexts' to a version of the TPACK framework and then updated it to "conteXtual knowledge" (Mishra, 2019) to draw attention to this influential factor (see Figure 3). The role of context on uptake and use of ICT by teachers, and subsequently teacher mentors, is now widely accepted in the research literature. Researchers such as Albion and Ertmer (2002); (Angeli & Valanides, 2005, 2009); Ertmer (1999); Groff and Mouza (2008); and Hew and Brush (2007) embed context in their frameworks to guide teaching practice. This addition of conteXtual knowledge emphasises the importance of the organisational and situational constraints within schools and enables the focus of the work of teachers "to go beyond seeing teachers as designers of curriculum within their classrooms but rather as intrapreneurs – knowing how their organization functions, and how levers of power and influence can effect sustainable change" (Mishra, 2019, p. 77).

In this research study, the teacher mentors acknowledged context, but they had a narrow and limited view as it generally related to the physical environment and its links to technical infrastructure and access, as well as, on occasion, to the role of leadership in shaping the physical environment. However, the teacher mentors did not consider that context could also include other dimensions such as social arrangements and organisational forms that surround ICT uptake as described by Selwyn (2016) and Mishra (2019).

In this research study, all teacher mentors spoke about access to ICT facilities that were available in their schools, with each identifying that school-issued laptops were provided to them, in line with government policy (Victorian Department of Education and Training, 2019j). They also commented on accessing the standard operating environment provided by the school's jurisdiction, and that they were reliant on resources supplied by the school to determine if, and how to, use ICT in specific settings. This access to ICT is discussed further in the following part of the chapter, under the heading '6.2. Challenges to mentoring pre-service teachers'. However, according to the teacher mentors, access did not just refer to access to a computer laboratory or a bank of ICT devices; access now was more critical to them in regard to needing to be immediately available. For these teacher mentors, it had to be ready and timely access to ICT in their classrooms, and without the need to change rooms, or pre-book digital devices. Access also broadly included ready availability of technical support if there was an issue with using devices as well. Thus, it would seem that the concept of access had shifted for these teacher mentors. This was specifically evident for Sarah who found that her school context determined where the ICT was located and how it was accessed. So, although Sarah considered ICT was important to teaching and considered herself ICT-competent, the realities of the classroom, where there was limited access to ICT, did not make it possible for her to access and subsequently use ICT as often as she wished due to the school context (Compton & Jordan, 2019b). In particular, Albion and Ertmer (2002) strengthen the importance of context by explicitly cautioning that beliefs about ICT may not inform classroom practice because of context and thus experiences and access within the classroom, as evidenced by teacher mentors in this research study. Therefore, this research study reinforced that the context of schools can determine if and how ICT was used by teacher mentors and subsequently pre-service teachers.

Charles did explicitly refer to context in a broader, yet still limited, manner, and Sarah and Rose expressed frustration with leadership within the context of their respective schools. This was very revealing particularly as Mishra (2019) states that "[c]onteXtual knowledge becomes of critical importance to teachers, and a lack of it limits the effectiveness and success of any TPACK development, or a teacher's attempts at technology integration (p. 77). As mentioned, the importance of leadership is also discussed in more detail in the next part of the chapter, under the heading '6.2. Challenges to mentoring pre-service teachers', thus highlighting the complexity of the interaction of factors. Thus, these teacher mentors tended to have a simplistic view of context identifying it with access and, on occasion, with leadership.

6.2. Challenges to mentoring pre-service teachers

There has been a lot of research around identifying and classifying the barriers and enablers to ICT uptake in teaching practice. Researchers have also attempted to construct models of how these factors operate, and this research has also been undertaken from various positions and involving a range of participants from higher education teachers, in-service teachers and pre-service teachers as well as students in the classroom. There is now considerable agreement that various factors do impact on ICT uptake such as access to ICT (Bigum, 1998; Bingimlas, 2009; Ertmer, 1999; Kopcha, 2012); technical infrastructure (Bingimlas, 2009; McKnight et al., 2016; Moses et al., 2012); leadership (Balanskat et al., 2006; Divaharan & Ping, 2010; Mumtaz, 2000; Petersen, 2014); time (Divaharan & Ping, 2010; Ekici et al., 2014; Mumtaz, 2000); confidence (Jamieson-Proctor & Finger, 2008; Jamieson-Proctor et al., 2010; Mumtaz, 2000; Phelps & Graham, 2013); self-efficacy (Garvis et al., 2011; Hew & Brush, 2007; Lemon & Garvis, 2015; Pendergast et al., 2011); and beliefs (Balanskat et al., 2006; Ertmer & Ottenbreit-Leftwich, 2010; Taimalu & Luik, 2019). Arguably, this concern around obstacles and enablers reflects a desire to find a solution to the complex problem around teacher ICT uptake. In other words, if these barriers can be identified, strategies can then be put into place to overcome them.

This research study confirmed that these teacher mentors were influenced by various factors that they believed impeded or enabled their use of ICT in their teaching practice. As such this research study does confirm that using ICT is complex, and that many factors come into play when teacher mentors use ICT in their teaching practice and pre-service teachers use ICT in their teaching practicum.

The most common barriers and enablers identified by the teacher mentors were access to ICT; technical infrastructure; leadership; time; confidence; self-efficacy; and beliefs. Access, technical infrastructure, and leadership are considered to be “first-order barriers” (Ertmer, 1999) to using ICT as these barriers are extrinsic to the teacher mentors (Becta, 2004; Groff & Mouza, 2008; Hew & Brush, 2007; Mumtaz, 2000; Prestridge, 2012). Time, confidence, self-efficacy and beliefs are regarded as “second-order barriers” (Ertmer, 1999) to using ICT because they are intrinsic to the teacher mentors, and for a teacher mentor to change them would require “challenging one's belief systems and the institutionalized routines of one's practice” (Ertmer, 1999, p. 48) and changing school culture regarding ICT integration.

6.2.1. Access

Researchers have commonly agreed that access is important to enable teachers to use ICT, often identifying lack of access as a barrier (Becta, 2004; Bigum, 1998; Bingimlas, 2009; Ertmer, 1999; Kopcha, 2012) while other researchers have identified that access to ICT as a crucial factor to support its use (Ayub, Bakar, & Ismail, 2015; Balanskat et al., 2006; Divaharan & Ping, 2010; Forgasz, 2006; Prestridge, 2012). Therefore, providing access becomes a given for teachers, and subsequently teacher mentors, when supporting ICT uptake. However, this discussion of the provision of access tends to be couched in broad or general terms, and often lacks detailed or specific exploration of access as 'to what' and 'how' access could be provided. That is, the focus of access has tended to be on asserting the importance of access, without exploring the issues related to stipulating what access is needed and how access is provided.

The teacher mentors in this research study had a more nuanced view of access. They referred to different concepts of access including access to ICT tools, such as hardware like computers and software like apps and computer programs; access to technical infrastructure including wifi and technical support; access in terms of availability of ICT when needed; access to professional learning; and access to leadership support. However, the differing concepts of access were not straightforward in this research study and indicated that there is a messiness with identifying access when using ICT. Perhaps it also suggested that greater clarity regarding access needs to be defined in future research. Access to availability of ICT tools (hardware and software) is discussed in this section and the other concepts of access are discussed in later sections of the chapter, with the relationship between these concepts recognised.

All teacher mentors identified access as a factor that influenced ICT uptake. Interestingly, it was not clear cut whether access to ICT was considered a barrier or an enabler as there was an even split between the teacher mentors. Sarah and Rose identified lack of access as a barrier while the Charles and Annie identified access as an enabler to using ICT in the classroom. Although Sarah and Rose acknowledged that they had access to ICT, as both their schools had invested heavily in providing access via BYOD and 1-to-1 programs and technical infrastructure, their view of access were more specific. Both these teacher mentors saw access as timely availability of ICT as they had difficulty accessing ICT because it had to be shared amongst other teachers or there was poor organisation of resources (Becta, 2004; Bingimlas, 2009; Cuckle & Clarke, 2003). Rose and Charles were also challenged to access sufficient ICT to meet the ever-increasing demand, and it could perhaps be suggested that the demand for ICT will always increase and never be met (Cuckle & Clarke, 2003), especially if there is a lack of ICT planning from leadership.

It is fair to say that schools in Victoria do have reasonable access to ICT. For many years the Victorian Department of Education and Training has invested in providing ICT for schools. The Victorian Department of Education and Training provides schools with a range of ICT resources including a centralised internet service provider (ISP) facility to all Victorian government schools as part of the Department's eduSTAR program, computers and cost-effective arrangements with ICT suppliers (Victorian Department of Education and Training, 2019g, 2019h). The 2017–2018 and 2018–2019 annual reports for the Victorian Department of Education and Training indicated that $341 227 million and $390 825 million respectively were spend on ICT expenditure. (Victorian Department of Education and Training, 2018a, 2019a). The Australian Government's Digital Education Revolution also provided funding to secondary schools to enable increased access to ICT devices and online resources (Australian Government Department of Education, 2013). At the time of this research, these devices would be considered obsolete. Although the age of devices in schools and possible links to increased demand for technical support for older devices is interesting, it is outside the scope of this research study. However, it is likely that this provision of access has contributed to teachers feeling that they need access to 'on tap' ICT as the teacher mentors felt in this research study.

Although ICT resources were provided to the schools in this research study, it has been highlighted that there were many shortcomings with the management of ICT assets in schools and it was dependent on localised good practice rather than systemic good practice (Victorian Auditor-General's Office, 2012b). For example, Sarah was unable to access a class-set of laptops in the classrooms where she taught due to school policy (Compton &

Jordan, 2019b); Charles discussed how increased use of ICT impacted on access because it was linked to inadequate internet, and this is discussed in more detail in ensuing paragraphs, under the heading ‘6.2.2. Lack of infrastructure’ in regard to technical issues. Of concern is that this issue of access again focuses attention on technological provision, and perhaps does not direct enough attention on the successful implementation of ICT in teaching practice. Balanskat et al. (2006) emphasises that the accessibility of ICT resources does not guarantee the successful implementation of ICT in the classroom because there is a range of teacher (or micro)-level, school (or meso)-level and system (macro)-level barriers to using ICT. Correspondingly Bingimlas (2009) emphasises that the potential of ICT is often not simply harnessed with the resources available. This discussion strengthens the argument in the research literature that the challenges to accessing and using ICT are interrelated when trying to understand the factors that impact upon its uptake in the classroom.

6.2.2. Lack of technical infrastructure

As identified earlier, technical infrastructure is linked to school context and was also identified as a factor influencing ICT uptake in this research study. An important part of the systemic support for ICT in Victorian schools is delivery of enabling technical infrastructure through a standard operating environment, which provides crucial services to schools such as the internet, network access, operating systems, security and school administration software. Each school in this research study was responsible for how they leveraged off the standard operating system and used ICT in the classroom.

Lack of technical infrastructure was identified by three of the four teacher mentors who were interviewed, as being a common barrier to using ICT in the classroom, and this is supported by the work of many researchers (Balanskat et al., 2006; Bingimlas, 2009; Moses et al., 2012; Mumtaz, 2000; Pelgrum, 2001; Unal & Ozturk, 2012). Lack of infrastructure is often intertwined with lack of school leadership because school leadership largely determines school infrastructure (Newhouse, 2012; Selwyn et al., 2018). Issues related to technical infrastructure identified by the teacher mentors in this research study included inadequate hardware and software; internet reliability and speed; and access to IT technicians – these issues are consistent with common technical infrastructure issues identified in the research literature (Bingimlas, 2009; Selwyn et al., 2018).

The BYOD policy, evident in Sarah's school, attempted to provide students with greater access to ICT tools, but differing device capabilities contributed to there being more issues, with Sarah, and subsequently the pre-service teacher, having to provide multiple types of instructions for the different student devices to be used for specific learning activities. Thus, reducing teaching time due to increased time needed for student instruction. Sarah also identified that BYOD devices such as smartphones relied on wifi, which also raised other issues linked to technical infrastructure, such as the quality of the internet. Although the research literature identifies that there is significant research that shows selective, quality and empowering applications of mobile phones provides opportunities for students to learn (Bannon & Thomas, 2015; Gao, Yan, Zhao, Pan, & Mo, 2014; Lahlafi & Rushton, 2016; Nielsen & Webb, 2011), it was problematic at Rusden P–12 College due to lack of reliable and robust internet. Also, different devices have different capabilities and functionality. For example, writing on a smartphone is not ideal and neither is using a laptop to video physical activities. While Charles and Annie identified that technical infrastructure was an enabler and discussed access to newly-built computer rooms, Charles also lamented that the internet access had been an issue in the past due to lack of ICT planning by school leadership personnel. This highlighted that lack of leadership support and ICT planning were interrelated and contributes to the discussion about the interconnectedness of issues related to using ICT.

As noted by Zhao et al. (2002), there are "serious problems with the current effort to prepare teachers to use technology [ICT]. Most of the current efforts take a very narrow view of what teachers need to use technology [ICT]—some technical skills and a good attitude" (p. 511).

This supports the views of Sarah who identified that factors outside of her control, such as the technical infrastructure of the school, hampered the use of ICT by both herself and the pre-service teacher, despite Sarah's competence and willingness to use ICT in teaching practice. Prestridge (2012) states that teachers, and therefore teacher mentors, who are more confident to use ICT in the classroom identify higher levels of competence with using ICT. However, despite Sarah's levels of competence and confidence, her intended ICT practices did not eventuate because of the school technical infrastructure that influenced her lack of ICT use.

As mentioned, substantial amounts of money has been invested in schools by Australian national and state governments over the past decades, mainly in technical infrastructure such as hardware and software (Australian Government Department of Education, 2013; Office of the Auditor General Western Australia, 2016; Selwyn et al., 2018; Victorian Auditor-General's Office, 2012a; Victorian Department of Education and Training, 2019a). For example, as mentioned, $390 825 million was spent on ICT in Victorian government schools in 2018–2019 (Victorian Department of Education and Training, 2019a). In this research study, 100% of teacher mentors who completed the questionnaire, including the four teacher mentors who were interviewed, indicated that they had access to school-issued digital devices such as laptops or iPads (see Table 10). Likewise, all the teacher mentors interviewed and 94% of teacher mentors who completed the questionnaire indicated that they had access to state-wide purchased software for use in the classroom, such as Microsoft Word (Microsoft Corporation, 2019b) and PowerPoint (Microsoft Corporation, 2016) (see Table 10). This software tended not to be subject-specific but rather was for generic use across a range of curriculum areas. Of note, the majority of teacher mentors in this research study indicated that they used software that was available through the school's standard operating system, or software (including computer programs and apps) or websites that were either free or required minimal costs. Investment for subject- (or content)-specific software was not considered a priority for most teacher mentors in this research study, including those who were interviewed. In the case of Rose, software was not typically included in class-based yearly budgeting requirements. Interestingly, Selwyn et al. (2018) explicitly discusses that the use of ICT in schools is “compromised” and questions whose interest does ICT assist especially in regard to “free” software. He signals that use of these free software, including computer programs and apps, often involves conciliations such as collection of personal data that “clash with the practices and ethics of public education” (Selwyn et al., 2018, p. 8). He goes on to state that “the immediate benefits of these [free] apps seemed to outweigh the benefits of any deeper critique or reflection” (Selwyn et al., 2018, p. 104). Although thought-provoking, further discussion is outside the scope of this research study.

Sarah, Rose and Annie all discussed how they used apps or websites that were free. They all commented that budgetary constraints were a factor. Various researchers have suggested that rather than being budget concerns *per se*, these issues relate more so to how school leaders manage their budget (Becta, 2006; Makkawi, 2010; Victorian Department of Education and Training, 2015b). This is consistent with the findings from Victorian Auditor-General's Office (2012b) that concluded there were major deficiencies in planning and asset management frameworks in Victorian government schools. However, it is not surprising as the rate of technological change is quite rapid, and so hardware and software can easily and quickly become obsolete. Although, the Victorian Department of Education and Training provides all government schools with an annual budget allocation for ICT resources as part of its ‘Student resource package’ (Victorian Department of Education and Training, 2019c), perhaps the teacher mentors did not consider it a wise investment especially as school budgets may be tight and their schools have competing priorities for ICT resources. It is evident that some schools are struggling to comprehend and keep up with changes in ICT, and so it is important to reconsider how to engage with these schools to provide support in order to better facilitate their use of ICT. Gil-Flores et al. (2017) states that important factors such as availability of appropriate software and suitable teacher training have been “neglected” as these components are key to “achieving true ICT integration” (p. 447).

6.2.2.1. Technical issues

Technical issues as an obstacle to teacher use of ICT are well reported in the research literature (Bingimlas, 2009; Ertmer, 1999; Mumtaz, 2000; Pelgrum, 2001; Salehi & Salehi, 2012; Unal & Ozturk, 2012). All the teacher mentors who were interviewed in this research study had access to technical assistance to support their integration of ICT in their teaching practice. For the most part, however, the teacher mentors had concerns around this support, and like their nuanced views of access, these teacher mentors had quite clear views on the level of technical assistance they expected. All teacher mentors wanted readily-available, just-in-time or immediate support for technical issues.

In addition, as mentioned, some of the teacher mentors interviewed identified that a lack of internet speed and bandwidth limited the use of ICT in the classroom. The Office of the Auditor General Western Australia (2016) highlights that lack of reliable and robust internet can curb access to classroom resources, “… restrict a teacher delivering a lesson … and even stifle innovation in the classroom (p. 19), and is consistent with findings from this research study. The Auditor-General report also highlights that “slow and unreliable internet is a reason some teachers limit the use of ICT in classrooms as it contributed to behaviour management problems amongst students” (Office of the Auditor General Western Australia, 2016, p. 18). Again, this highlights the complexity between factors. Some teacher mentors interviewed in this research study identified that pre-service teachers were reluctant to use ICT in the teaching practicum because of a sense of loss of control in regard to behaviour of the students, especially if ICT failed when being used for classroom instruction. Sarah spoke about the pre-service teacher believing she would lose control when students were using ICT but also stated that the pre-service teacher used ICT to control the students via her use of ICT to assist with planning and structuring lessons. Charles spoke about being able to monitor student use on laptops rather than iPads. Rose discussed that she had no control when experiencing technical issues and was not able to leave the class to seek assistance.

Also, lack of quality internet, especially access to wifi, was regarded by most teacher mentors interviewed in this research study as under resourced or its usage underestimated, resulting in limited access for digital devices that relied on the internet, such as iPads and smartphones. The increasing number of digital devices being used in the classroom due to policies such as BYOD and 1-to-1 devices impacted on bandwidth and internet speed affecting reliability and performance issues of the internet (Office of the Auditor General Western Australia, 2016; Selwyn et al., 2018). As mentioned, Sarah discussed her school's BYOD policy yet highlighted that slow and unreliable internet access was an ongoing issue in the classroom that limited the use of these ICT devices. Charles also claimed the demand for the internet initially hampered the uptake of ICT at his school. Therefore, it seems that the delivery of ICT in the classroom can be undermined by slow or unreliable internet that perhaps was due to underestimated usage by the school in regards to how many devices would be using it simultaneously.

It was interesting that Charles was the only teacher mentor who discussed how the school technical infrastructure was an enabler to using ICT in the teaching practicum. Charles was responsible for the management of a newly-built computer complex at Ebden College so this conceivably explains these observations. Yet Charles did identify other barriers to using ICT, and so perhaps also emphasised the complexity of using ICT, as described by Gil-Flores et al. (2017), who stresses that having a sound technical infrastructure, quality internet and suitable hardware is not enough for the uptake of ICT in the classroom. This is pertinent to Sarah who identified that lack of technical infrastructure, including quality internet and suitable devices, hindered use of ICT by both herself and the pre-service teacher.

6.2.3. Lack of leadership

Leadership was identified as another factor that influenced ICT uptake by all the teacher mentors interviewed in this research study. School leadership personnel is considered a critical factor, and one of the many stakeholders involved, in ensuring the effective use of ICT in the classroom and subsequently teaching practicums. School leadership also influences the school context (Mishra, 2019). The research literature discusses the importance of commitment of school leaders articulating and supporting the school's vision for the successful integration of ICT for learning (Blau & Shamir-Inbal, 2017; Dickerson, Coleman, & Geer, 2012; Flanagan & Jacobsen, 2003; Hayes, 2007; Law, Yuen, & Fox, 2011; Mumtaz, 2000; Newhouse, 2012). Lack of support from school leadership personnel as an obstacle to ICT uptake in the classroom is consistent with the work of other educational researchers (Blau & Shamir-Inbal, 2017; Dickerson et al., 2012; Flanagan & Jacobsen, 2003; Hayes, 2007; Law et al., 2011; Newhouse, 2012). This was reflected in the views of teacher mentors who were interviewed that school leadership issues were "multi-faceted" (Divaharan & Ping, 2010) as they identified different aspects related to issues with school leadership in this research study. Most teacher mentors commented that lack of school leadership made it challenging to use ICT in teaching practice.

It also seems that for some of the teacher mentors, leadership was particularly required for technical infrastructure. Both Sarah and Charles commented that a lack of whole-school planning evident at the leadership level in regard to wifi use, was a common barrier to teacher uptake of ICT in schools (Mackey & Mills, 2003; Moses et al., 2012; Pelgrum, 2001; Shiue, 2007; Vanderlinde, Dexter, & van Braak, 2012). Ertmer (1999) regards lack of planning as a first-order barrier as it is extrinsic to the teacher mentor. Yet discussion also indicates it impacted on "second-order barriers" (Ertmer, 1999) as it is difficult to separate the two categories of barriers. For example, the Office of the Auditor General Western Australia (2016) reveals that schools that lack internal expertise or are unable to fund ICT support are more likely to make poor ICT planning and investment decisions and be less able to ensure their ICT is operating reliably and used optimally.

In Victoria, leadership teams are responsible for planning, supporting and managing ICT within schools. In this research study, the leadership teams had both accountability and flexibility to make decisions regarding ICT within their schools. For example, the leadership team within schools can determine how they want ICT tools to be used by implementing strategies, such as using dedicated computer laboratories; laptop trolleys; tablet devices; 1-to-1 initiatives; and/or student-owned devices (BYOD) programs. However, the decision-making depended upon the level of expertise within the leadership team and may rely on staff within the schools with limited ICT expertise making significant ICT investment decisions. Selwyn et al. (2018) discusses how BYOD programs complicate the work of technical support staff. For example, varying types of digital devices, and subsequent different configurations and software introduce a wide variety of technological hurdles that need to be overcome by the school technicians contributing to greater workload; internet content must also be filtered, and this requires technological considerations that may be more difficult to manage because of different devices; and school wireless networks can easily become overloaded if they are not appropriately designed to accommodate all the wireless devices. The Office of the Auditor General Western Australia (2016) advises that "[p]oor procurement decisions can have lasting implications in terms of financial outlay, equipment performance, reliability and required level of support" (p. 16). This was perhaps evident when Sarah discussed lack of access to devices; when Annie revealed the replacement of interactive whiteboards with Apple TVs that have less functionality; and when Rose identified an inability to obtain teaching content from a CD ROM. While all these issues related to the teacher mentors, they all had an impact on the use of ICT by pre-service teachers during the teaching practicums too. Consequently, there can be long-term impacts on the school's ICT uptake if the leadership team making decisions does not understand the complexity of issues related to ICT in the classroom as evident in this research study.

6.2.4. Confidence and ICT uptake

Prior studies have shown that confidence is critical when using ICT to facilitate student learning (Albion et al., 2011; Bate, 2010; Heck & Sweeney, 2013; Jamieson-Proctor et al., 2010; Jamieson-Proctor et al., 2006; Yeung, Lim, Tay, Lam-Chiang, & Hui, 2012). Lack of confidence is identified as a barrier that hinders the use of ICT in the classroom (Balanskat et al., 2006; Becta, 2004; Bingimlas, 2009; Groff & Mouza, 2008; Mumtaz, 2000; Wozney et al., 2006). Wozney et al. (2006) argues that teacher confidence is a predictor of ICT use in the classroom. Confidence was also identified as a factor that influenced ICT uptake by all of the teacher mentors who were interviewed in this research study. However, there were differences in whether the confidence related to the teacher mentor or the pre-service teacher, and the discussion related to both possessing and lacking confidence. Rose spoke about confidence in relation to her own skills whereas Annie and Sarah identified lack of confidence as a barrier for the pre-service teacher. Sarah identified confidence of the teacher mentor as an enabler while Rose identified confidence of the pre-service teacher as an enabler. In addition, Charles identified confidence of both the teacher mentors and pre-service teacher as enablers.

While three out of four teacher mentors interviewed in this research study indicated personal competence and confidence in using ICT, they also felt their use was constrained by ease of access (Becta, 2004; Bingimlas, 2009; Mumtaz, 2000). The research literature has clearly shown that teachers can face various obstacles when trying to use ICT in their teaching practice. This research study reiterated that these obstacles can be interconnected in unique ways. As Bingimlas (2009) argues the complexities related to using ICT include “confidence, competence and accessibility … [that are] critical components of technology integration into schools” (p. 235). Bingimlas (2009) also goes on to emphasise that “[n]o one component in itself is sufficient to provide good teaching. … [It is] the presence of all components [that] increases the possibility of excellent integration of ICT in learning and teaching opportunities” (p. 235). The teacher mentors interviewed in this research study interconnected various factors that contributed to ICT uptake and reinforced its complexities of factors.

As previously mentioned, Sarah specifically linked confidence of the pre-service teacher using ICT with control in the classroom. She contended that the pre-service teacher saw some loss of control in the classroom occurring through the use of ICT because the pre-service teacher felt uncomfortable not understanding some of the technical issues related to ensuring ICT would work seamlessly during teaching practicums. Sarah commented that this lack of understanding impacted on the pre-service teacher's confidence to use ICT as a teaching tool. The link between confidence and fear of losing control is well-referenced in the research literature (Bingimlas, 2009; Jamieson-Proctor & Finger, 2008; Jamieson-Proctor et al., 2010; Jamieson-Proctor et al., 2006; Yeung et al., 2012). Howard and Mozejko (2015) claim that shame is associated with lack of confidence when using ICT tools as it can make individuals "feel out of control and that their professional competence is being compromised" (p. 318). Cuckle and Clarke (2003) agree that pre-service teachers consider that there is more chance of losing control of the class when using ICT, especially if there are technical issues. This also relates back to earlier discussion that the use of ICT in the classroom is different to the use of ICT in one's personal life and there are different knowledge, skills and decisions to be made by the pre-service teacher, all of which contribute to lack of confidence and a sense of being overwhelmed and daunted by its use. Thus, supporting the views presented about the complexities of the issues with using ICT in the classroom.

6.2.5. Time

The research literature commonly identifies time as a barrier to using ICT. References to time are often associated with having time to learn how to use ICT, thereby reinforcing a technical determinist view. In this research study, the teacher mentors interviewed also felt that time was a barrier. However, they tended to have nuanced views of time. Time was identified by Sarah and Charles as a factor that influenced use of ICT in the classroom. They both identified issues related to lack of sufficient time for teacher mentors and pre-service teachers to become aware of specific ICT tools; time to learn technological knowledge and skills for specific school-based ICT; and time for ICT to become part of the school culture.

While time in previous research tends to be associated with learning how to use ICT, this was not really the case in this research study. This is because according to the teacher mentors interviewed, pre-service teachers have grown up using ICT and therefore don't need more time to learn how to use them. It would also seem that these teacher mentors felt that having technological skills was a fixed state – one either has the skills or one does not. There was little acknowledgement, for example, that pre-service teachers, who may be unfamiliar with apps used in teaching practice, would necessarily need time to learn how to use them. The assumption was that if one has ICT knowledge and skills, further knowledge and skills can be just added, and that this process was a simple one. Therefore, time to learn technological knowledge and skills was generally not indicated as an issue for pre-service teachers as three out of four of the teacher mentors interviewed in this research study considered that the pre-service teachers would have competence in using ICT because of their younger age and personal experiences with ICT. Thus, this research study generally does not support the finding of researchers that time is needed for ICT uptake (Bhati et al., 2009; Bingimlas, 2009; Divaharan & Ping, 2010; Prieto-Rodriguez, 2016; Salehi & Salehi, 2012; Taimalu & Luik, 2019). Some researchers (Bingimlas, 2009; Chen, 2010; Wenli, Lee, Tan, & Chiu-Pin, 2012) specifically indicate that time is needed to explore and practise using ICT; deal with technical issues; prepare lessons using ICT; receive technical training to use ICT; and also that it takes more time to prepare lessons that incorporate ICT.

Charles specifically referred to lack of time as a barrier for other teacher mentors and identified having time as an enabler for him as a teacher mentor as it complemented his Leading Teacher role (Victorian Department of Education and Training, 2019f). Although he discussed how ICT freed up time for teachers to do less administrative tasks and that the pre-service teacher would need to learn pedagogical knowledge and the school context, he was quite unconcerned that the pre-service teacher would need time. Like Annie and Rose, Charles considered that the pre-service teacher would easily incorporate ICT into the teaching practicum. Inconsistently, he stated that the pre-service teacher would need time to understand how to use specific school-based ICT resources but indicated that this would not be that onerous for the pre-service teacher.

Rose also emphasised that the amount of time it took her to learn to use ICT was much greater than other teaching colleagues and so contributed to her workload. This supported the views of Bhati et al. (2009) and Taimalu and Luik (2019) who discuss that many teachers consider they were employed to teach, not to learn new ICT tools, which they regarded as increasing their workload unnecessarily. However, all the teacher mentors interviewed in this research study identified the importance of using ICT – both Annie and Rose justified that it was necessary to use time to ensure use of ICT by students to develop “21st century skills”, which supports the views of Selwyn et al. (2018) that one of the “… promises of technology … [includes being] celebrated as supporting practices that are inherently creative, communicative and collaborative in nature – what are sometimes referred to as ‘twenty-first century skills’” (p. 6).

Lack of productivity in the classroom when using ICT, as Selwyn et al. (2018) recognises, was identified by Sarah, who commented that it contributed to limiting the amount of classwork undertaken, including during the teaching practicum. In other words, Sarah discussed that the pre-service teacher found it more time-consuming to teach with ICT as she identified that there were various other factors to be considered such as the heightened role of classroom management (Compton & Jordan, 2019b). Three out of four of the teacher mentors interviewed considered that the pre-service teacher would use ICT in teaching practicums yet would not need extra time to do this, namely because the pre-service teacher had technical skills – the teacher mentors regarded that the pre-service teachers could use ICT in teaching practicums. The research literature also discusses that pre-service teachers find it more time-consuming to teach with ICT as there are various factors to consider including classroom management (Cuckle & Clarke, 2003; Lemon & Garvis, 2015), which is consistent with Sarah's comments, and all of these factors can be more challenging for pre-service teachers when learning to teach. Cuckle and Clarke (2003) emphasise that classroom management and lesson preparation "… would almost always take priority [over ICT uptake]" (p. 389). Yet this was not evident in the responses three out of the four teacher mentors interviewed in this research study. Interestingly, Bingimlas (2009) laments that it takes more than competence and confidence to use ICT as time is a critical factor as to whether there is ICT uptake in the classroom. For example, there are challenges with scheduling adequate time to use ICT as highlighted by Sarah.

None of the teacher mentors spoke about time being needed by the pre-service teacher to have opportunities to reflect on development of their teaching identity or teaching philosophies in order to reform the teaching profession. Yet Beutal and Spooner-Lane (2009) specifically discuss how it is fundamental for pre-service teachers to have time to "question their own underlying personal philosophies and current practices" (p. 358) to reculture and reshape the profession, rather than just knowing how to "fit in" Walkington (2005). The mentoring process also plays an important role in the development of one's teaching identity (Beck & Kosnick, 2000; Nielsen et al., 2017; Pendergast et al., 2011). Perhaps the teacher mentors did not consider that this was part of the role of mentoring as most teacher mentors in this research study, including three of the four teacher mentors who were interviewed had not had formal training – these teacher mentors who were interviewed perhaps were uncertain of the breadth of mentoring roles outside of being an instructional coach.

6.2.6. ICT knowledge and skills

Discussion now turns to examining how both lack of ICT knowledge and skills were identified by the teacher mentors who were interviewed in this research study. Lack of skills to use ICT was identified by three out of four teacher mentors who were interviewed. Specifically, Rose identified her own lack of skills to use ICT while Sarah and Annie identified lack of ICT knowledge in the pre-service teachers. As previously mentioned, three out of four teacher mentors interviewed identified that pre-service teachers would possess technical skills because of their age, and so did not consider lack of skills as being pertinent. However, both Sarah and Rose indicated that perhaps the pre-service teacher lacked technological pedagogical knowledge to use ICT and so lacked knowledge to use ICT to support learning despite having technical skills.

Researchers such as Bingimlas (2009) and Becta (2004) identify that lack of teacher competence is a barrier to using ICT, but also highlight the complexity of using ICT – they state that there are various elements to ensure its use, such as providing effective training that recognises the actual amount of time required for this training, and the provision of training related to both pedagogy and technical skills. So, while three out of four teacher mentors identified that the pre-service teachers came with skills from their personal lives to use ICT, Sarah and Rose identified that knowledge was also needed to know how to use ICT to support student learning during the teaching practicum. There is a complex relationship between factors related to using ICT and perhaps it suggested that these teacher mentors were somewhat naïve to not consider both the knowledge and skills of pre-service teachers that relate to using ICT in the classroom. Both Sarah and Annie spoke about the pre-service teacher needing support to understand how and why ICT was being used and therefore suggesting an understanding of technological pedagogical knowledge was needed.

In the questionnaire, most research participants including the four teacher mentors who were later interviewed, commented that they used a wide array of ICT tools in their teaching practice. However, interviews with the four teacher mentors revealed use of only a few ICT resources were discussed, perhaps demonstrating limited technological content knowledge and technological pedagogical knowledge. The rhetoric about the use of ICT in the classroom is generally very optimistic (Dawson, 2008; Livingstone, 2012; Selwyn, 2011) and so the expectations of teachers, including teacher mentors, to use ICT seems to be overestimated. This is one of the limitations of using self-reporting data and further research would be desirable to see if ICT use is replicated in the classroom as stated in self-reported data. As discussed in chapter 2, there is a need to integrate ICT across all curriculum areas in the Victorian Curriculum F–10 (VCAA, 2018a) and so there are implications from the findings of this research study as to whether students in the classroom are given such opportunities. Similarly, there are also implications for the TPACK development of pre-service teachers if there are no opportunities to develop their technological content knowledge and technological pedagogical knowledge. This is reinforced by Angeli and Valanides (2005) and Sweeney and Drummond (2013) who state it is critical to receive explicit instruction about technological content knowledge so pre-service teachers know what ICT is available to be used within specific subjects.

It was also quite interesting that Rose identified a range of ICT tools that she used in the classroom through both the questionnaire and interview data, yet she rated her level with using ICT as ‘somewhat comfortable’. She also discussed how she believed that she was not competent with using ICT even though she was using a range of ICT tools in the classroom. It appeared that Rose underrated her technical skills perhaps because she believed she needed to use the latest tools and perhaps may not have understood that there are other dimensions to technological knowledge (as well as other knowledge domains), and that possessing technical skills was only part of the picture with using ICT for classroom instruction.

6.2.7. Professional learning to use ICT

Going hand-in-hand with knowledge and skills is professional learning to use ICT. While the research literature is quite clear that professional learning can be a barrier to using ICT (Bingimlas, 2009; Cabero & Barroso, 2016), it was not considered to be of much significance to the teacher mentors in this research study. In part, this maybe because the teacher mentors considered that pre-service teachers came equipped with technological knowledge and therefore had no need for further professional learning. Also, in part, it maybe because three out of four teacher mentors rated their own level of ICT skills as very competent.

However, they all suggested that other teachers at their respective schools needed professional learning.

On the contrary, Rose rated her level with using ICT as 'somewhat comfortable' and identified that she lacked knowledge and skills to use ICT explicitly in regard to problem-solving and troubleshooting technical issues. While Rose's belief that ICT often did not work in the classroom is regarded as a "second-order barrier" (Ertmer, 1999), it is likely it may be a symptom of lack of support or guidance to troubleshoot technical issues; lack of professional learning; or lack of competence (Becta, 2004). This was perhaps elaborated on when Rose mentioned that she had recently had her school-owned laptop upgraded but had difficulties in getting access to a particular software program that had been purchased for use and downloaded onto her previous laptop. This highlighted that the professional learning related to using ICT needs to be all-encompassing and include a wide range of knowledge and skills. Wozney et al. (2006) supports this by asserting that ICT uptake in the classroom needs more than skill development and suggests that ICT implementation would be less challenging if professional learning also related to other types of knowledge including contextual knowledge. Researchers such as Bingimlas (2009) and Becta (2004) also claim a lack of either pedagogical or technical training as the reason why many teachers do not use ICT, thereby supporting this research study that ICT professional learning needs to address both knowledge and skills, and include more than knowledge of technical skills, and encompass all the dimensions of technological knowledge, such as cybersafety.

Castañeda and Selwyn (2018) state that often ICT is used in the classroom for purposes other than enhancing learning. Sarah, Charles, Annie and Rose all discussed the importance of using ICT to support learning and reinforced that this was their role when supporting the pre-service teacher. However, generally both technical and pedagogical training were identified as lacking in other teacher mentors, but not in regard to the teacher mentors who were interviewed. Perhaps this was identified by some teacher mentors who stated that their colleagues want to learn how to use ICT but often lack suitable opportunities for professional learning. This research study highlighted that there are complex relationships between barriers to using ICT, and often these barriers are symptoms of other barriers (Becta, 2004).

In summary, previous research suggests that there is a complex range of factors that influence the use of ICT in the classroom and during the teaching practicum. This research study has also identified numerous barriers and enablers to using ICT as identified in the research literature. Many of these barriers and enablers are intertwined and influence other barriers and enablers, highlighting the complexity and 'messiness' of ICT uptake.

6.3. Beliefs of teacher mentors

This part of the chapter turns to consider the beliefs of the teacher mentors in this research study, and is written in three sections. The first section explores the training undertaken by the teacher mentors using both quantitative and qualitative data collected in this research study. The second section unpacks the roles of the teacher mentors as revealed in the interviews while the third section discusses their beliefs about supporting pre-service teachers to use ICT during teaching practicum.

6.3.1. Training of teacher mentors

This section is concerned with the previous experience of mentoring and mentor training. It also is intertwined with some examination of the roles of teacher mentors as it is difficult to separate training and the roles of teacher mentors. It is apparent from the questionnaire and interview data that although the teacher mentors had all previously mentored, the majority had not undertaken any training to undertake this role. It was also reflected in the questionnaire data where the majority (76%) of the teacher mentors had not undertaken any mentor training (see Table 5), including three out of four teacher mentors who were interviewed.

In the interviews, three out of four teacher mentors implied that mentoring was a practice that was intrinsic to teaching and not an additional knowledge and skill set possessed by teachers. The assumption that teacher mentors only need teaching experience to mentor is revealing, especially in light of the discussion in chapter 2 where researchers questioned the notion that teaching experience equates to quality mentoring experiences (AITSL, 2015; Ambrosetti, 2014; Davis & Fantozzi, 2016; Hudson, 2010; PTR Consulting Pty Ltd, 2017; Zimpher & Rieger, 1988), and stated that training for teacher mentors is beneficial for the mentoring process (Ambrosetti, 2014; Evertson & Smithey, 2000; Giebelhaus & Bowman, 2002; Hudson, 2010, 2013; Izadinia, 2017).

Three out of four teacher mentors interviewed had narrow views of mentoring, often equating mentoring to a ‘master/apprentice’ role, in which they, as the ‘master’ passed on their teaching expertise to the pre-service teacher (i.e. ‘apprentice’) (Compton & Jordan, 2019c). There was little exploration of mentoring as involving a particular knowledge and skill set including establishing rapport, providing emotional support and having empathy, and assisting with the development of teaching identities and personal teaching styles or philosophies. Yet this is despite the research literature stating that mentoring is a complex knowledge and skill set; that knowledge to mentor is regarded as different to the knowledge to teach; and that the mentoring process is not intuitive (Ambrosetti, 2014; Beutal & Spooner-Lane, 2009; Giebelhaus & Bowman, 2002; Hudson, 2013; Mena, Hennissen, & Loughran, 2017; PTR Consulting Pty Ltd, 2017; Zimpher & Rieger, 1988). Hudson (2010) explicitly asserts that “[m]entoring is a developed skill not a practice that is inherent” (p. 5).

Also, the teacher mentors interviewed in this research study did not demonstrate an extensive understanding of the AITSL teacher standards for graduates (AITSL, 2018b). In the main, the teacher mentors referred generally to ‘ICT standards’ but were not able to articulate the three separate teacher standards related to ICT (i.e. teacher standards 2, 3 and 4), or demonstrate an understanding of the difference between these three standards let alone differences between the focus areas of each of them.

In addition, the allocation of a teacher mentor to a pre-service teacher tended to occur on the requirements of the pre-service teacher (e.g. teaching methods) and/or the willingness or enthusiasm of the teacher mentor that volunteered. Izadinia (2017) supports this by stating that the selection of teacher mentors is "… based on convenience, volunteerism and entitlement" (p. 78). As mentioned, there was no expectation at the school level that additional training to the initial teaching qualification was a pre-requisite to mentor pre-service teachers as "… there is no standard for mentoring preservice teachers in Australian education systems" (Hudson, 2010, p. 39). These findings from my research study are also consistent with the research literature (Clarke et al., 2013; Nielsen et al., 2017; Walkington, 2005) that highlight teacher mentors are rarely provided with formal opportunities for professional learning and "… thus remain underprepared for the role of supervising preservice teachers" (Nielsen et al., 2017, p. 2). Only one of the teacher mentors who were interviewed decided to undertake mentor training because she believed she needed extra knowledge but it was not a requirement at the school level (Compton & Jordan, 2019b). Therefore, none of the teacher mentors indicated that there was a requirement, at a school leadership level, for training to have been undertaken to be a teacher mentor. Correspondingly, the role of the teaching practicum coordinator within a school was seen as purely administrative by the teacher mentors who were interviewed. Overall, from the findings from this research study, it appeared that training for teacher mentors is voluntary, ad hoc and underdeveloped.

6.3.2. Roles of teacher mentors

The consensus view in the research literature is that there is no overall agreed practice of mentoring but there is agreement that the relationship between teacher mentors and pre-service teachers is important to their interactions. As previously discussed in this research study, it was evident that the relationship was more of a 'master/apprentice' model because three out of four teacher mentors interviewed indicated that it was their role to be a facilitator or instructional coach to support the pre-service teacher and indicated that the content to be taught was tightly controlled by them – these teacher mentors did not identify that one of their roles was to enable the pre-service teacher to develop their teaching identity (Beck & Kosnick, 2000; Nielsen et al., 2017; Pendergast et al., 2011) or own teaching style or philosophies (Beutal & Spooner-Lane, 2009; Compton & Jordan, 2019c; Nielsen et al., 2017; Soccorsi, 2013; Vumilia & Semali, 2016).

However, the research literature argues that 'master/apprentice' views of the operation of mentoring are too narrow and limited, especially as the 'master' (i.e. teacher mentor) is in control and has authority over the pre-service teacher, rather than the relationship being equal and negotiated, with both the teacher mentor and pre-service teacher contributing to the relationship. To the contrary, recent researchers argue that mentoring should be more collaborative and shared (Ambrosetti, 2014; Bradbury, 2010; Hudson, 2013; Hudson et al., 2012; Irby, 2012; Moyle, 2016; Smith & Nadelson, 2016). The approach in this research study juxtaposes with the description in the research literature that identifies the roles of the teacher mentor as more encompassing and broader than instructional coach alone and involves providing emotional support and acting as a socialising agent for the pre-service teacher (Davis & Fantozzi, 2016; Hudson, 2013; Shih-Hsiung, 2014; Vumilia & Semali, 2016). In contrast to the other teacher mentors interviewed, Sarah's responses implied that she needed more than knowledge of teaching and teaching experience to understand the roles of being a teacher mentor, but this response was an anomaly in this research study.

The research literature also suggests that teacher mentors need training so that they can effectively perform the complex roles that they consider mentoring entails when supporting pre-service teachers (Beutal & Spooner-Lane, 2009; Hudson, 2010). Hudson (2010) asserts that "[e]ducational reform will necessitate mentors to be educated on effective mentoring practices, including articulating pedagogical knowledge, so the mentoring process can be more purposeful" (p. 39). Yet as evident in this research study, few teachers receive formal training to prepare them sufficiently for their mentoring roles. Therefore, when examining mentoring knowledge, it was clear that both mentor training and understanding the various roles of being a mentor teacher are closely associated with effective mentor training of pre-service teachers but it was not evident in practice.

6.3.3. Beliefs about ICT

Many researchers argue that beliefs of the teacher and subsequently the teacher mentor, are pivotal to the uptake of ICT in the classroom (Abbitt, 2011a; Gil-Flores et al., 2017; Lee & Lee, 2014; Phelps & Maddison, 2008; Prestridge, 2012; Topkaya, 2010). The teacher mentors in this research study considered ICT to be a key part of everyday life, and so necessary to be included in the teaching practice in a variety of ways, such as using interactive whiteboards to deliver content; using the internet to research content; using apps to locate information; using software to organise content; and using a learning management system for communication and reporting. Three out of the four teacher mentors interviewed also believed they were compelled to use ICT in the classroom to prepare students for the future (Bingimlas, 2009; OECD, 2016; Selwyn et al., 2018; Tallvid, 2016).

Beliefs about how students learn can also contribute to the use of ICT in the classroom (Becta, 2004; Nespor, 1987; Phelps & Maddison, 2008; Prestridge, 2012; Taimalu & Luik, 2019). Teachers, and subsequently teacher mentors, that have constructivist pedagogical beliefs are more likely to use ICT to facilitate learning (Hsu, 2016; Prestridge, 2012; Taimalu & Luik, 2019). This view was reinforced by the majority of teacher mentors who also spoke about ensuring that the use of ICT enhanced student learning, with Charles, Annie and Rose highlighting that their pedagogical knowledge was critical, and in particular stressing the importance of constructivist approaches too.

The research literature also argues that teachers, and subsequently teacher mentors, need to be able to continually upgrade their use of ICT tools (Bingimlas, 2009; Selwyn et al., 2018). Yet this view was not shared by the teacher mentors who were interviewed in this research study. A techno-centric view prevailed. They believed that pre-service teachers, on coming to their schools for teaching practicum, also had a knowledge and skill set acquired from growing up with ICT and did not recognise that there would be ongoing learning for these pre-service teachers. The teacher mentors also often failed to recognise that while pre-service teachers may have used ICT in their personal lives, they did not have experiences of using ICT for pedagogical purposes. Three out of four teacher mentors who were interviewed also seemed to feel comfortable with their own level of ICT knowledge and skill and believed that was enough.

As mentioned in the research literature review, the “digital native” (Prensky, 2001) concept is a popular view, and was held by three out of the four teacher mentors who were interviewed in my research study. This dominant view believes that younger pre-service teachers are familiar with using ICT. That is, the pre-service teachers are born in a generation where ICT is a natural part of the culture and so use it intuitively because they have innate technological knowledge and skills. Cabero and Barroso (2016) found that teachers with less teaching experience “tend to describe their technological knowledge and knowledge of technological content … as significantly higher than teacher with more teaching experience” (p. 636). This suggests that younger teachers are more likely to rate their knowledge of ICT as higher than older teachers and therefore support the view that age is a factor that contributes to ICT competence. However, this view has also been criticised by numerous researchers (Bennett et al., 2008; Bhati et al., 2009; Brown & Czerniewicz, 2010; Gil-Flores et al., 2017; Kennedy et al., 2008; Koutropoulos, 2011; Selwyn, 2009) who state that age does not define one’s technological knowledge. It is very easy to pigeonhole pre-service teachers and presume that understandings of particular types of ICT tools means mastery over all ICT tools. It also assumes that technological knowledge only encompasses technical skills and overlooks other dimensions within this knowledge domain, such as knowing about cybersafety. The concept of “digital native” (Prensky, 2001) assumes that the pre-service teachers will have knowledge, skills, access, and confidence to use ICT and overlooks other barriers that may impact on the use of ICT by pre-service teachers. It is challenging to develop knowledge to harness ICT in “pedagogically meaningful ways … [to support teaching practice]" (Valtonen et al., 2019). Yet three out of the four teacher mentors interviewed believed that the pre-service teachers would naturally be able to use ICT because of their age and expected that the pre-service teachers would have knowledge and skills from using ICT in their personal lives to be able to use ICT in the teaching practicum.

Over the last thirty years, there has been a colossal swing to using ICT in all facets of society, but the exposure and experience of each pre-service teacher is different and simply using age as a factor would be quite inaccurate. It is important to continually challenge the assumption that pre-service teachers will have knowledge and skills to use ICT solely because of their age. Assuming ICT that is used in one's personal lives will also be used in the classroom overlooks the explicit decision-making that occurs in regard to technological pedagogical knowledge, technological content knowledge and subsequently TPACK. This is reinforced by Orlando and Attard (2016) who caution that using ICT is different to teaching with ICT, and it is a stretch to expect pre-service teachers to know how to use ICT in the classroom just because they are younger and use it in their personal lives. The use of ICT in both these circumstances (i.e. personal lives and classrooms) is driven by different decisions. As previously highlighted, the belief that pre-service teachers are "digital natives" (Prensky, 2001) because of their age has been challenged in the research literature by numerous researchers as too simplistic (Bennett et al., 2008; Bhati et al., 2009; Brown & Czerniewicz, 2010; Kennedy et al., 2008; Koutropoulos, 2011; Selwyn, 2009) because it disregards the diverse range of complex issues related to the use of ICT in the classroom by the pre-service teacher during the teaching practicum.

In summary, this research study found that the beliefs of the teacher mentors tended to be quite narrow, with three out of four teacher mentors who were interviewed believing that teaching experience was sufficient to be a mentor, and that the roles of the teacher mentors were primarily as an instructional coach and so adopted a 'master/apprentice' approach. There was no stated expectation from the school leadership personnel for mentor training to be undertaken. Teacher mentors believed the younger pre-service teachers would bring ICT knowledge and skills just because of their age.

6.4. Knowledge needed to mentor pre-service teachers to use ICT

This part of the chapter is concerned with the specific knowledge needed to mentor pre-service teachers to use ICT. Discussion initially focuses on the eight domains of knowledge evident in the TPACK framework. That is, the three primary domains of knowledge (content knowledge, pedagogical knowledge and technological knowledge); the resultant four domains that occur from the intersection of these three domains (pedagogical content knowledge, technological pedagogical knowledge, technological content knowledge and TPACK); and conteXtual knowledge, which surrounds these seven domains of knowledge (see Figure 3). Discussion then focuses on mentoring knowledge. Therefore, these nine domains of knowledge are explored as an important influence on supporting the pre-service teacher's use of ICT in teaching practicums.

As discussed in chapter 2, Mishra and Koehler (2006) conceived the TPACK framework, based on the PCK model of Shulman (1986). The TPACK framework has been influential in understanding the domains of knowledge needed to make ICT integral to classroom practices and so has often been used to explore use of ICT within teaching practice. Many educational researchers have endeavoured to measure the TPACK of teachers and understand the complexity of the interrelationships between the different domains of knowledge needed to teach using ICT (Bate & Maor, 2010; Cox & Graham, 2009; Graham et al., 2012; Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Schmidt et al., 2009; Tondeur, van Braak, Siddiq, & Scherer, 2016). Yet the TPACK framework is regarded as useful when considering the different knowledge domains needed to use ICT, despite issues related to defining the domains of knowledge and how each domain of knowledge interacts with other domains of knowledge. It is apparent from the interviews that each of the teacher mentors discussed a range of different domains of knowledge needed to use ICT in teaching practice. Also, in this section, mentoring knowledge is examined in regard to supporting ICT uptake of pre-service teachers. The discussion of the combined findings from the questionnaire and interviews of the teacher mentors is organised around nine sections, using the different knowledge domains of TPACK that were identified by the teacher mentors, namely technological knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technological pedagogical knowledge, technological content knowledge, TPACK and contextual knowledge in addition to mentoring knowledge.

6.4.1. Technological knowledge

Often the discourse presented around ICT in the classroom is quite techno-centric (Mishra & Koehler, 2006) with a focus on technological knowledge, and not on the other knowledge domains needed to use ICT in teaching practice. Not surprisingly, technological knowledge was highlighted by the teacher mentors interviewed in this research study, who generally believed that the pre-service teachers would bring technological knowledge from their personal lives to use in teaching practicums (Compton & Jordan, 2019c). As previously discussed, this finding corroborates the "digital native" concept of Prensky (2001) and Cabero and Barroso (2016) who conclude that less experienced teachers are more adept with using ICT and so have more advanced technological knowledge than that of more experienced teachers.

It is apparent that the teacher mentors in this research study had a strong awareness of ICT tools, but this did not necessarily mean that they had a strong understanding of technological knowledge. As discussed in chapter 2, technological knowledge refers to more than just knowing how to use specific tools, and the concept of the "digital native" (Prensky, 2001) overlooks other dimensions of this knowledge domain such as ways of thinking about using ICT so it can assist teaching practices (Mishra & Koehler, 2006) and being cybersafe. In this research study, the teacher mentors demonstrated limited understanding of other dimensions of technological knowledge described by Mishra and Koehler (2006). ICT uptake tended to focus on technical skills, with three out of four of teacher mentors who were interviewed identifying that the pre-service teachers had ICT skills. This techno-centric view not only has a narrow interpretation of this knowledge domain but also assumes that mastering only ICT knowledge and skills is sufficient for teacher mentors and pre-service teachers to be able to use ICT in the classroom (Compton & Jordan, 2019c). Consequently, it discounts the connection of using technical skills with other domains of knowledge (Becta, 2004) as well as the knowledge to use ICT tools safely, ethically and responsibly (AITSL, 2018b). Orlando and Attard (2016) assert that "[w]hile lifelong experience [using ICT] is valuable, teaching brings with it the expectation for student learning" (p. 119), revealing that the other knowledge domains besides technological knowledge are important when using ICT in the classroom. This is supported by Ertmer and Ottenbreit-Leftwich (2010) who maintain the personal use of ICT needs different knowledge to that of instructional uses in teaching practice. The prevalence of this restricted view of technological knowledge suggests that these teacher mentors are therefore unable to have a complex view of ICT integration. To them, it is rather simple and straightforward; technological knowledge, specifically technical skills, is only needed and barriers such as access have to be overcome so that they can put this knowledge into practice.

Moreover, Ertmer and Ottenbreit-Leftwich (2010) highlight that it is impossible to have "complete knowledge" about ICT tools as there are always new tools emerging and so ICT tools are "… always in a state of flux" (p. 261). ICT tools are constantly changing, fluctuating and evolving, and it is impossible for the teacher mentors who were interviewed to be aware of the tools available, let alone all the affordances of these tools (Selwyn et al., 2018). These views about the dynamic nature of ICT are supported by Orlando and Attard (2016) who claim the fast-paced nature of new technologies makes it difficult for empirically based research to filter down into teaching practice. This was perhaps suggested by two of the teacher mentors interviewed in this research study, such as Charles, who discussed using emerging virtual reality software, and Annie who spoke about new technology in the form of Apple televisions (Apple Inc., 2019a). While technological knowledge is important, it is only part of the 'puzzle' regarding the domains of knowledge required to teach with ICT (Compton & Jordan, 2018).

6.4.2. Content knowledge

Content knowledge was also regarded as important by all teacher mentors who were interviewed in this research study. These teacher mentors identified that they had a significant role in supporting pre-service teachers to understand the curriculum, and considered that they were best placed to decide the content that needed to be taught during teaching practicum. They all had taught for at least six years, and not surprisingly they all also rated their content knowledge as very high. Redmond and Peled (2019) and Ertmer and Ottenbreit-Leftwich (2010) concur that content knowledge is critical. Cabero and Barroso (2016) also found that experienced teachers rated their knowledge of content as higher than those with less experience. As relatively experienced teachers, all the teacher mentors interviewed thought they had a good command of content knowledge to deliver the required curriculum. Therefore, it was clear that the teacher mentors considered that they had a major role to support pre-service teachers to understand content knowledge.

However, two of the teacher mentors interviewed tended to have a controlling view of the content. Both Annie and Rose explained that it was their responsibility to map the curriculum to the teaching and learning program, thereby suggesting that there was little room for the preservice teacher to develop their content knowledge, rather they just needed to implement what was already set. Redmond and Peled (2019) and Ertmer and Ottenbreit-Leftwich (2010) explicitly caution that a lack of opportunities to develop content knowledge would perhaps hinder TPACK development. On the other hand, Sarah highlighted that development of content knowledge was a very important area of improvement for the pre-service teacher.

6.4.3. Pedagogical knowledge

The teacher mentors who were interviewed did not explore the relevance of pedagogical knowledge to any great degree. As with their views of technological knowledge and content knowledge, they tended to have a classroom-focused view. Valtonen et al. (2019) states the important role of pedagogical knowledge is emphasised in most research studies. Yet this research study does not support the research literature as pedagogical knowledge was barely mentioned by the teacher mentors, although it was described in regard to technological pedagogical knowledge and pedagogical content knowledge. Two of the teacher mentors interviewed noted a more didactic approach to teaching with ICT by the pre-service teachers because they were learning to teach and this assisted with classroom control (i.e. they used ICT to deliver teacher-directed PowerPoint (Microsoft Corporation, 2016) presentations that tended to be an online, structured lesson plan). Possibly, the teacher mentors tended not to focus on providing an opportunity for pre-service teachers to develop their pedagogical knowledge as perhaps pedagogical knowledge was regarded as a given for pre-service teachers, and so their discussion concentrated on developing technological pedagogical knowledge and to a lesser extent pedagogical content knowledge.

6.4.4. Pedagogical content knowledge

Pedagogical content knowledge was also discussed earlier in chapter 2 and refers to teacher mentors' understanding the best practices for teaching specific content knowledge to their students (Koehler & Mishra, 2009; Mishra & Koehler, 2006, 2009). In the main, pedagogical content knowledge was not discussed by the teacher mentors in this research study. However, Sarah highlighted that she was responsible for supporting the pre-service teacher to understand how to teach specific content and identified particular teaching strategies that she guided the pre-service teacher to use during teaching practicum. Sarah highlighted that lack of content knowledge of the pre-service teacher therefore hindered her selecting pedagogical strategies and implicitly identified lack of pedagogical content knowledge. It could be construed that Sarah indicated that until the three basic domains of knowledge are mastered by the pre-service teacher, the understanding of the interrelationship between the domains of knowledge was underdeveloped or overlooked. That is, the pre-service teacher needed to master content knowledge before they were able to learn about pedagogical content knowledge. Annie also signalled that technological knowledge may overshadow development of pedagogical content knowledge.

6.4.5. Technological pedagogical knowledge

As discussed in chapter 2, technological pedagogical knowledge refers to understanding how to use ICT tools as a vehicle to achieve the learning outcomes and expected teaching experiences. Possessing technological pedagogical knowledge is important because there may be many ICT tools suitable for a particular learning task, yet the teacher, and subsequently teacher mentor, needs to have the "… ability to choose a tool based on its fitness, strategies for using the tool's affordances and knowledge of pedagogical strategies and the ability to apply those strategies for use of technologies" (Mishra & Koehler, 2006, p. 1028). Technological pedagogical knowledge augments the teacher mentor's "… pedagogical practices across multiple aspects of the planning, implementation, and evaluation processes" (Ertmer & Ottenbreit-Leftwich, 2010, p. 260) when supporting the pre-service teacher to use ICT during teaching practicum.

In this research study, three out of four teacher mentors who were interviewed identified that they had technological pedagogical knowledge, as they said that their role was to assist the pre-service teacher to select ICT tools to support teaching and learning in the teaching practicum. That is, the teacher mentors considered that the pre-service teachers had technological knowledge and from the interview transcripts, it was assumed that they saw their core role as a teacher mentor primarily as an instructional coach to develop technological pedagogical knowledge of the pre-service teacher based on assumptions that the pre-service teacher already had technological knowledge. Ertmer and Ottenbreit-

Leftwich (2010) highlight that knowledge of pedagogical strategies to facilitate student learning and knowledge of the specific ways in which ICT can support these pedagogical strategies is also essential. Therefore, although not explicitly stated, the interconnectedness of the domains of knowledge was evident in this research study.

6.4.6. Technological content knowledge

Technological content knowledge refers to knowing how the ICT tools available to the teacher mentor can enhance the delivery of the content knowledge for their students (Mishra & Koehler, 2006). Therefore the teacher mentor needed to have an understanding of the knowledge of both the students and the curriculum to select the most appropriate ICT tools to enable students to demonstrate their understanding of content (Ertmer & Ottenbreit-Leftwich, 2010). Technological content knowledge is about understanding the relationship between the affordances of a range of ICT tools and the concepts, skills and processes of content knowledge (Ertmer & Ottenbreit-Leftwich, 2010).

All the teacher mentors interviewed considered that they were proficient in technological content knowledge, even Rose who self-reported that she was ‘somewhat comfortable’ with using ICT. All these teacher mentors, to a certain extent, believed that they had the knowledge of content to ensure the most appropriate ICT tool was used to teach. This was interesting and perhaps suggested in Rose’s case that content knowledge was more significant as she did consider she was more proficient with content knowledge than technological knowledge. Perhaps as Pierson (2001) illustrates in her model in chapter 2 (see Figure 5), in this research study, the emphasis was not equal on all three domains of knowledge when teaching with ICT. It seemed to appear that content knowledge had a greater weighting in regard to technological knowledge with Rose when using ICT in the classroom.

However, the research literature identifies that the challenge with technological content knowledge is that there may be a lack of access to content-specific ICT. All teacher mentors interviewed identified the availability of generic ICT tools, rather than content- (or subject-) specific ICT resources, except for Sarah. Therefore, it appears that it is challenging for teacher mentors to support pre-service teachers to use ICT because technological content knowledge is an area where there is lack of resources, and possibly a domain of knowledge that was overlooked by the teacher mentors in this research study. Valtonen et al. (2019) optimistically predicts that with the ever-increasing availability of new ICT for particular purposes, this may not necessarily be the case in the future. Further research in this area would be advised as the teacher mentors revealed that the focus was usually on technical aspects of teaching with ICT, with technological knowledge considered most important. Also, the earlier discussion regarding budgetary constraints surrounding content-specific ICT tools and the preference for schools to purchase generic software needs further research too.

Many researchers have asserted that knowing how to use ICT tools is not enough to enable teacher mentors to use ICT effectively in the classroom (Ertmer & Ottenbreit-Leftwich, 2010; Wozney et al., 2006). This is consistent with this research study where all teacher mentors who were interviewed identified that they needed to provide support to the pre-service teachers to use ICT in the classroom by referencing at least one knowledge domain, most noticeably content knowledge. However, paradoxically, this also seemingly contrasts with the views of the three of the four of teacher mentors who were interviewed in this research study and held the “digital native” concept (Prensky, 2001), and so did not highlight the importance of technological content knowledge. That is, there needed to be a greater emphasis on technological pedagogical knowledge because pre-service teachers need more than technical knowledge to use ICT in the classroom as there is a gap between their personal use of ICT and instructional uses of ICT (Ertmer & Ottenbreit-Leftwich, 2010).

6.4.7. TPACK

The TPACK framework builds on the PCK model, and is considered to be a way of thinking about the different domains of knowledge needed by teacher mentors to integrate ICT into their teaching practices (Koehler & Mishra, 2009; Mishra & Koehler, 2006, 2009). As explained in chapter 2, the TPACK framework described the domains of knowledge needed by teachers and therefore teacher mentors, for the successful integration of ICT in the classroom.

In this research study, there was limited understanding of the complex relationships between the three domains of knowledge (content, pedagogical and technological) to create individual learning experiences for students. The teacher mentors interviewed tended to discuss the three different domains of knowledge as individual entities and did not interconnect them. The relationships between the three domains of knowledge, which is considered just as important as three primary, standalone domains of knowledge, was not discussed in any depth. “It is the interactions, between and among these [domains of knowledge], … playing out differently across diverse contexts, that account for the wide variations seen in educational technology integration” (Koehler & Mishra, 2008, p. 3). Shinas et al. (2015) also emphasise that pre-service teachers must “… examine the intersection of these [three knowledge] domains to bridge the gap between theory and practice” (pp. 53–54) while Redmond and Peled (2019) assert that the teaching practicum is regarded by pre-service teachers as the best context for developing their ability to address TPACK. It appeared the importance of the complex interaction between the three domains of knowledge to integrate ICT in the classroom was overlooked by the teacher mentors interviewed in this research study as often the domains of knowledge were discussed separately.

Therefore, in this research study, there was no evidence that pre-service teachers were provided with sufficient opportunity to develop their TPACK because the interactions between the domains of knowledge were generally not emphasised. Commonly, the teacher mentors did not concentrate on developing technological knowledge because it was considered to be inherent with the pre-service teacher. This is in contrast with other researchers who state that it is important for teacher mentors to develop this knowledge of the pre-service teachers. For example, Bilge, Secil, and Asiye (2017); Brown and Englehardt

(2017); and Öz (2015) emphasise that it is vital to acknowledge that pre-service teachers are inexperienced in using ICT as learners and so need to be supported to develop their technological knowledge in order to learn from, and teach with ICT, during teaching practicums to demonstrate their TPACK. That is, developing the technological knowledge of pre-service teachers would facilitate the development of both content and pedagogical knowledge and subsequently TPACK, and so exemplifying the critical and intricate interrelationship between the various knowledge domains.

6.4.8. Contextual knowledge

ConteXtual knowledge refers to "everything from a teacher's awareness of available technologies, to the teacher's knowledge of the school … state, or national policies they operate within" (Mishra, 2019, p. 76). ConteXtual knowledge is regarded as important to understand as it enables the teacher mentors and pre-service teachers to know what they can "act on, change and help … develop" (Mishra, 2019, p. 76) and is essential to have in order for ICT uptake.

"First-order barriers" are extrinsic to the teacher mentor and are often dependent upon the context in which each operates (Ertmer, 1999). Prestridge (2012) claims that the "first-order barriers", such as lack of access, time, and technical infrastructure including technical support, are being overcome in schools. However, this research study found that despite governments and schools investing in hardware and software, and teachers, and subsequently teacher mentors, being provided with some access to ICT tools, digital resources and professional learning, this was not the case for three out of the four teacher mentors interviewed. That is, they had access to ICT but not to the level that they wanted and this access was dependent upon the context of the school. This reinforced the importance of conteXtual knowledge that was explicitly included in the TPACK framework in 2019 (Mishra, 2019). The acquisition and development of TPACK is challenging for some teacher mentors because of specific school contexts, thereby accentuating its influence on the enactment of the TPACK of teacher mentors. Hew and Brush (2007) also caution that there is a likelihood of assuming that overcoming “second-order barriers” (Ertmer, 1999) is sufficient without truly understanding how intractably that both “first and second-order barriers” (Ertmer, 1999) are linked and it is impossible to independently address them.

Only one out of the four teacher mentors interviewed in this research study explicitly spoke about context and it was in regard to resources in the school. However, all teacher mentors demonstrated an awareness of the available ICT and knowledge of school policies they operated within. Sarah in particular was well aware of policies regarding access to ICT devices and policies regarding BYOD as discussed. Contextual knowledge is significant to teacher mentors and subsequently to pre-service teachers as it provides the boundaries in which they operate within. A lack of contextual knowledge may limit TPACK development.

6.4.9. Mentoring knowledge

Mentoring knowledge generally was not discussed by the teacher mentors interviewed in this research study. The knowledge in relation to mentoring was regarded as being obtained through the experience of teaching. It was not seen as a different skillset to teaching nor something that was special. The various roles associated with mentoring pre-service teachers were mostly ignored by the teacher mentors interviewed, with limited discussion that focused solely on the role of instructional coach. In the main, the teacher mentors in this research study were chosen to be teacher mentors because of teaching experience or the subjects they taught or because they volunteered, and they considered themselves to be ‘experts’ in the mentoring relationship.

6.5. Summary of discussion

Thus, in this research study, all teacher mentors who were interviewed seemed to perceive that they were strong in both content knowledge and pedagogical knowledge, and three out of four of these teacher mentors rated their technological knowledge as very high. They all seemed confident with the curriculum and their teaching ability, and three out of four of the teacher mentors rated themselves very comfortable with the use of ICT, suggesting that they were able to demonstrate TPACK when supporting pre-service teachers to use ICT during teaching practicum. Yet an understanding of other domains of knowledge that were needed to support pre-service teachers to use ICT during the teaching practicum such as knowledge of mentoring and some domains of knowledge from the TPACK framework (Mishra & Koehler, 2006) such as technological content knowledge tended to be overlooked by these teacher mentors, as well as the interactions between these domains of knowledge. Koehler and Mishra (2008) reinforce the views of Rittel and Webber (1973) that teaching with ICT is a "wicked problem" in that it is very complex, requiring lots of intricate decisions to be made from a range of domains of knowledge. Understanding the complex interactions between these domains of knowledge is important for both teacher mentors and pre-service teachers.

It was apparent from the interviews with the teacher mentors that access to ICT tools did not necessarily ensure that TPACK would occur because there are many domains of knowledge that were needed to ensure its successful implementation in teaching practice. While the TPACK framework (Mishra & Koehler, 2006) is useful to address issues related to the successful integration of ICT into the classroom from a knowledge perspective of the teacher mentors, the teacher mentors identified that there were numerous barriers to these ICT tools. Teaching with ICT is not straightforward and demands complex thinking about the various domains of knowledge to assist with decision-making. In particular, Koehler and Mishra (2008) highlight that teacher mentors, when working with pre-service teachers to use ICT in teaching practicums, need to support this "tumultuous and unrestrained" decision-making process to ensure the integration of several domains of knowledge.

7. Conclusions and implications

This chapter presents the conclusions and implications of my research study, and is written in five parts. The first part presents an overview of the research study. This is followed in the second part by reporting on the research conclusions, addressing the main research question and four research sub-questions. The third part discusses the implications of this study in relation to policy development, professional learning of teacher mentors, design of initial teacher education programs, support for ICT uptake and future research directions. The fourth part examines the contribution of my research study to existing research and the creation of new research. The fifth and final part discusses the limitations of the study, and ending with concluding remarks.

7.1. Overview

It is timely to remind the reader that my research study examined the domains of knowledge that teacher mentors need to support pre-service teachers to use ICT during teaching practicums. It was set in a particular context, namely government and Catholic primary and secondary schools in the Northern Metropolitan Region of Melbourne, Victoria. It used a mixed methods approach, and employed a sequential explanatory research design. Questionnaire data from 50 primary and secondary teacher mentors was collected, along with interview data from four teacher mentors (who volunteered to participate and who met inclusion criteria) and school artefacts including school ICT policies, eLearning plans, My School website data, school website data and information about the technical infrastructure of schools. Data from these varied sources was analysed separately and then mixed in the discussion stage to facilitate triangulation. Four case studies were produced using questionnaire data and the interview transcripts that complemented information from the analysis of artefacts.

My research study had one main research question: “What knowledge do teacher mentors need to support pre-service teachers to use ICT during teaching practicums?”, and I respond to this question through the following research sub-questions:

1. What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?

2. What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?

3. What are the teachers’ beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?

4. What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?

7.2. Research conclusions

In order to address to my main research question, I will respond to each of the research sub-questions 1–4. This response is in the ensuing paragraphs.

7.2.1. Research sub-question 1: Background of teacher mentors

I now address the first research sub-question in my research study ‘What are the backgrounds of teacher mentors who are supporting pre-service teachers to use ICT during teaching practicums?’ The influence of sex and teaching experience of the teacher mentors in supporting pre-service teachers was not conclusive in my research study. That is, neither being male or female nor years of teaching experience distinguished teacher mentors’ use of

ICT in teaching practicums. However, there were indications that teacher mentors uncritically adopted a “digital native” (Prensky, 2001) view of pre-service teachers. That is, because they had been raised with digital technologies, it was considered that the pre-service teachers would be knowledgeable in using ICT in teaching practice. So, the teacher mentors assumed the pre-service teachers had technological knowledge but would need support with both content knowledge and pedagogical knowledge.

7.2.2. Research sub-question 2: Challenges to mentoring pre-service teachers to use ICT

The second research sub-question in my research study that I respond to was ‘What are the challenges to mentoring pre-service teachers in regard to supporting the use of ICT by pre-service teachers during teaching practicums?’ In my research study, teacher mentor support of pre-service teachers to use ICT was complex and influenced by various challenges previously reported in the research literature such as access to ICT; technical infrastructure; leadership; confidence; time; ICT knowledge and skills; professional learning and self-efficacy and beliefs of both the teacher mentor and the pre-service teacher. In addressing research sub-question 2, my research study also concluded that teacher mentors have complex views of access and leadership that illustrated evolving concepts of these two challenges as discussed in chapter 6.

7.2.3. Research sub-question 3: Mentoring beliefs

I now respond to the third research sub-question in my research study, which was ‘What are the teachers’ beliefs about their roles as mentors to support the use of ICT by pre-service teachers during teaching practicums?’ The majority of teacher mentors who were interviewed in my research study had not undertaken formal mentor professional learning. These teacher mentors identified that they were selected by the school leadership personnel for their role as a teacher mentor within each school. These teacher mentors also indicated that they could volunteer to be a teacher mentor, and generally the selection on teacher mentors was based on the needs of the pre-service teacher, such as teaching method or year level or the teaching experience of the teacher mentor. Consistent with the research literature, the teacher mentors believed that teaching experience was what mattered and saw their main role merely as an instructional coach.

7.2.4. Research sub-question 4: Specific knowledge needed to mentor pre-service teachers

The fourth research sub-question I respond to in my research study was 'What specific content, pedagogical, technological and mentoring knowledge is needed to mentor pre-service teachers to use ICT?' Teacher mentors believed that pre-service teachers came 'preloaded' with technological knowledge and focused their support on developing content knowledge and pedagogical knowledge. Teacher mentors also had a narrow view of technological knowledge as solely technical skills, and ignored other dimensions of this domain of knowledge such as ways of thinking and knowing how to use ICT safely, responsibly and ethically. Teacher mentors did not interconnect technological knowledge, content knowledge and pedagogical knowledge. However, the influence of contextual knowledge was also considered an important aspect, albeit in a narrow way.

7.3. Implications of the research study

This discussion regarding implications is structured around ICT policy development, professional learning of teacher mentors, design of initial teacher education programs, support for ICT uptake and future research directions in the following paragraphs.

7.3.1. Implications for ICT policy development

Australian policy makers, like many others around the world, have articulated numerous motivations for the use of ICT in teaching practice. There is an emphasis on tackling educational challenges through improving teaching and learning, and increasing flexibility and engagement with content delivery as well as preparing students for a progressively technological world. However, how these educational challenges can be addressed often lack specificity and practicalities for schools to understand what to implement in their specific contexts. There is also enormous pressure on school leaderships teams to acquire funding, and understand how best to use this funding in regard to ICT implementation, in light of educational policy, research and school contexts. It is essential that policy makers recognise the true cost of professional learning and that time is needed for its effective implementation. This includes empowerment of school leadership teams to make local decisions for local needs as well as enable a breadth of different types of professional learning to cater for different needs.

My research study results suggest implications for ICT policy in regard to how the Victorian Department of Education and Training could provide additional leadership support for schools. Specifically, those that are at risk of making poor ICT decisions that affect the use of ICT in teaching practice, and those who are negotiating multiple devices and BYOD programs. In particular, this advice could relate to compliance issues with the school operating environments as well as an increased need for quality internet and technical support. Similarly, policy makers need to ensure school leadership personnel are provided with adequate support to make appropriate ICT decisions to suit their contexts. This will facilitate adequate actions to access ICT and human resources and support for instructional practices in line with educational research.

7.3.2. Implications for teacher mentors in schools

Another implication from the results of my research study is that teacher mentors are considered to be a critical factor in supporting pre-service teachers to use ICT during teaching practicums, yet there is no requirement for them to have any formal training or further qualifications other than a teaching degree to undertake the responsibility of teacher mentor. While there are no equivalent AITSL standards for teacher mentoring, which is unlike the AITSL teacher standards for teaching, mentoring is considered to be more purposeful when teachers undergo professional learning on mentoring practices. Therefore, more support is needed to ensure teacher mentors are appropriately trained and that this training goes beyond offering voluntary or non-mandated courses. In my research study, there was inconsistency with theoretical underpinnings related to the roles of teacher mentors. This suggests that educational reform is needed so that teacher mentors are exposed to training that supports the practices appropriate to undertake the various roles associated with mentoring. This hinges on the Victorian Department of Education and Training to ensure high-quality mentoring programs are available for teacher mentors and support is provided in terms of planning processes and adequate funding for schools to enable these programs to be accessed by these teachers. It is also critical that it is a school-wide priority for all teachers to have the opportunity to participate in these mentoring programs. Currently the only Victorian Institute of Teaching (VIT) requirement for professional learning is that it aligns with the Australian Professional Standards for Teachers (AITSL, 2018b). However, planning is essential for the development of strong professional learning and so it is imperative that teacher mentors have more autonomy to determine how and when they complete their annual professional learning hours to ensure they develop knowledge and skills to effectively mentor. Also, the role of Student Placement Officers in schools needs to take a more formal approach in supporting both teacher mentors and pre-service teachers.

My research study results explicitly recommends that accreditation for teacher mentors is required in order for teachers to understand and demonstrate the various associated roles and so demonstrate ‘mentoring standards’ that can be aligned with theoretical underpinnings and empirical evidence. Specifically, it is recommended that micro credentials, or short, certificate-style qualifications, are implemented to assist teacher mentors with gaining a better understanding of the knowledge and skills to mentor pre-service teachers and so enhance the practicum experiences of pre-service teachers. These micro credentials also need to include an explicit focus on supporting ICT uptake.

7.3.3. Implications for design of initial teacher education programs

Initial teacher education providers play a significant role in supporting pre-service teachers to use ICT during teaching practicums, and are considered an essential part of the partnership along with teacher mentors and pre-service teachers. My research study accentuated the critical nature of this partnership, and also highlighted that initial teacher education providers need to work closely with schools in order to develop the TPACK of pre-service teachers. Consequently, there are implications for both university staff and for how school partnerships are formed with initial teacher education providers to facilitate this partnership.

Pre-service teachers need exposure to university staff who use ICT in their teaching practice. Therefore, the TPACK of university staff, who deliver initial teacher education programs, needs to be fostered and supported in order to facilitate the development of the TPACK of pre-service teachers. The initial teacher education programs need appropriately trained university staff to provide opportunities for pre-service teachers to examine all the domains of knowledge needed for ICT uptake. It is important to ensure training for both university staff, and subsequently pre-service students, focuses on more than just providing knowledge and skills to use ICT tools (i.e. technical skills), and unpacks all the domains of knowledge, including specific dimensions within each knowledge domain. Equally importantly, it is fundamental that the connectedness between each of the domains of knowledge is examined in detail, as there is a complex interplay of knowledge to teach using ICT. Consequently, all domains of knowledge need to be interrogated, and specific attention paid to understanding technological knowledge in teaching practice, without assuming it is a given for the younger pre-service teachers. Conversely, it needs to be assumed for established university staff that technological knowledge is not absent. Thus, there needs to be a focus on development of competence to use ICT specifically for teaching with no assumptions that personal use is sufficient for, or age contributes to, this competence. Also, the confidence and self-efficacy of both university staff and pre-service teachers to use ICT needs to be addressed. In addition, the development of constructivist approaches to teaching about ICT uptake by both university staff and pre-service teachers needs to be dealt with.

Similarly, it is vital that beliefs about using ICT are interrogated, rather than just an exploration of knowledge alone, as beliefs are a powerful influence on behaviour. Importantly, it is essential that these initial teacher education programs concentrate on examining the interrelationship of traditional pedagogical beliefs about student learning with beliefs about the role of ICT in the classroom. In particular, pedagogic assumptions of university staff and pre-service teachers need to be explored and challenged as often ICT is typically assimilated into current pedagogic beliefs without any transformation of teaching or enactment of TPACK and so retaining the status quo. Likewise, information about the value of using ICT in the classroom needs to be highlighted in these programs for both university staff and pre-service teachers.

In addition, initial teacher education program need to incorporate an understanding of social awareness when using ICT so pre-service teachers develop an insight into the school landscape and dynamics and learn how to interact and negotiate with school leaders, IT technicians and other teaching colleagues in regard to ICT uptake so they know where to get support to use ICT in their teaching practice. Finally, these initial teacher education programs need to interrogate a range of barriers that relate to both “first-order” and “second-order barriers” (Ertmer, 1999) so that pre-service teachers get an understanding of how “second-order barriers” that relate to contextual factors and “second-order barriers” that relate to personal and human factors impact upon one another and also how these barriers can be overcome.

7.3.4. Implications for supporting ICT uptake

There are also implications for provision of professional learning to support ICT uptake. My research study has identified that contextual knowledge is a significant domain of knowledge that teacher mentors need to possess to support pre-service teachers to use ICT during teaching practicums. Thus, the school context needs to be highly regarded and it is proposed that the support for ICT uptake focus on smaller, classroom-based programs, rather than state-wide, top-down initiatives, to put context at the forefront. I concur with this ground-up approach support for ICT uptake as it will take into consideration and prioritise contextual knowledge more effectively, as highlighted in the research literature. This approach would also emphasise that such support needs to be ongoing and just-in-time, which could be controllable at a local school level.

The development of an audit tool to capture vital information about the barriers and enablers to ICT uptake and the need for teacher mentors to review these influences within their local context would be more beneficial to address "first-order barriers" that are located within schools. It is also noted that there were changing concepts of access and leadership evident in my research study. Therefore, implications of my research study include recognition that these factors are not static, and that perhaps these factors require periodic review so they reflect what is actually happening within schools – the audit tool could cyclically be adapted or updated to capture these changes at a school level.

There are also implications for the development of a case management approach to enable teacher mentors and pre-service teachers to input their goals, targets, improvement strategies and monitoring arrangements. These need to be in a consistent format to help map the needs to teacher mentors and pre-service teachers regarding their reciprocal mentoring relationships. This would assist with decreasing the administrative burden to support the mentoring process as well as enable the leveraging of this information to understand how to effectively support both teacher mentors and pre-service teachers. In addition, it would provide more information regarding on-the-ground implementation of the contextualised mentoring process. Ideally it could be linked into other professional learning needs of both teacher mentors and pre-service teachers, and frame the breadth, as well as the ongoing and collaborative nature, of effective professional learning in teaching practice to develop a culture of trust and reflection.

7.3.5. Implications for future research directions

The complex relationships of different domains of knowledge needed to use ICT in teaching practice, including teaching practicums, means that simple solutions are not possible. It is important that sense is made of the complexity of the range of factors that contribute to the use of ICT in the classroom. This in itself it challenging, especially as the findings of my research study detailed in chapter 6, highlight a range of barriers and enablers to using ICT in the classroom and consequently the teaching practicum, and also suggest that there has been 'shifting sands' in factors that influence the uptake of ICT in teaching practice and the evolution of new challenges. It is important to undertake further research in regard to these barriers and enablers to determine how these can be documented and overcome to develop effective professional learning programs for teacher mentors to support ICT uptake.

As mentioned in chapter 2, this research study presented a summary of the factors that influence the uptake of ICT in the teaching practicum. It provided a lens to explore the domains of knowledge needed by the teacher mentor to support the pre-service teacher to use ICT during teaching practicums. It appeared schools have obtained what they wished for in terms of ubiquitous and generally accessible ICT but it is still problematic as different types of challenges have been created that perhaps were not considered previously. BYOD programs have enabled greater access to ICT but this has resulted in more time needed for student instruction; more demand for internet usage; and more time needed for technical support. The discussion surrounding the benefits of ICT tend to have an uncritical, simplistic view with a narrow technological knowledge. There appeared to be an indiscriminate acceptance of using ICT, with its use not interrogated by teacher mentors, and an acceptance of the use of ICT by pre-service teachers in teaching practicums, without any examination of its purposes as it tends to be taken at face-value. Further research is warranted to unpack how ICT can be leveraged in the best interests of students and learning outcomes in the classroom, with a focus on what knowledge and skills are needed for TPACK. Furthermore, this further research would also provide insights into how ICT can be leveraged in the best interests of pre-service teachers in the university classroom.

In my research study, mentoring was generally not regarded as a negotiated and reciprocal relationship and the knowledge to undertake mentoring was considered as a sub-set of teaching knowledge and so not new knowledge to learn. The mentoring relationship between the teacher mentor and pre-service teacher was often ad hoc and based on availability or teaching experience, which is potentially problematic in regard to supporting the pre-service teacher to use ICT during teaching practicum. Further research about the knowledge and skills needed to support pre-service teachers to use ICT is required. There is also a need to understand what professional learning is needed to shift competence and confidence with using ICT of teacher mentors and pre-service teachers. In particular, there is a need to breakdown the mentality of the 'master/apprenticeship' model when mentoring pre-service teachers. In addition, there was limited understanding of the AITSL teacher standards (AITSL, 2018b) evident in my research study, so further research regarding what support could be provided to teacher mentors to assist them with aligning the teaching practice of pre-service teachers to these standards would be beneficial. Moreover, further research is required about where this support for teacher mentors to align their professional practice with AITSL teacher standards (AITSL, 2018b) should come from (e.g. school leadership personnel, Victorian Institute of Teaching [VIT] etc). My research study highlighted the importance of mentoring knowledge as a part of this contextual knowledge. It would be worth further investigation of the different roles of teacher mentors as discussed in chapter 2 (i.e. roles of instructional coach, providing emotional support and acting as a socialising agent) to specifically identify the function of mentoring knowledge to ascertain whether this finding can be more generalised.

7.4. Contribution of the research study

In this research study I confirm the complexity of the domains of knowledge needed by teacher mentors to support pre-service teachers to use ICT during teaching practicum. Specifically, I proposed that the intricacies of using ICT were influenced by numerous factors which manifests in different contextual knowledge. I suggest that these factors can be identified as barriers or enablers, and that they are not straightforward but rather interconnected and contextual. I identified that influences on ICT uptake has a ‘contagion effect’ in that often barriers and enablers were interrelated and built upon each other and also that factors can be considered a barrier or enabler depending on context. Correspondingly, in my research study, I suggested that new barriers have manifested due to changing conceptualisations of time, access and leadership and additional issues emerging from initiatives such as BYOD and 1-to-1 programs and therefore due to the use of increasing ICT and competing demands on resourcing schools. In addition, I suggested that contextual knowledge needs to explicitly identify mentoring knowledge when supporting pre-service teachers to use ICT during teaching practicum. The results of my research study make a significant contribution to the context of the research, including the broader context, the North Western Metropolitan region of Melbourne, Australia by recognising the complexity of factors that influence the uptake of ICT in teaching practicums.

7.4.1. Contribution to existing and creation of new knowledge

My research study provides further in-depth and rich data about the knowledge needed by teacher mentors to support pre-service teachers to use ICT during teaching practicums and adds new knowledge to the field of TPACK. It reinforces that the knowledge needed by teacher mentors to support pre-service teachers to use ICT during teaching practicums is quite simply complicated. The TPACK framework (Mishra & Koehler, 2006) asserts that three domains of knowledge (content, pedagogical and technological) interconnect when teachers integrate ICT into their classrooms and when they do so, these domains of knowledge create other domains of knowledge, namely pedagogical content knowledge, technological pedagogical knowledge, technological content knowledge, and TPACK. It also asserts that contextual knowledge is a critical domain of knowledge that connects with the other domains of knowledge.

The case studies in my research study accentuated the complexity of the knowledge needed, and acknowledged the importance of contextual knowledge, with particular recognition that mentoring knowledge needs to be identified when discussing the knowledge needed by teacher mentors to support the use of ICT by pre-service teachers during teaching practicums. My research study suggests that when teacher mentors and pre-service teachers are involved, mentoring knowledge needs to be added to the contextual knowledge that frames the TPACK framework (Koehler & Mishra, 2009; Mishra & Koehler, 2006). This is exemplified in the adapted TPACK framework (Mishra, 2019) that explicitly pinpoints mentoring knowledge as part of conteXtual knowledge (see Figure 9). Contextual knowledge, in the latest version of the framework is included as another influential type of knowledge when using ICT.

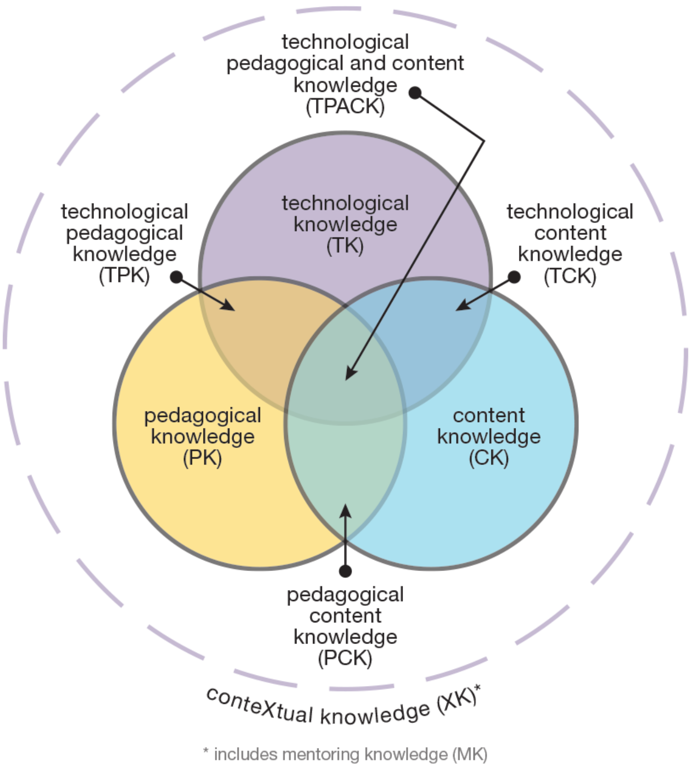

Figure 9: Adapted TPACK framework to support mentoring pre-service teachers to use ICT. Adapted from "Considering contextual knowledge: The TPACK diagram gets an upgrade", by P. Mishra, 2019, *Journal of Digital Learning in Teacher Education*, *35*(2), p. 77. (Used with permission).

7.4.2. Contribution to the context of the research

My research study has added to a greater understanding of the significance of the knowledge of the teacher mentors in regard to supporting the pre-service teachers to use ICT during teaching practicums. It identifies that mentoring knowledge needs to be heightened when identifying conteXtual knowledge as one of the domains of knowledge of the TPACK framework. Like other educational research, there are numerous ways in which the domains of content, pedagogical and technological knowledge are represented in teaching practice, and also that mentoring knowledge is needed in addition to teaching experience.

My research study suggests that further work is needed for the teacher mentors to gain a more comprehensive understanding of the various dimensions of the technological knowledge domain and placing emphasis on other dimensions within this domain such as ways of thinking and using ICT safely, responsibly and ethically rather than just focusing on technical skills. My investigation suggests that mentoring knowledge needs to be explicitly identified as a dimension of contextual knowledge in the TPACK framework to represent that it is needed for teacher mentors to support pre-service teachers to use ICT during teaching practicums. It also suggests that there are implications for university courses in regard to revisiting their planning and programs for teaching pre-service teachers about ICT in the classroom, as there is currently a disconnect between what occurs at universities and what occurs in the classrooms in schools.

7.5. Limitations of the research study

My PhD research study had some limitations. The scope of this research study was intentionally small: the collection of quantitative data focused on the responses to a questionnaire completed by 50 teacher mentors in the North Western Metropolitan region of Melbourne, Australia; and the collection of qualitative data came from four teacher mentors who volunteered to be interviewed.

The integration of the quantitative and qualitative data enabled me to gather in-depth understandings about the experiences of the teacher mentors regarding mentoring pre-service teachers and the use of ICT in the classroom. However, the analysis and interpretation of this data is localised and decidedly contextual. Improvement in the depth of items in the questionnaire and the type of question items, such as use of Likert scales and more open-ended questions, may have enabled more sophisticated statistical analysis and discussion of research questions. Further research regarding personal opinions related to enablers and barriers to using ICT in the classroom would be valuable.

It is acknowledged that the data only came from the perspective of teacher mentors and therefore results should be confined to this cohort, and not to other stakeholders involved in supporting pre-service teachers to use ICT in teaching practicums. Further research of these other stakeholders would also be valuable. In addition, another limitation of this research study was using self-reporting data, gathered through questionnaires and interviews, and further research through critiquing lesson plans and classroom observations would be desirable to see if ICT use is replicated in the classroom as stated in self-reported data.

7.6. Conclusions

The main research question addressed in my research study was 'What knowledge is needed by teacher mentors to support pre-service teachers to use ICT during teaching practicums?' Much 'hype' continues to surround the use of ICT in teaching practice, with an optimistic view of the potential that has been couched in "techno-romantic" terms. Despite the push for teachers, including teacher mentors and pre-service teachers, to use ICT in teaching practice and teaching practicums, it is well-documented in the research literature that there are challenges with ICT uptake in the classroom. Yet making sense of what knowledge is needed for teacher mentors to support pre-service teachers to use of ICT during teaching practicum is not straightforward, nor is there clear consensus in the research literature in regard to what knowledge is needed.

My research study concluded that teacher mentors need a complex set of knowledge, one that interconnects content, pedagogy, technology, context and mentoring to support pre-service teachers to use ICT. While this research study was a small one, consisting of a questionnaire, semi-structured interviews and artefact analysis, it adds new knowledge to the ongoing examination and analysis in this field. Teacher mentors are unlikely to revert back to traditional forms of technology, such as the blackboard and chalk, but it is important to take stock of the current situation and recognise that ongoing research is needed because, simply, integrating ICT into teaching is not easy. I hope that my research study will inspire other researchers to contribute to the ongoing deliberation, dialogue, dissection and debate regarding the knowledge needed by teacher mentors to support pre-service teachers to use ICT during teaching practicums.

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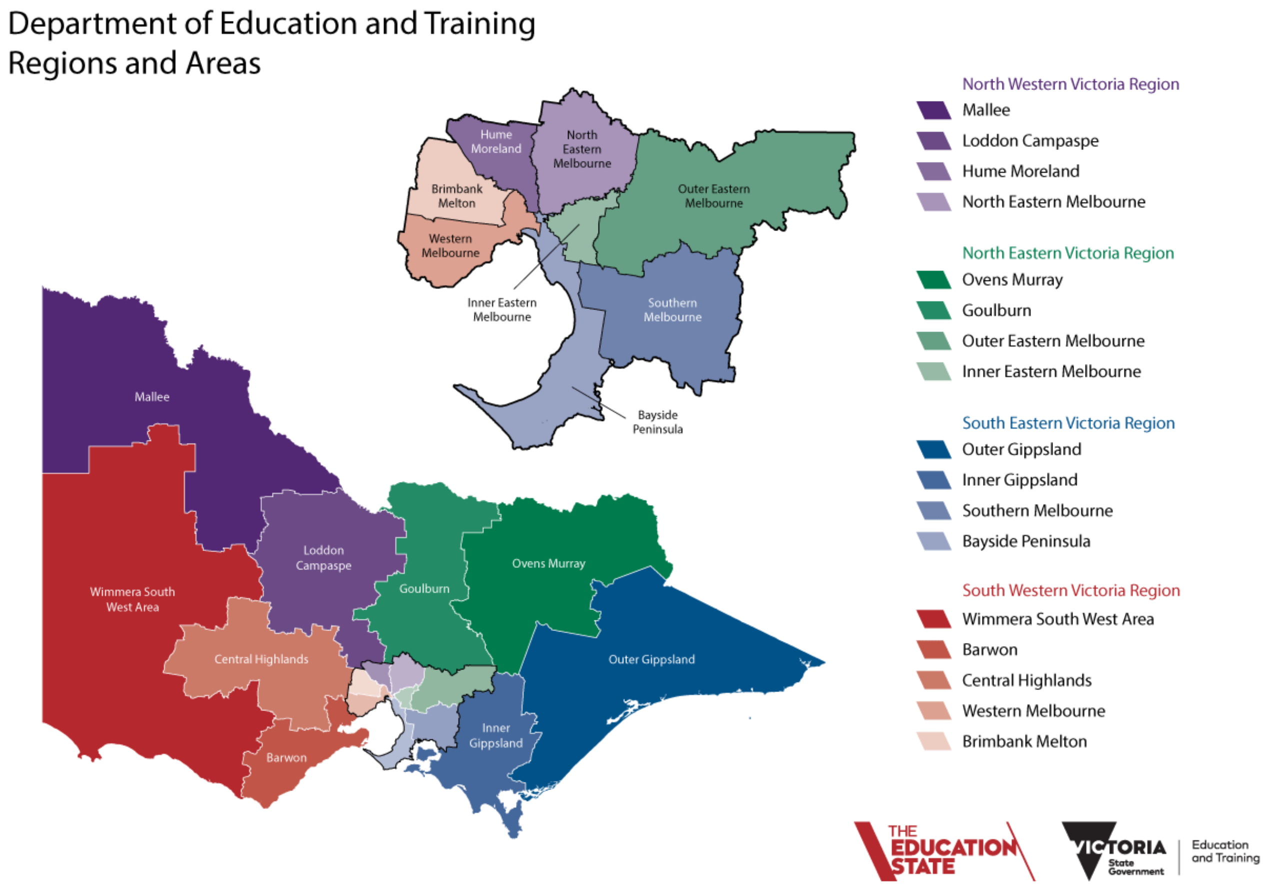
Appendices

Appendix A: Map of Victorian Department of Education and Training's regions and areas



Appendix B: Email to principals that was forwarded to teacher mentors

Dear [Principal]

Recently a number of pre-service teachers from RMIT University undertook their four-week teaching practicum at your school, where they were supported by a teacher mentor. I am a PhD student at RMIT University and am conducting research around the professional learning needs of teacher mentors to support pre-service teachers to use ICT during their teaching practicums.

I would like your permission to invite teacher mentors to undertake an interview about their recent mentoring experiences at your school. If you consent to this research project being conducted at your school, could you please circulate this email request to the teacher mentors and ask them to respond directly to me via the email address listed below. The interviews will be held at a day, time and location that is most convenient to them. This interview should take around 30 minutes. Please let me know if you have any queries about this request.

A copy of the Participant Information and Consent Form (PICF) form is attached. The participation of teacher mentors in the research is voluntary and the teacher mentors should not feel compelled to participate if they do not want to. Teachers also have the right to withdraw from participation at any time If the teacher mentors wish to participate, can they carefully read the attached PICF form and sign and get the form witnessed before returning to me. If they require further information about the research or their role, please contact me on mobile or by email. Thank you very much for your consideration in this regard.

Yours sincerely

Leanne Compton

Appendix C: Copy of Participant Information Consent Form (PICF)

School of Education

PO Box 71
Bundoora VIC 3083
Australia

[attached with email to principal to forward to teacher mentors]

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

PARTICIPANT INFORMATION

Research title: Knowledge of teacher mentors to support pre-service teachers to use ICT during teaching practicums

Investigators*:*

Dr Kathy Jordan (Senior Lecturer, Education, RMIT University, Kathy.jordan@rmit.edu.au)
Dr Jennifer Elsden-Clifton (Senior Lecturer, Education, RMIT University, jennider.elsden-clifton@rmit.edu.au)
Leanne Compton (PhD candidate)

Dear

You are invited to participate in a research study being conducted by RMIT University. Please read this sheet carefully and be confident that you understand its contents before deciding whether to participate. If you have any questions about the research study, please ask one of the investigators.

Who is involved in this research study? Why is it being conducted?
This research study is being completed by Leanne Compton as part of a Doctor of Philosophy (PhD) (Education). Her supervisors are Dr Kathy Jordan and Dr Jennifer Elsden-Clifton. All data collection will be completed by Leanne Compton. The research study aims to investigate the domains of knowledge needed for teacher mentors to support pre-service teachers to use ICT during teaching practicums. The research study has been approved by the RMIT Human Research Ethics Committee and Victorian Department of Education and Training.

Why have you been approached?
You have been approached to participate in this research study because you have recently supervised RMIT pre-service teachers on teaching practicums. An email requesting your participation in this research was sent to your principal who forwarded the email onto you. Your participation in this research is voluntary.

What is the research study about? What are the questions being addressed?

This PhD study is being completed as a research study. The synthesis of data collected will inform the domains of knowledge teacher mentors need to support pre-service teachers to use ICT during their teaching practicums. The main research question is "What knowledge is needed by teacher mentors to support pre-service teachers to use ICT during teaching practicums?" Approximately 30–50 teacher mentors will participate in this research study.

If I agree to participate, what will I be required to do?

You will be asked to take part in the research study by participating in a ten-minute questionnaire relating to your experiences of mentoring pre-service teachers and their usage of ICT during teaching practicums, with the option to participate in a thirty-minute interview relating to your knowledge and beliefs about using ICT in the classroom during the teaching practicum.

What are the possible risks or disadvantages?

There are no perceived risks outside of your normal day-to-day activities. However, if you are unduly concerned about your responses to any of the questions or if you find participation in the research study distressing, you should contact Kathy Jordan or Jennifer Elsden-Clifton as soon as convenient and they will discuss your concerns with you confidentially and suggest appropriate follow up, if necessary.

What are the benefits associated with participation?

Involvement in this research study may help direct the future of the professional learning of teacher mentors within teacher education programs at RMIT University. In particular it may help focus on the professional learning needs of teacher mentors to support pre-service teachers. Involvement in this research study may inform research/publications that may be of assistance to other providers and researchers.

What will happen to the information I provide?

The data collected will be analysed and the results will appear in the PhD candidate's exegesis. The data may appear in publications such as journals and conferences. All participants will remain anonymous, all names and personal means of identification will not be used. Aliases/pseudonyms known only to the participant and researcher will be used. The results will be reported in a manner which does not enable you to be identified. Thus, the reporting will protect your anonymity.

Information that you provide can be disclosed only if (1) it is to protect you or others from harm, (2) if specifically required or allowed by law, or (3) you provide the researchers with written permission.

Users should be aware that the World Wide Web is an insecure public network that gives rise to the potential risk that a user's transactions are being viewed, intercepted or modified by third parties or that data which the user downloads may contain computer viruses or other defects. This research study will use an external site to store data collected. The site we are using is Google Drive. If you agree to participate in this research, the responses you provide to the questionnaires will be stored on a host server that is used by Google Drive. No personal information will be collected in the interviews, so none will be stored as data. Once we have completed our data collection, we will import the data we collect to the RMIT server where it will be stored securely for five (5) years before being destroyed. The data on the Google Drive's host server will then be deleted and expunged.

What are my rights as a participant?

- The right to withdraw from participation at any time
- The right to request that any recording cease
- The right to have any unprocessed data withdrawn and destroyed, provided it can be reliably identified, and provided that so doing does not increase the risk for the participant.
- The right to be de-identified in any photographs intended for public publication, before the point of publication
- The right to have any questions answered at any time.

Whom should I contact if I have any questions?

- Dr Kathy Jordan (kathy.jordan@rmit.edu.au)
- Dr Jennifer Elsden-Clifton (jennifer.elsden-clifton@rmit.edu.au)

Yours sincerely

Dr Kathy Jordan (PhD)

Dr Jennifer Elsden-Clifton (PhD)

Ms Leanne Compton (PhD candidate)

All researchers must sign the information sheet, with their qualification/s listed below each name.

If you have any complaints about your participation in this project please see the complaints procedure at Complaints with respect to participation in research at RMIT [ctrl + click to follow]/ http://www.rmit.edu.au/research/human-research-ethics

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RMIT UNIVERSITY

School of Education
PO Box 71
Bundoora VIC 3083
Australia

CONSENT to participate in 'Knowledge needed by teacher mentors to support pre-service teacher to use ICT during teaching practicum' research study

1. I have had the project explained to me, and I have read the information sheet
2. I agree to participate in the research project as described
3. I agree**:**
   - to participate in the interview session
   - that my voice will be audio recorded
   - submit assessment items/lesson plans for analysis
4. I acknowledge that:

(a) I understand that my participation is voluntary and that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied (unless follow-up is needed for safety).

(b) The study is for the purpose of research. It may not be of direct benefit to me.

(c) The privacy of the personal information I provide will be safeguarded and only disclosed where I have consented to the disclosure or as required by law.

(d) The security of the research data will be protected during and after completion of the study. The data collected during the study may be published, and a report of the project outcomes will be provided to the Head of School, School of Education, RMIT University). Any information which will identify me will not be used.

5. Participant's consent

Participant : ______________________ Date : ____________

(Signature)

Witness:

[only required if research is assessed as more than low risk; otherwise please delete]

Witness: ______________________ Date: ____________

(Signature)

Participants will be given a photocopy of this PICF after it has been signed.

Appendix D: Sample of questionnaire for teacher mentors

Thank you for taking the time to complete this questionnaire. It will take approximately ten minutes to complete this questionnaire. Please answer each question to the best of your knowledge. Your responses will be kept completely confidential.

Section 1: Demographics

1. Sex:

☐ Male

☐ Female

☐ Other

2. Total number of years teaching (excluding any leave):

☐ 3 years or less

☐ 4–6 years

☐ 7–9 years

☐10 years or greater

3. Age

☐ 24 years or less

☐ 25–29 years

☐ 30–34 years

☐ 35– 39 years

☐ 40–44 years

☐ 45–49 years

☐ 50–54 years

☐ 55–59 years

☐ 60–64 years

☐ 65 + year

4. Type of school you currently teach in

☐ Primary

☐ P-10 College

☐ Secondary

☐ Specialist School

☐ P–12 College

☐ Other, please specific

5. What year level do you currently teach?

(You can select more than one option)

☐ None

☐ Year 7

☐ Prep

☐ Year 8

☐ Year 1

☐ Year 9

☐ Year 2

☐ Year 10

☐ Year 3

☐ Year 11

☐ Year 4

☐ Year 12

☐ Year 5

☐ Other, please specify

☐ Year 6

Section 2: Mentoring experience

6. Have you previously been a teacher mentor?

☐ Yes

☐No

7. If you ticked ‘Yes’ in Q5, how many times have you mentored a pre-service teacher previously?

☐ 1–2 times

☐ 3–4 times

☐ 5 times or more

☐ Not applicable

8. Have you undertaken any training related to being a teacher mentor

☐ Yes ☐No

9. If you ticked ‘Yes’ in Q7, identify the type of training you have undertaken

(You can select more than one option)

☐ Australian Institute of Teaching and School Leadership (AITSL) Supervising preservice teachers’ program

☐ Victorian Department of Education Teacher (DET)mentor support program

☐ Victorian Institute of Teaching (VIT) Teacher mentoring training

☐ Other, please specify ________________________

Section 3: Experiences of ICT in your teaching practice

10. How comfortable are you with using ICT in your own teaching practice?

☐ Very comfortable

☐ Somewhat comfortable

☐ Not comfortable at all

11. What digital tools do you use in your teaching practice?

(You can select more than one option)

☐ Digital devices such as laptop, desktop, iPad or another tablet device, interactive whiteboard, mobile phones, digital cameras

☐ Web 2.0 tools such as blog, wiki, social media, surveys and polls, comic creator etc

☐ School intranet and/or learning management system such as Schoology, Moodle, Compass etc

☐ Online searching using the internet

☐ Digital resources from Scootle, FUSE [Find, Use, Search Educational Resources], ABC Splash** etc

☐ Software such as PowerPoint, Excel, Word, Publisher

☐ Applications (apps), widgets or other

☐ Robotics such as Bee-Bots, drones, Pro-Bots, etc

☐ Other, please specify ________________________

12. How important is it to use ICT in your own teaching practice?

☐ Very important

☐ Somewhat important

☐ Not important at all

Section 4: Participation in interviews

If you are happy to be contacted to discuss your views in an interview (with a possible follow-up interview), please provide your email address and/or contact number.

**Scootle, FUSE and ABC Splash (now known as ABC Education) are repositories delivering educational digital content, aligned to either the Australian Curriculum F-10 or Victorian Curriculum F-10, provided by Education Services Australia https://www.scootle.edu.au/ec/p/home, the Victorian Department of Education and Training https://fuse.education.vic.gov.au/Teacher, and the Australian Broadcasting Commission (ABC) https://education.abc.net.au/home#!/home respectively.

Appendix E: Sample of semi-structured interview questions

Thank you for participating in this interview related to your teaching practicums. You are about to mentor a pre-service teacher and I would like to ask you a series of six questions that should take you approximately 20–30 minutes to answer about your expectations of mentoring this pre-service teacher.

Questions

1. Tell me about yourself and what you teach?

(*prompts:* year level, subject, roles within school, teaching experience, time at school)

2. Tell me about the class/es that your pre-service teacher. What ICT was used in these lesson/s? How was it used and why is it being used? What enabled the use of ICT? How did you work with your pre-service teachers to teach a lesson sequence that incorporates ICT?

(*prompts*: main topics being studied, ICT tools and devices planned to be used. Purpose of using ICT? Who will be using the ICT?)

3. Are you aware of the Australian Professional Standards for Teachers?

(*prompt:* AITSL standards for teachers. Explicit mentioning of ICT)

4. What knowledge do you need to assist the pre-service teacher with the development of this lesson sequence that incorporate ICT?

(*prompts*: What specific knowledge (content, pedagogy, technological, mentoring) do you think is important? Are these types of knowledge the same as those needed for mentoring without ICT?)

5. What do you think will be the challenges/barriers with mentoring the pre-service teacher to develop this lesson sequence with ICT?

   (prompts: planning, access, belief, specific knowledge and skills, confidence)

Appendix F: List of artefacts collected from each school

	Rusden P–12 College	Ebden College	Nepean North Primary School	Cochrane Primary College
Artefacts	• My School data • College website • BYOD school policy • Student acceptable use agreement • Student mobile phone use policy	• My School data • College website • ICT professional learning policy • Students and electronic devices at school policy • ICT acceptable use agreement • Strategic direction	• My School data • College website • Mobile phone permission policy	• My School data • College website • Online services assessment documentation • Parent introduction letter to online portal

Appendix G: Ethics approval from RMIT University

RMIT UNIVERSITY Design and Social Context College Human Ethics Advisory Network (CHEAN)
Sub-committee of the RMIT Human Research Ethics Committee (HREC)

Notice of Approval

Date:	**25 September 2017**
Project number:	**CHEAN A 19608-08/15**
Project title:	**'The Professional Learning Needs of Teacher Mentors to Support Pre-service Teachers to Use ICT during Practicum'**
Risk classification:	**Low Risk**
Investigator:	**Associate Professor Kathy Jordan, Ms Leanne Compton, Dr Jennifer Elsden-Clifton**
Approved:	**From: 25 September 2017 To: 31 December 2019**

I am pleased to advise that your extension request has been granted ethics approval by the Design and Social Context College Human Ethics Advisory Network (CHEAN), as a sub-committee of the RMIT Human Research Ethics Committee (HREC). Ethics approval is extended until 31 December 2019.

Terms of approval:

1. **Responsibilities of investigator**
   It is the responsibility of the above investigator/s to ensure that all other investigators and staff on a project are aware of the terms of approval and to ensure that the project is conducted as approved by the CHEAN. Approval is only valid whilst the investigator/s holds a position at RMIT University.
2. **Amendments**
   Approval must be sought from the CHEAN to amend any aspect of a project including approved documents. To apply for an amendment please use the 'Request for Amendment Form' that is available on the RMIT website. Amendments must not be implemented without first gaining approval from CHEAN.
3. **Adverse events**
   You should notify HREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
4. **Participant Information Sheet and Consent Form (PISCF)**
   The PISCF and any other material used to recruit and inform participants of the project must include the RMIT university logo. The PISCF must contain a complaints clause.
5. **Annual reports**
   Continued approval of this project is dependent on the submission of an annual report. This form can be located online on the human research ethics web page on the RMIT website.
6. **Final report**
   A final report must be provided at the conclusion of the project. CHEAN must be notified if the project is discontinued before the expected date of completion.
7. **Monitoring**
   Projects may be subject to an audit or any other form of monitoring by HREC at any time.
8. **Retention and storage of data**
   The investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

Please quote the project number and project title in any future correspondence.

On behalf of the DSC College Human Ethics Advisory Network, I wish you well in your research.

Dr David Blades
DSC CHEAN Secretary
RMIT University
E: dscethics@rmit.edu.au

Appendix H: Ethics approval from Victorian Department of Education and Training

Department of
Education & Training
Strategy & Review Group

2 Treasury Place
East Melbourne Victoria 3002
Telephone: 03 9637 2000
DX210083

2015_002879

Dear Ms Compton

Thank you for your application of 25 September 2015 in which you request permission to conduct research in Victorian government schools titled *Professional learning needs of Teacher Mentors to support pre-service teachers to use ICT during practicum.*

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 Training.
2. Separate approval for the research needs to be sought from school principals. This is to be supported by the Department of Education and Training 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 Training 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 Training 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.

VICTORIA
State
Government

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

Yours sincerely

Joyce Cleary
Director
Insights and Evidence

/01/2016

Appendix I: Chi-square tests of association

Table I1: Chi-square test for association: Mentoring training is influenced by sex of teacher mentors

		Female	Male	All teacher mentors
Mentor training undertaken	Count	8	4	12
	Expected count	8.400	3.600	
No mentor training undertaken	Count	27	11	38
	Expected count	26.600	11.400	
All teacher mentors		35	15	50

Table I2: Chi-square test for association: Mentoring training is influenced by type of classes taught by teacher mentors

		Primary school classes	Secondary school classes	All teacher mentors
Mentor training not undertaken	Count	15	23	38
	Expected count	12.920	25.080	
Mentor training undertaken	Count	2	10	12
	Expected count	4.080	7.920	
All teacher mentors		17	33	50

Table I3: Chi-square test for association: Mentoring training is influenced by teaching experience of teacher mentors

		6 or less years	7 years or greater	All teacher mentors
No mentor training undertaken	Count	6	32	38
	Expected count	6.080	31.920	
Mentor training undertaken	Count	2	10	12
	Expected count	1.920	10.080	
All teacher mentors		8	42	50

Table I4: Chi-square test for association: Mentoring training is influenced by age range of teacher mentors

		25–34 years	35–44 years	45–54 year	55–64 years	All teacher mentor s
Mentor training not undertaken	Count	13	9	11	5	38
	Expected count	12.92 0	8.360	12.160	4.560	
Mentor training undertaken	Count	4	2	5	1	12
	Expected count	4.080	2.640	3.840	1.440	
All teacher mentors		17	11	16	6	50

Table I5: Chi-square test for association: Mentoring training is influenced by number of times previously mentored

		1–2 times	3–4 times	5 times or more	All teacher mentors
No mentoring training undertaken	Count	7	12	19	38
	Expected count	6.840	9.880	21.280	
Mentoring training undertaken	Count	2	1	9	12
	Expected count	2.160	3.120	6.720	
All teacher mentors		9	13	28	50

Table I6: Chi-square test for association: Mentoring training is influenced by beliefs about level of importance to use ICT in teaching

		Very confident	Somewhat confident	Not confident	All teacher mentors
No mentor training undertaken	Count	19	15	4	38
	Expected count	22.800	11.400	3.800	
Mentor training undertaken	Count	11	0	1	12
	Expected count	7.200	3.600	1.200	
All teacher mentors		30	15	5	50

Table I7: Chi-square test for association: Comfort level with using ICT is influenced by age range of teacher mentors

		25–34 years	35–44 years	45–54 year	55–64 years	All teacher mentors
Very comfortable	Count	14	8	9	5	36
	Expected count	12.490	8.082	11.020	4.408	
Somewhat comfortable	Count	3	3	6	1	13
	Expected count	4.510	2.918	3.980	1.592	
All teacher mentors		17	11	15	6	49

Table I8: Chi-square test for association: Comfort level with using ICT and teaching experience

		6 years or less	7 years or greater	All teacher mentors
Very comfortable	Count	7	29	36
	Expected count	5.878	30.122	
Somewhat comfortable	Count	1	12	13
	Expected count	2.122	10.878	
All teacher mentors		8	41	49

Table I9: Chi-square test for association: Level of comfort with using ICT is influenced by type of classes taught by teacher mentors

		Primary classes	Secondary classes	All teacher mentors
Very comfortable	Count	9	28	37
	Expected count	12.082	24.918	
Somewhat comfortable	Count	7	5	12
	Expected count	3.918	8.082	
All teacher mentors		16	33	49

Table I10: Chi-square test for association: Comfort level with using ICT is influenced by beliefs about level of importance to use ICT in teaching

		Very important	Somewhat important	Not important	All teacher mentors
Very comfortable	Count	22	13	1	36
	Expected count	22.041	11.020	2.939	
Somewhat comfortable	Count	8	2	3	13
	Expected count	7.959	3.980	1.061	
All teacher mentors		30	15	4	49

Table I11: Chi-square test for association: Beliefs about level of importance to use ICT in teaching is influenced by sex of teacher mentors

		Male	Female	All teacher mentors
Very important	Count	7	23	30
	Expected count	9.000	21.000	
Somewhat important	Count	6	9	15
	Expected count	4.500	10.500	
Not important	Count	2	3	5
	Expected count	1.500	3.500	
All teacher mentors		15	35	50

Table I12: Chi-square test for association: Beliefs about level of importance to use ICT in teaching is influenced by age range of teacher mentors

		25-44 years	45-64 years	All teacher mentors
Very important	Count	15	15	30
	Expected count	16.800	13.200	
Somewhat important	Count	11	4	15
	Expected count	8.400	6.600	
Not important	Count	2	3	5
	Expected count	2.800	2.200	
All teacher mentors		28	22	50

Table I13: Chi-square test for association: Beliefs about level of importance to use ICT in teaching is influenced by teaching experience of teacher mentors

		9 years or less	10 or greater years	All teacher mentors
Very important	Count	9	21	30
	Expected count	12.600	17.400	
Somewhat important	Count	10	5	15
	Expected count	6.300	8.700	
Not important	Count	2	3	5
	Expected count	2.100	2.900	
All teacher mentors		21	29	50

Table I14: Chi-square test for association: Beliefs about level of importance to use ICT in teaching is influenced by type of classes taught by teacher mentors

		Primary classes	Secondary classes	All teacher mentors
Very important	Count	10	21	31
	Expected count	10.540	20.460	
Somewhat important	Count	5	10	15
	Expected count	5.100	9.900	
Not important	Count	2	2	4
	Expected count	1.360	2.640	
All teacher mentors		17	33	50

Table I15: Chi-square test for association: Beliefs about level of importance to use ICT in teaching is influenced by mentoring experience of teacher mentors

		1–4 times	5 times or more	All teacher mentors
Very important	Count	8	22	30
	Expected count	13.200	16.800	
Somewhat important	Count	12	3	15
	Expected count	6.600	8.400	
Not important	Count	2	3	5
	Expected count	2.200	2.800	
All teacher mentors		22	28	50

Appendix J: Number of Australian male and female primary and secondary teachers according to sectors

Sector		Government		Catholic		Independent		Total	
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percent
Primary	Female	14 948.5	78.95%	4501.5	83.24%	2021.7	75.97%	21 477.7	79.52%
	Male	3985.1	21.05%	906.4	16.76	639.5	24.03%	5531	20.48%
Secondary	Female	9676.6	55.77%	3403.5	58.54%	3014.4	54.93%	16 094.5	56.17%
	Male	7674.1	44.23%	2410.6	41.46%	2473.3	45.07%	12 558	43.83%

(Australian Bureau of Statistics, 2016)

Appendix K: Process used to purposefully select teacher mentors to be interviewed using three pre-determined factors of interest

Criteria of interest	**Teacher mentors who volunteered to be interviewed**							
Type of classes taught	**Primary**				**Secondary**			
	1, 3 ,6, 7, 8, 9, 10, 11, 13, 14, 16, 18				2, 4, 5, 12, 15, 17			
Sex	**Female**		**Male**		**Female**		**Male**	
	1, 3, 6, 7, 8, 9, 10, 11, 13, 14, 16, 18		N/A		2, 4, 15		5, 12, 17	
Mentor training undertaken	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
	N/A	1, 3, 6, 7, 8, **9**, 10, 11, **13**, 14, 16, 18	N/A	N/A	**2**, 4, 15	N/A	N/A	**5**, 12, 17
Teacher mentors purposefully selected	N/A	**9 (Annie)** **13 (Rose)**	N/A	N/A	**2 (Sarah)**	N/A	N/A	**5 (Charles)**

Appendix L: Further information about Rusden P–12 College's select-entry program and elite sports program

Rusden P–12 College's select-entry program

Students entering Year 7 at Rusden P–12 College can apply to be part of the school's select-entry accelerated learning program that is designed for gifted and talented students who are capable of working at a much faster pace and in greater depth than their peers. Students needed to complete a select-entry test to be eligible for the program. The select-entry program, which covered Years 7–10, is typically completed by students in three years.

Rusden P–12 College's elite sports program

Sport and physical education are mandated for all students from Prep to Level 10 in Victorian government schools https://www.education.vic.gov.au/school/principals/spag/curriculum/Pages/sport.aspx. This voluntary program at Rusden P–12 College aimed to nurture the development of potential athletes by exposing students to a range of sports in Year 8 and then streaming students into specific programs such as Australian Rules Football, rugby league and court sports in Years 9–12. Students, who were part of the program, trained before school for two one-hour sessions and one one-hour after-school session each week. Students were supported to develop capacity in their chosen sport as both a future athlete as well as a student, with the teaching of skills in leadership, interpersonal development and communication that was evident in content from the Victorian Curriculum F–10.

Appendix M: Teacher and Principal Notebook Program

Information about the Victorian Education Department of Education and Training's Teacher and Principal Notebook Program can be found at: https://www.education.vic.gov.au/Documents/about/programs/infrastructure/notebookprogram2016-factsheet.pdf.

This program supports Victorian government schools by offering the central provision of Windows laptops as a universal platform. Participation in the *Teacher and Principal Notebook Program* is optional for government teachers in Victoria, and the laptops, which are assets of the schools, are assigned by the school to teachers to use them at school and at home. Details about the eligibility criteria for the program can be found at: https://www.education.vic.gov.au/school/principals/spag/infrastructure/Pages/notebooks.aspx

Appendix N: eSmart accreditation

eSmart accreditation was a step-by-step process for school to create a holistic approach to cybersafety. Monetary grants from the Victorian Department of Education and Training, through the Alannah and Madeline Foundation, were provided to support schools through the process to gain accreditation. The Alannah and Madeline Foundation is an Australian national charity with a vision that every child will live in a safe and supportive environment and a mission is to keep children safe from violence https://www.amf.org.au/.

Appendix O: About Animalia

Animalia is a 1986 Australian picture book written and illustrated by Graeme Base http://graemebase.com.au/book/animalia/, which tells the story of two human children who discover a magical library that takes them to the fantasy, animal-inhabited world of Animalia.

The Animalia program is an American–Australian–British–Canadian children's television series based on the Animalia book https://actf.com.au/education-programs/animalia-series-1. The Australian Children's Television Foundation (a national children's media and policy hub that markets children's television programs and is responsible for the Australian children's digital television channel, ABC3) developed supporting resources for 12 selected episodes of the Animalia program https://actf.com.au/teaching_resources/res/10336.