Assessing the impact of teachers’ technology, pedagogy and content knowledge, and beliefs, in a regional vocational education and training context.

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This thesis is presented for the degree of Doctor of Education
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I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

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Abstract

This thesis examines the knowledge and beliefs that teachers have about teaching with technology in a regional vocational education and training (VET) institute in Australia. Vocational teachers must demonstrate teaching expertise (pedagogical knowledge) as well as industry expertise (content knowledge) to work with diverse learners in different contexts. Recent surveys have revealed that teachers’ use of technology within the VET sector is not effectively incorporated nor has it been embraced in pedagogically defensible ways. Thus there is a need for teachers to embrace ‘technology’ knowledge commensurate with industry and workplaces and to integrate it more effectively into their pedagogy.

Through the lens of the TPACK (technological pedagogical content knowledge) framework, this study examined teachers’ beliefs about the nature of knowledge (epistemology) and beliefs about effective ways of teaching and learning (pedagogy). Using a mixed-methods approach, this research sought to understand how VET teachers’ knowledge and beliefs influenced their technology integration practices. The study found that teachers’ beliefs had a significant impact upon their use of technology. In particular, their epistemological beliefs were reflected in their perceptions of students and thus shaped their decisions about integrating technology into their teaching.

These findings concluded that teacher beliefs about the nature of knowledge and its influence on teaching should be further studied since these core beliefs acted as a springboard from which to understand vocational teachers’ technology integration practices. Finally, this thesis illuminated the need for teacher education and professional development programs to focus on developing teachers’ knowledge by examining their beliefs across the technological, pedagogical and content domains.
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Chapter One: Context of the Study

Regional Australia provides fertile ground for the integration of a multiplicity of technological tools and resources to support training and education. Geographically, Western Australia is equivalent to the size of Western Europe and represents one-third of Australia’s total landmass with a population of just over 2.5 million people. Historically, this large geographical space has blocked access to education and participation in structures which often marginalise minority groups in regional areas (Dandaragan, 2001; Donovan & Heitmeyer, 2000; Gorski, 2009; McKavanagh, 2003). Through its vast communication channels and the long awaited rollout of the National Broadband Network, technology offers the promise of reducing the tyranny of distance.

The Bradley Review of Higher Education (Bradley, Noonan, Nugent & Scales, 2008) reported that the equity groups most under-represented in Australian higher education were students from remote Australia, indigenous students and students from lower socio-economic backgrounds. As many of these students from rural communities aim for vocational education and training, Abbott-Chapman (2011) highlighted the need to create appropriate and accessible education and training by using various technological forms to enable disadvantaged groups to create stories of their own. As Spender (1995) warns:

…the computer is not a toy; it is the site of wealth, power and influence, now and in the future. Women and indigenous people and those with few resources cannot afford to be marginalised or excluded from this new medium. To do so, will risk becoming information poor. It will be to not count; to be locked out of full participation in society in the same way that illiterate people have been disenfranchised in a print world. (p. 16)

Technology provides the means through which vocational education can reach into Australia’s vast regional areas. Its promotion in teaching is therefore vital to avoid marginalisation and exclusion. The success of technology integration in VET depends largely upon vocational
teachers: their epistemological, pedagogical and technological knowledge and the relationship between their beliefs about these constructs. This study aimed to explore the reasons why there has been a relatively slow uptake of educational technology by a group of vocational teachers in regional Australia.

**Overview of the Australian VET Sector**

The Glossary of VET (National Centre for Vocational Education Research, 2013) defines Vocational Education and Training (VET) as post-compulsory education and training, excluding degree and higher-level programs, delivered by further education institutions that provide people with occupational or work-related knowledge and skills (p. 119). The National Training System is a term used to describe the Australian VET system which is ‘characterised by the use of competency based training, Training Packages and the Australian Quality Training Framework (AQTF). Other features of this system are that it is industry-led, demand-driven and client centred’ (McKenna & Mitchell, 2007, p. ii).

VET is an integral component of the Australian education system. It is one of three major sectors of education and training in Australia designed to deliver workplace-specific skills and knowledge based competencies. It is controlled by both government and independent bodies and functions within the Australian Qualification Framework (AQF) to teach qualifications defined by industry training packages under a set of national quality standards, the AQTF.

The Council of Australian Governments, a peak intergovernmental forum, has set ambitious goals for participation in education and training. In 2010, the government’s advisory group on VET released a discussion paper linking the nation’s economic and social prosperity to the development of human capital by the VET sector. According to the paper, the strength of the sector is its ‘very close connection between learning, employment and the economy’ (Skills Australia, 2010, p. 88). Central to these goals were appeals to increase workforce productivity and participation, to remain internationally competitive and to strengthen the social fabric of an inclusive and resilient nation. At the Council of Australian Governments Industry and Skills
Council Meeting in 2014, ministers discussed reforms which would ensure that the VET sector supports the current and future skills needs of business and the economy. A key goal of the sector, they argued, was that ‘to provide industry with skilled and productive workers, the training system needs to capitalise on the opportunities of the future, and to give young people and workers in declining industries the best opportunity to get a job’ (Department of Industry, 2014). Similarly, the National VET Sector Sustainability Policy and Action Plan (2009-2012) identified the need for the sector to:

…support the development and maintenance of a productive national economy through the provision of a skilled workforce. The VET sector must identify emerging areas of skills demand and ensure the availability of relevant training products and delivery. (p. 3)

Tasked to address the needs of the national economy and its workforce, the vocational education sector clearly plays an important role. VET teachers, in particular, have a pivotal role in preparing students for the workplace (Fransson & Holmberg, 2012; Loogma, Kruusvall & Umarik, 2012). It is therefore imperative that the VET sector and its teachers participate in an ongoing culture of technological innovation to develop and maintain currency in the technology of the industries for which workers are prepared (Guthrie, Harris, Simons & Karmel, 2009; Toner, 2005). However, according to the findings from a national survey of VET teachers, there are doubts as to whether teachers can rise to the challenge (2013 E-Learning Benchmarking Survey).

The VET sector is inherently diverse. Its students include those from secondary schools and alternative Year 12 programs up to degree level qualifications. VET providers include technical and further education (TAFE) institutes, adult and community education providers and agricultural colleges. Private VET providers include community organisations and industry skill centres as well as commercial and enterprise training providers. In addition, some universities and schools provide VET.

To accommodate the needs of diverse contexts and student cohorts, VET teachers are expected to develop a wide repertoire of pedagogical practices. According to Robertson (2010),
no other sector is required to accommodate such diversity, nor has there been greater pressure on VET teachers to meet these challenges.

Recent literature pertaining to the restructure of the Australian VET system cites the need to increase the professionalism of its workforce (Wheelahan & Moodie, 2010). There are imperatives to challenge traditional ways of teaching (Guthrie, 2010), to balance pedagogical skills and vocational currency, to research new pedagogical models to inform teaching (Darwin, 2007), and to develop more complex pedagogies to remove the tension between education and economics (Kemmis, Sutcliffe & Ahern 2009). That this requires high-level involvement from governments, industry and teachers demonstrates a deficit pedagogical model and an unstable foundation upon which VET practices exist.

The development of technological knowledge in a competitive, global economy is required to rebuild the professionalism of VET teachers in high-level teaching skills and high-level industry knowledge. It is therefore worthwhile examining how VET teachers’ technological knowledge is characterised when it is aligned with their pedagogical and content knowledge.

**VET Teacher Knowledge**

According to a set of newly released standards for Registered Training Organisations (RTOs), trainers and assessors must have vocational competencies to the level being delivered and assessed, current industry skills directly relevant to the training and assessment provided, current knowledge and skills in vocational training and a training and assessment qualification (Commonwealth of Australia, 2014). Therefore, teachers are required to demonstrate expertise in pedagogical knowledge and content knowledge.

It is common for VET teachers to enter the sector with rich content knowledge of a particular trade or vocation. It is assumed they bring with them knowledge of the tools and the technology of that industry. Coming from the workplace, it cannot be assumed that teachers have developed sufficient pedagogical knowledge to inform their teaching practices, let alone...
the technological knowledge required to integrate technology with their pedagogy (Wheelahan & Moodie, 2010).

The emergence of new digital technologies highlights an increasing need for teachers to embrace the technological knowledge required of the industry for which they prepare students (Chua & Jamil, 2012). It also highlights the need for teachers to integrate these technologies into their teaching. Integrating the technology-rich outside world with the education world is fundamental for effective teaching and meaningful learning (Levin & Wadmany, 2008; Mitchell, Chappell, Bateman & Roy, 2006). However, there is concern that the immediacy of technology and its rapid pace of development may be in conflict with the slow pace of educational change (Bos, 2011; Kinchin, 2012).

**VET Teacher Qualifications**

Recent research has focused on the quality of VET teacher qualifications (Clayton 2009, 2010), the need for professional development in relation to VET pedagogy (Cornford, 1999; Guthrie, 2010; Mitchell & Ward, 2010; Productivity Commission, 2011) and the possibility of a VET professional association (Clayton & Guthrie 2011; Wheelahan & Moodie, 2010). Trainer and assessor capability has also been investigated (Clayton 2009, 2011; Guthrie et. al. 2011; Mitchell & Ward, 2010; Robertson, 2010; Walker, 2010; Wheelahan, 2010). Much of the focus has been aimed at the nature of the Certificate IV in Training and Assessment and its origin as competency-based training grounded in behaviourist pedagogy. Its educational impact subverts alternative pedagogies reflecting the course from which it came (Darwin, 2007; Hodge, 2009). The only requirement for its successful completion is to fulfil the need to collect evidence to achieve the listed competencies regardless of how it is taught (Guthrie, 2010; Hodge, 2009). Such extensive commentary surrounding VET teachers and the mandatory teaching qualification in vocational education in Australia, has been directed at its fitness for purpose to provide the necessary knowledge and skills to teach in the VET sector (Clayton, 2009; Skills Australia, 2011).
Until recently, there was no requirement for new teachers to have a teaching qualification. Consequently, teachers were recruited with no teaching experience beyond their own learning histories (Darwin, 2007). As Darwin (2004) persuasively argued, the TAFE system appears to be economically sustained because it has limited pedagogical expectations for vocational teachers as educators. This minimal expectation of teachers implies a potentially weaker pedagogy required to teach in VET than in other educational settings (Robertson, 2010; Toner, 2010; Wheelahan, 2010).

The highly regulated and organised nature of the VET system presupposes explicit pedagogical practices, limited by Training Packages and a competency-based training and assessment structure which hinders effective innovation (Dalitz, Toner & Turpin, 2011; Kemmis, Sutcliffe & Ahern, 2009). But, according to Guthrie, Perkins and Nguyen (2006), VET teachers as skilled professionals need to have a ‘highly sophisticated pedagogical repertoire’ (2006, p. 6) developed beyond the transmissive educational paradigm. The rapid growth of the knowledge society challenges these traditional epistemologies and their means to prepare students for the workplace (Tsai, Chai, Wong, Hong & Tan, 2013).

Training packages contain the curriculum that industries require, stipulate the standards for competent performance and dictate the required knowledge and skills. The critical aspects of assessment are mandated as are the requirements for gathering assessment evidence. Assumptions about the nature of knowledge and how it is acquired are reflected in these packages. The way VET teachers design and implement their programs, thus influences what counts as knowledge and how that knowledge is acquired (Hofer & Pintrich, 1997; Pajares, 1992). Integrating technology into existing training programs requires changing both content and pedagogical knowledge (Park & Ertmer, 2008). It also involves changing beliefs, attitudes, pedagogies and ideologies.

Traditional pedagogies manifest themselves in multiple ways and in various forms. Darwin (2007) described the strong institutional barriers to change:
From the epistemic sustenance provided by a behaviourist competency based training framework, through the direct recruitment of vocational experts with limited or no teaching experience beyond their own learning histories to the conventional casting of vocational teachers as knowledge ‘conduits’ rather than knowledge creators. (p. 65)

Such a deeply entrenched and traditional educational paradigm would indicate that changing teachers’ core beliefs relating to their teaching approaches and their teaching philosophies might take considerable energy.

Doolittle and Camp (1999) reflected on the need for vocational and career education to move beyond the traditional transmissive educational paradigm to an emphasis on a constructivist paradigm. They argued that vocational education was founded on behaviourist principles. For it to be better aligned with the development of vocational skills, they advocated the development of teaching practices predicated on constructivist principles and the integration of emergent technologies. Teaching, therefore, would no longer need to involve the transmission of knowledge. Constructivism offers the means to address the emergent worker, their sense of enquiry and curiosity piqued (Marsden & Piggot-Irvine, 2012) from active engagement in social settings that reflect the growing demands for new worker capabilities (Chappell, 2004).

The traditional factory model of education is incompatible with the evolving demands of the technology and of the workplace (Tee & Lee, 2011). For teachers, to prepare students for the knowledge society and the knowledge economy presents a significant paradigm shift. This shift would need to include significant epistemological change. It would mean recognising that students are able to create and produce knowledge rather than merely consume the knowledge that is produced by those in power. Teachers, therefore, need to re-evaluate their teaching practices and rethink the nature of teaching. According to Bonk and Koo (2014), all sectors are calling for teachers to change their teaching practices:

…whether one is peeking to observe a teacher in a K–12 classroom, walking down a cavernous hallway of some large higher education institution, sitting in
the back rows of a military or corporate training summit or institute, or attending a grantees’ meeting of an educational foundation or government agency. (p. 3)

There are clear imperatives for VET teachers to reflect on their practices to ensure they meet the needs of their students, their workplaces and the economy.

**Knowledge VET Teachers Need**

The way in which knowledge is conceptualised in vocational education has attracted attention in recent years (Bathmaker, 2013; de Bruijn and Leeman, 2011; Wheelahan, 2014). Understood as gaining vocational knowledge and skills, vocational education presents opportunities for the future, especially as it relates to questions of equity and justice (Bathmaker, 2013). Effective use of technology in teaching may provide the catalyst for change towards constructivist pedagogical practices.

Do teachers have the knowledge to incorporate technology into their teaching in pedagogically discriminating ways? In Australia, the Digital Education Revolution (DER) (AICTEC, 2009) recognised that ‘educators require the pedagogical knowledge, confidence, skills, resources and support to creatively and effectively use online tools and systems to engage students (p. 6). The National VET E-Learning Strategy (2012-2015) also supports a strong policy push for the use of technology in the vocational sector. Although these different agendas emphasise the need to adopt more global perspectives, they do not address the knowledge teachers need to realise their ambitious goals. For example, the Strategy’s aim was to develop sector-wide capability in adapting to the new technological environment. This meant: strengthening the Australian training sector’s use of new learning technologies, stimulating innovative approaches to increasing participation in training and employment and improving the skill levels of the Australian workforce.

Missing from the aim was a mandate to develop vocational teachers’ pedagogical skills to integrate the new learning technologies into their teaching. Amendments were recently made to refocus the strategy’s activities on the development of new training options using the National Broadband Network pilot sites, delivery of e-learning of foundation skills and e-
literacy programs for disadvantaged groups. Another amendment was to support improved learner access to programs based on jurisdictional labour market priorities. Developing teachers’ knowledge was clearly not part of those amendments.

The umbrella of the National VET E-learning Strategy, the Flexible Learning Advisory Group (FLAG) recently endorsed an e-learning quality model developed for use by Registered Training Organisations (RTOs). While ambitious, the model provides a solid means for assessing e-learning pedagogies. However, the model is based on the assumption that teachers are already using technology. It does not provide guidance on how teachers need to adapt or develop their pedagogies so that they can integrate them with technology.

Similarly, the VET Practitioner Capability Framework recently developed by Innovation and Business Skills Australia (IBSA) in 2013 was mapped to fill identified gaps in the teacher education programs for vocational teachers, namely, the Certificate IV in Training and Assessment and the Diploma of Vocational Education and Training. The Framework described three levels to reflect the expertise and responsibility required of VET teachers, four domains to describe the specialist skills required of VET teacher, and six skill areas that address more generic work skills required for VET teacher job roles. In light of the gaps identified in the Certificate IV in Training and Assessment, the specialist skills required of teachers at the three different levels provide little guidance about the pedagogical changes required to implement digital and technological resources for vocational teaching in the 21st century.

Technology

Technology is a potentially powerful tool in educational discourse. For geographically and socially isolated rural students especially, technology has opened up possibilities never before available. Although technologies change, they do not disappear; rather, the repertoire of available options increases (Anderson & Dron, 2010). They provide the means for students to establish communicative relationships with each other and to co-construct knowledge reflectively by engaging in open and critical discourse (Taylor & Maor, 2000). Technology provides the social, cognitive and motivational support to students through collaborative
activities to address the issue of isolation (Maor & Volet, 2007). Most importantly, the enhanced learning opportunities for rural and regional students provide the means for empowerment and participation in mainstream culture through which they are able to author (ise) their own lives.

In this study, technology is defined as all technologies that allow individuals to achieve personal and professional goals. In this context, technology is viewed as more than digital. It goes beyond information and communication technology (ICT) to incorporate content specific technologies, more broadly those that are used productively at work (Koehler & Mishra, 2009).

**Constructivism and Web 2.0**

The advent of technology has enabled many opportunities for teachers to transform their practices. Technology offers a wealth of cognitive and social resources to encourage meaningful interaction with a wealth of information and bring people together to challenge and support each other. There is little room to doubt that constructivist teaching can be enabled by the multiplicity of collaborative tools, making learning active, meaningful (Jonassen, 1999) intentional, authentic and co-operative (Jonassen, 2002; Jonassen, Howland, Marra & Crismond, 2008; Maor & Taylor, 1995).

Web 2.0 describes Web-based technologies that include blogging platforms, wikis, and media sharing sites, podcasting, social networks, social bookmarking sites, and other emerging forms of participatory and social media (Jimoyiannis, Tsiotakis, Roussinos & Siorenta, 2013). Its earlier version, Web 1.0, was read-only. It allowed users to search for information and read it. It did not allow users to share or interact with the information. In contrast, Web 2.0 technologies provide the software tools to support the shift from a transmissive model of learning to a model that empowers learners through collaboration, communication and interaction. They support social interaction and experience in education through the construction of knowledge with others and focus on the community rather than the individual (Wenger, 1998). They enable the sharing of knowledge, giving students exposure to new ideas and new forms of representation (McLoughlin & Lee 2008). Such technologies also allow students to
actively produce and share their knowledge in ways more creative than consuming pre-packaged course content (Downes, 2005).

Twenty-first century learning focuses on mastering the multi-dimensional abilities now required of students and of workers (Jimoyiannis et al., 2013). Importantly, Web 2.0 promotes learning by strengthening students’ critical thinking, writing, and reflection. It also engages students in a world of information sharing and collaborative learning. Thus technology has broadened the scope for new insights, experiences and knowledge to be articulated, shared, constructed and distributed (Chai & Lim, 2011).

Social constructivism posits that learning and the social nature of knowledge resulting from social and cultural interactions is a shared, rather than an individual experience (Vygotsky, 1978; Jonassen, 2000). Social constructivist teaching approaches emphasise students as active constructors of knowledge in collaborative settings (Chai, Koh & Tsai, 2010) so that students co-construct new understanding in a reflective way. It is an approach based on the notion that learners personally construct knowledge because knowledge is socially situated (Maor, 2008). Social constructivism is facilitated by emerging technologies (Ferdig, 2006) especially through their inherent features of connectivity, interactivity and collaboration. In regional areas in particular, technology provides the social interaction, whether synchronous or asynchronous.

Constructivist and social constructivist learning theories differ radically from traditional transmissive teaching. Crotty (1998), a proponent of constructivist thinking, posits that teaching is a process of supporting constructivism rather than merely transmitting knowledge. As an ideology, constructivism has demonstrated its potential as an effective pedagogical framework for guiding and broadening vocational learning (Doolittle & Camp, 2009; Jonassen, 2000; Jonassen, Howland, Marra & Crismond, 2008; Reigeluth & Moore, 1999).

To prepare remote and regional VET students for the 21st century workplace, it is essential that VET teachers adopt constructivist principles and practices thereby offering students a more socially interactive and relevant learning experience. When students undertake apprenticeships and traineeships, work placement and work experience, the workplace provides authentic, practical, co-operative, constructive and intentional opportunities (Dirkx, Kielbaso &
Smith, 2004). In other words, vocational education presents opportunities within essentially constructivist environments. However, without conviction and commitment to constructivist thinking, teachers are unlikely to change their practices. Studying VET teachers and their changing environment presents an ideal context to understand the influence of teachers’ knowledge and beliefs on their decisions about integrating technology into their teaching and adopting a pedagogy that is essentially constructivist in nature.

**Regional Context**

Marin Institute, (pseudonym used) where this study took place, had a student population of approximately 3000 in 2013. It delivers courses to students in a geographic area of 154,000 square kilometres and 44 local government shires. Around three quarters of all training is delivered via open learning, giving students flexibility in time and location of training. The region’s population of over 72,000 is widely distributed; only two towns in the region have populations of over 5,000. The institute provides a range of vocational training programs including apprenticeships and traineeships, which are delivered mostly in the workplace and complemented by either block-release or day-release training off-the-job. It is accredited to deliver training in rural and primary production industries, such as agriculture, horticulture, wool handling and conservation and land management as well as in other courses in community services, health, nursing, business, education and trades. Despite the availability of infrastructural and organisational support and cognisant of the institute’s strategic direction as a provider of open learning (Marin Strategic Plan 2014-2016), technological integration remains largely unimaginative.

The institute’s Open Learning Development and Investment Plan (2013-2015) articulates two goals. The first goal is to strengthen and expand participation and access to training for individuals through e-learning. To achieve this, the institute plans to: promote and facilitate the uptake of e-learning as a means of increasing flexibility in provision and quality of the learning experience; utilise e-learning initiatives to enable learners to develop knowledge
and skills that reflect local labour market priorities and promote and facilitate digital literacy and online study skills for all learners as preparation for education, training and employment.

The second goal is to build institute capability to deliver new training solutions through technology. The plan is to: undertake coordinated action for the deployment and utilisation of infrastructure and the provision of technical support for open learning with contingency backup; expand the range of technological tools for increased access by diverse users; build staff proficiency to facilitate industry specific learning through technology and develop e-capability and commitment in institute leadership.

Implicit in this plan is that implementing open learning, and developing technological infrastructure and capability depends as much on the organisation as it does on the teacher. It is based on the assumption that teachers either have the technological knowledge and skills, or that they will develop them to achieve the objectives of the plan. However, providing educational organisations with equipment and technological resources does not equate to effective integration nor changes in teaching practices (Holt and Challis, 2007; Lim & Chai, 2008; Lowther, Inan, Strahl & Ross, 2008).

Recent findings from the Australian 2013 E-Learning Benchmarking Survey have indicated a long road ahead before teaching with technology is accepted as mainstream pedagogical practice. While technology has proliferated both within education and beyond, VET teachers’ experiences with using technology have remained relatively unchanged. Toner (2005) has long asserted that the VET sector’s role in innovation has been largely ignored. The potential for technology to contribute to innovation in the sector undeniably rests with the teacher.

**Theoretical framework**

Teacher preparation programs are often held accountable for failing to adequately prepare teachers to establish pedagogical connections between the pedagogy and the technology (Jimoyiannis et al., 2013). Hedberg (2006) highlights the need to adopt ‘disruptive pedagogies’ in order to exploit the capacities of technologies and digital content. Rethinking teaching
practices under this light requires radical changes in the way teachers are prepared to teach with technology.

This study will be guided by a framework for understanding VET teachers’ epistemologies in terms of their Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006). The framework is grounded in an understanding that quality teaching does not occur unless the three knowledge bases of technology, pedagogy, and content intersect equally. The TPACK framework allows close examination of teachers’ existing structures of knowledge and the complex relationship between their technology, pedagogy and content knowledge.

The TPACK framework offers an analytical lens through which to structure professional development programs. In particular, it provides a model for researching what teachers know and what they should be able to do when integrating technology. According to Angeli and Valanides (2009), ‘The issue is no longer a decision whether teachers should integrate technology into their existing practices but rather how to use technology to transform teaching and create new opportunities for learning’ (p. 154). Technological tools are ‘not in themselves transformation mechanisms, or vehicles for change’; rather, they are tools ‘invoked by its users to reconstruct the subject matter from the knowledge of the teacher into the content of instruction’ (p. 157). The TPACK framework, therefore, provides a means through which teachers conceptualise the relationship between technology, pedagogy and content. It does not, however, acknowledge teachers’ epistemic beliefs (Angeli & Valanides, 2009). In this study, it is proposed that such beliefs significantly influence technology integration and have a major bearing on whether technology is used in constructivist or transmissive ways.

**Epistemology**

Epistemology is the study of knowledge. Epistemological beliefs are core beliefs about the nature of knowledge and knowing and how one comes to know things (Hofer & Pintrich, 1997; Harteis, Gruber & Hertramph, 2010). Epistemologically, it is contended that the more elaborate that one’s epistemic beliefs are, the better their teaching performance will be. Thus,
teachers’ epistemological beliefs may have a significant influence on what students come to believe about the nature of knowledge and what it means to learn. This assertion implies that traditional epistemologies are often reflected in teacher-centred pedagogies whereas beliefs that knowledge is not fixed but is evolving, tends to reflect a more student-centred, constructivist epistemology (Buehl & Fives, 2009).

Research suggests that teachers with traditional pedagogical beliefs apply a didactic approach to technology integration whereas teachers with more constructivist beliefs and pedagogical practices use technology more meaningfully and more often (Park & Ertmer, 2008; Tondeur, Hermans, van Braak & Valcke, 2008). Therefore, epistemological beliefs are important to this particular study in that they are identified as significantly influencing teachers’ pedagogy.

Previously, it was argued that for teachers to shift from traditional, transmissive teaching practices to constructivist practices requires a concerted effort to bring about that change (Hedberg, 2006; Prawat, 1992; Windschitl, 2002). The two models of teaching have very different epistemological assumptions about what knowledge is and thus very different views of what teaching and learning should be. The differences between them tend to influence how technology in teaching is perceived.

Regardless of their transmissive or constructivist perspective of learning, teachers cannot avoid thinking about the nature of knowledge and ways of knowing (Tsai et al., 2013). The democratisation of knowledge as a consequence of technological advance has meant that knowledge that was once known as fixed or given can now be challenged. Of relevance to this study is that technology provides both teachers and students access to a ‘universe of authorized texts’ (Hedberg, 2006, p. 176). Knowledge viewed from this perspective threatens to destabilise and crumble the hierarchies that have served to suppress minority groups in regional areas. In this study, teaching with technology offers a powerful means to empower students as creators and producers of knowledge.
Problem Statement

Increasing pressure on teachers to integrate digital and technological tools into their practices represents a significant paradigm shift for teachers within the VET sector. The emergence of new digital technologies illustrates an increasing need for teachers to embrace ‘technology’ knowledge commensurate with industry standards. As they prepare students for technologically-rich workplaces, the problem becomes more compelling.

Recent national surveys (E-learning Benchmarking Survey, 2011; 2013) have revealed that teachers’ use of technology within the VET sector is only slowly increasing. Despite a heavy national investment in e-learning, the 2013 E-learning Benchmarking Survey’s formal estimate of the proportion of VET training activity that involves e-learning indicates that there has been only a modest increase in the uptake of e-learning since the 2011 survey. It was estimated in 2013 that less than half (48%) of VET training involved e-learning, a 4% increase from 2011.

While teachers are slowly increasing their use and confidence in using technology across a range of training activities, their beliefs about how e-learning impacts upon student learning has diminished, particularly as it relates to their pedagogical practices. According to the survey results, teachers’ beliefs that technology-enhanced student learning had decreased by 16% over the last three years. Teachers appear to have become less confident about the impact of e-learning on their teaching practices as well as the extent to which e-learning improves students’ learning. That so few teachers/trainers are seeing incremental learning benefits from e-learning over alternative methods suggests that teachers may not have developed the technological, pedagogical and content knowledge that is required to teach with technology.

From a pedagogical perspective, the results of this survey indicated a consistently traditional orientation to teaching, guided by a teacher-centred delivery model, despite the fact that one of the major affordances of technology for teaching was to facilitate and promote constructivist teaching and learning approaches. This survey finding illustrates a continuing problem that despite barriers to technology integration many teachers are not effectively
incorporating technology nor embracing it in pedagogically defensible ways. E-learning appears to have failed with many teachers and students finding that its main purpose is to provide information (Hedberg, 2006).

A number of researchers have sought explanations for this problem; these studies will be discussed in the literature review. There is pressure on VET practitioners to develop their own skills and that of their students, to increase participation in training and to prepare graduates for the workplace in innovative ways using new learning technologies. This requires a significant paradigm shift in current VET practices. However, it remains unclear the extent to which VET teachers’ pedagogical and epistemological beliefs influence teachers’ decisions to integrate technology. For that reason, this research aims to explore VET teachers’ technology, pedagogy and content knowledge and in relation to their belief systems.

**Purpose Statement**

Research indicates that teachers’ beliefs predict, reflect, and determine their actual teaching practice (Kagan, 1992; Pajares, 1992; Hofer & Pintrich (1997). Using the TPACK framework as a lens through which to understand teaching with technology, this study examines the correspondence between VET teachers’ epistemological and pedagogical beliefs and the way technology is integrated into their practices.

**Research Questions**

These five research questions were designed to provide a more accurate picture of the influences on the decisions teachers make about integrating technology into their teaching practices:

1. How do VET teachers perceive their knowledge in relation to technology, pedagogy and content?
2. How do VET teachers’ epistemological and pedagogical beliefs relate to their beliefs about teaching and about teaching with technology?
3. What are the characteristics of VET teachers’ technology use?
4. How do VET teachers’ attitudes towards technology shape their teaching practices?
5. How useful is the TPACK framework for understanding VET teachers’ technology integration practices?

Significance of the Study

Across educational sectors, teachers play a key role in helping students to prepare to become digitally competent in today’s global world (Archambault & Crippen, 2009; Fransson & Homberg, 2012). Since teachers were identified in the research as contributing to the ways technology is, or is not being used, they serve a vital role in preparing students for the workplace. The outcomes of this study may provide some insight into how to improve the Certificate IV in Training and Assessment. Thus it will prepare VET teachers more effectively for teaching in a potentially globally diverse market.

To date, there is a paucity of research on how VET teachers’ beliefs influence their teaching practices and thus their decision to integrate technology into their courses. The study is one of very few which have applied the TPACK framework to teachers in the vocational sector. As discussed in Chapter Two, the TPACK has been used internationally for a multitude of purposes and in a range of contexts. As this study is set in a regional VET institute, it is an ideal site to examine teachers’ knowledge and beliefs so that they meet the needs of diverse learners in remote and regional contexts. Moreover, there is little evidence of research undertaken in Australia that examines teachers’ pedagogical and epistemological beliefs alongside their TPACK. Combined, these are factors which may constrain teachers’ use of technology in teaching.

Organisation of Thesis

The thesis is divided into seven chapters, including this chapter. Chapter Two presents a review of the literature. Firstly, it identifies the barriers faced by teachers as they begin to integrate technology into their teaching practices. Teachers’ knowledge about teaching with technology and their beliefs about doing so are identified as significant barriers. The TPACK framework, as developed by Mishra and Koehler (2006), is presented as the theoretical framework for the study. The framework is described and then defined in relation to the
knowledge vocational teachers need. The literature is then reviewed in relation to beliefs about technology, pedagogy, epistemology and self-efficacy. Within these beliefs, constructivism is presented as a key pedagogical referent in which to frame teachers’ technology practices.

Chapter Three outlines the research methods of the study. The chapter starts with a review of the theoretical basis for the data collection techniques and then discusses the pragmatic research paradigm. This chapter also presents the research design, the data sources, data collection and data analysis. The chapter concludes with an overview of the trustworthiness of the research from the perspective of a mixed-methods design. It includes an acknowledgement of bias, the limitations of the research and some ethical considerations.

Chapter Four presents the findings of both the TPACK survey and the interview. The first phase of the research presents survey results by TPACK domain and survey results by TPACK item. The second phase presents the interview findings of (a) teachers’ beliefs as they relate to teaching and teaching with technology, (b) characteristics of teachers’ technology use and (c) teachers’ attitudes about their use of technology in relation to their teaching practices. This chapter answers the first research question.

Chapter Five provides a detailed discussion of the findings relating to teachers’ beliefs and knowledge. It is divided into three sections, each containing an assertion with supporting evidence from the survey and the semi-structured interviews. The first assertion (Assertion One) describes teachers’ epistemological and pedagogical beliefs and their relation to technology. The second assertion (Assertion Two) describes the value teachers place on the constructivist affordances of technology. These two assertions answer the second research question. The third assertion (Assertion Three) addresses the ways teachers used technology and the reasons why they were using technology. This assertion answers research question three.

Chapter Six presents the findings related to the way teachers’ attitudes towards technology shape their teaching practices. This chapter is also divided into three sections, each containing an assertion with supporting evidence from the survey and the semi-structured interviews. The first assertion in this chapter (Assertion Four) describes the reasons behind teachers’ attitudes towards technology and their intentions to develop technological knowledge
in the future. The second assertion in this chapter (Assertion Five) emerged as a theme for which there was substantial evidence. It is therefore presented to create a connection between teachers’ attitudes and their understanding of technology and its function in teachers’ practices. Assertions Four and Five answer research question four. The third assertion in this chapter (Assertion Six) addresses the usefulness of the TPACK framework for understanding how teachers teach with technology. This assertion answers research question five. Table 1.1 represents a summary of the relationship between the research questions and the assertions.
Table 1.1

The Relationship between the Research Questions and the Assertions

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Assertion</th>
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<tr>
<td>1. How do VET teachers perceive their knowledge in relation to technology, pedagogy and content?</td>
<td>Chapter Four</td>
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</tbody>
</table>
| 2. How do VET teachers’ epistemological and pedagogical beliefs relate to their beliefs about teaching and about teaching with technology? | Assertion One: VET teachers expressed traditional, transmissive beliefs about teaching, learning and knowledge.  
Assertion Two: VET teachers valued the constructivist affordances of technology but lacked the means to harness its potential to transform their teaching practice. |
| 3. What are the characteristics of VET teachers’ technology use?                  | Assertion Three: VET teachers used technology to support traditional teaching practices. |
| 4. How do VET teachers’ attitudes towards technology shape their teaching practices? | Assertion Four: VET teachers expressed positive attitudes towards technology. Teachers’ intentions to develop technology knowledge for personal and professional purposes were of greater importance than their intentions to develop and transform pedagogical knowledge.  
Assertion Five: VET teachers’ technology use was largely shaped by their perceptions of students. |
| 5. How useful is the TPACK framework for understanding VET teachers’ technology integration practices? | Assertion Six: TPACK is a useful framework for understanding how teachers teach with technology. However, applying it to VET teachers’ practices requires significant change. |

The final chapter (Chapter Seven) summarises the findings of the research questions and draws together the components to answer the overarching research question. That is, why has there been a relatively slow uptake of educational technology by a group of vocational teachers in regional Australia? Implications for vocational teachers, teacher education programs and professional development are then presented. A modified TPACK model is proposed to address the implications of the research with recommendations for applying the model.
Chapter Two: A Review of the Literature

Chapter Overview

This chapter reviews existing research about vocational teachers’ knowledge, beliefs and attitudes about teaching with technology. Its purpose is to situate the research within an existing body of knowledge and to provide a context for the subsequent chapters. Where possible, the literature review focuses on empirical studies that involve vocational teachers. However, there are limited research studies that fit these criteria and therefore insights are drawn from a wider scope of studies drawing out key themes that are perceived to have relevance for the study. Firstly, barriers to technology integration into teaching in the vocational sector will be reviewed. Secondly, TPACK will be presented as the conceptual framework for examining VET teachers’ knowledge. Where limitations in the framework are found, the literature is reviewed to provide a more comprehensive understanding of ways to address these limitations. Finally, there is a review of the literature relating to teachers’ beliefs about epistemology and pedagogy, technology and self-efficacy.

Barriers to Technology Integration

From both a research and practical perspective, the need for teachers to develop technological knowledge has become part of the educational landscape. Although knowledge about technology is deemed essential, teachers’ lacklustre efforts to integrate technology into their practice have become a cause for concern (Paryono & Quito, 2010). Two sets of barriers are often discussed in an attempt to understand the uptake and implementation of technology into teaching practice (Ertmer, 1999, 2005; Hew & Brush, 2007): external and internal barriers.

The external barriers commonly reported are: access to computer and internet resources (Hew & Brush 2007; Lowther, Inan, Strahl & Ross, 2008; Marsden & Piggott-Irvine 2012; Marwan & Sweeney, 2010); teacher knowledge and skills (Babic, 2012; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012; Hew & Brush 2007; Kilpatrick & Bound, 2003; Lawless and Pellegrino, 2007; Lowther, Inan, Strahl & Ross, 2008; Yurdakul, Odabasi, Kilicer, ...
Coklar, Birinci & Kurt, 2012); institutional constraints (Ertmer & Ottenbreit-Leftwich, 2010; Hew & Brush 2007; Kilpatrick & Bound, 2003; Lawrence & Lentle-Keenan, 2013; Liu, 2011; Lowther et al., 2008; Somekh, 2008) and curriculum (Chai, 2010; Hechter & Vermette, 2013; Orlando, 2013). Hechter and Vermette (2013), for example, reported that while technological infrastructure has developed considerably, many regions throughout the world are still relying on substandard and intermittent technological systems and are therefore trying to overcome first-order barriers. As these barriers gradually diminish, the focus turns towards internal barriers. These barriers are often harder to change (Ertmer, Addison, Lane, Ross, & Woods, 1999).

Internal barriers relate to constraints including mainly teachers’ attitudes and beliefs (Abbitt, 2011; Albion & Ertmer, 2002; Angeli & Valanides, 2009; Bai & Ertmer, 2008; Bound, 2011; Chen, 2008; Cuban, 1993; Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hew & Brush 2007; Kilpatrick & Bound, 2003; Liu, 2011; Pajares, 1992; Palak & Walls, 2009; Park & Ertmer, 2008; Toner, 2005; Windschitl & Sahl, 2002). As these barriers are teacher-specific and often more difficult to address, they are worthy of further study to understand why teachers differ in their use of technology.

**Barriers to Technology Integration in the Vocational Sector**

Within the vocational sector, nationally and internationally, barriers to technology integration have tended more towards organisational factors and insufficient teacher knowledge.

**Organisational support.** The level of organisational support and strategic direction appear to be key determinants of teachers’ decisions to use technology. Mars and Ginter (2007) explored the organisational environment of three community colleges in the United States to investigate the emphasis placed on technology-based instruction. Considerable variation in the range of technologies used produced inconsistent staff uptake. One of the colleges with well-developed policies, practices and strategies, staff incentives and professional development opportunities was viewed as more successful because technology was central to its core business. Holt and Challis’ (2007) study of strategic changes that were made to implement an
online learning policy in an Australian university also reported that having an organisational strategic direction did not necessarily bring about the desired outcomes. As Salomon (2002) warns, technology that has been forced onto existing teacher practices can often result in domesticated and trivialized uses that are subservient to current pedagogies.

**Teacher Knowledge.** Findings from a study of 400 vocational teachers in Cyprus revealed a significant digital gap that impacted upon teachers’ ability to adequately prepare students for learning and work in the knowledge society (Uzunboylu & Tuncay, 2010). A comparison of research findings on technology integration in vocational education institutions from six Southeast Asian countries (Brunei, Indonesia, Lao PDR, Malaysia, Philippines, Thailand, and Vietnam) was undertaken (Paryono & Quito, 2010). Based on quantitative research carried out by the Southeast Asia Vocational Education Research Network (SEAVERN) in 2009/2010, teachers’ insufficient technological pedagogical knowledge was a contributing factor to the ineffective use of technology despite the support from teachers, administrators and government.

In the following studies, technology use did not equate to effective teaching with technology. Marsden and Piggot-Irvine’s (2012) study in the New Zealand VET context implemented blogging and use of laptop computers to improve writing skills in an automotive trades’ course. From the findings, Marsden and Piggot-Irvine recommended that teachers play a more active role in embedding Web 2.0 technology in vocational classes. They reported that few teachers had the skills and the confidence to deliver courses using Web 2.0 technology. Similarly, Fletcher, Djajalaksana and Eison’s (2012) study of career and technical education teachers in the United States found that technology was used to support traditional pedagogical approaches and that there was little use of Web 2.0 technologies. A study of 416 vocational teachers in Turkey found that ICT was used more frequently for managerial purposes than for learning purposes (Kuskaya & Kocak, 2010) suggesting that teachers were not able to integrate technology into their teaching and therefore needed to develop new technical and pedagogical skills to teach with technology effectively. Having technology knowledge and skills alone does not guarantee effective adoption of technology into teaching practice.
Marwan’s (2008) study of ten business teachers in an Indonesian polytechnic investigated the factors that supported and constrained the use of educational technology. Their interview finding supported research from Western countries confirming that multiple factors exerted a significant influence on the ways in which technology was used to support teaching. Teachers’ use of technology was found to support teachers’ traditional teaching practices, such as enabling more effective administrative practices, more so than it did enabling constructivist teaching. However, the teachers in the study were from the Business Department possibly indicating a narrow focus on the specific teaching of computer technology skills to prepare them for their vocation. Although their research did not use TPACK, they recommended the development of it.

Kilpatrick and Bound (2003) identified the absence of VET teachers’ technological pedagogical knowledge in regional Australia. Although they did not use, or refer to TPACK, they explored the benefits and barriers of online learning. They found that lack of an institutional culture of online learning to support online pedagogy as well teachers’ limited technological pedagogical knowledge were the main barriers. They suggested developing teachers’ technical pedagogical content knowledge. In another Australian study, 81 vocational teachers’ conceptions of blended learning were examined (Bliuc, Casey, Bachfischer, Goodyear & Ellis, 2012). The term ‘blended learning’ was described ‘as the systematic integration of learning in face-to-face and online situations within the same course’ (p. 238). Findings indicated a correlation between teachers who expressed traditional teacher-centred pedagogical approaches and teachers who expressed student-centred pedagogies and their use of blended learning approaches. As their study relied on quantitative data alone, it may not have provided sufficient data on teachers’ actual technology use or their beliefs about technology in teaching and learning.

Salter and Bound’s (2009) study of 14 Australian vocational trade teachers and their managers used a profiling instrument to gather data about teachers’ pedagogical beliefs, their technology knowledge and their confidence using technology. While technology was relatively novel to many of the teachers, they felt positive about its potential to teach procedural and
theoretical knowledge, to enable students to master skills and to promote autonomous learning. The authors concluded that although constructivist learning principles have been promoted in the VET sector, there was a tendency by the teachers to adopt a teaching practice grounded in transmissive pedagogy. Despite the professional development provided as well as the intensive support offered, teachers had some difficulty adopting a constructivist approach. Salter and Bound (2009) acknowledged inconsistencies between teachers’ espoused and actual practice and suggested that teachers’ core beliefs about teaching, learning and knowing require further study.

Brennan, Horton, McNickle, Osborne and Scholten (2003) noted the same inconsistency in their study of the assumptions and practices underpinning the online delivery of vocational education across Australia. Their findings revealed that the way teachers and students perceived best online practice were similar. They both agreed that features of this practice were characterised by a student-centred, constructivist approach to learning. However, teachers’ actual practices in online delivery did not necessarily reflect their espoused practice.

There is little doubt that the introduction of technology into teachers’ practices creates assumptions about the nature of knowledge and the teacher’s role in it (Brennan et al., 2003). As Callan and Fergusson (2009) reported, one of the major barriers to developing innovative pedagogies was the pressure on teachers to change their established teaching practices. It would appear then that a significant barrier might be insufficient pedagogical knowledge, or when technology is introduced, technological pedagogical knowledge. Therefore, there is a pressing need for the implementation and development of theoretical models to support vocational teachers’ professional development in order to challenge such fundamentally entrenched beliefs.

One prominent researcher in the VET landscape reported on a survey of the factors that influenced Australian VET teachers’ use of technology (Robertson, 2007). In his study, 138 vocational teachers were drawn from the Australian Flexible Learning Framework’s Community Forum to compare the use of 21 online functionalities. Robertson’s (2007) findings noted that the longer a technology has been available and the simpler it is, the more likely it will be used. Newness of the technology, and the complexity involved in using that technology did
not constrain its use if it was compatible with teachers’ practices and their needs. Further, evidence was presented to suggest that technologies that supported teacher-centred practice were more likely to be used than technologies that supported student-centred practice. According to Robertson (2007), both curriculum and teachers’ pedagogical beliefs influenced teachers’ pedagogical approaches.

In the New Zealand higher education context, Lawrence and Lentle-Keenan (2013) examined the relationship between teaching beliefs and practices, institutional constraints, and teachers’ uptake of Web-based technology for teaching in higher education. Findings indicated that teachers who saw alignment between technology and their teaching beliefs seemed to embrace technology more enthusiastically than those who did not subscribe to the view that there was a clear pedagogical imperative for using technology as a teaching tool. In their study, pressure from the institution to use a learning management system, regardless of the pedagogical changes required to teach with technology was reported to be a concern.

The need for VET teachers to develop TPACK has never been more pressing. The studies reported above indicate that teachers may lack sufficient knowledge to teach with technology, thus presenting a significant barrier to how teachers might integrate technology.

**TPACK Origins**

Shulman (1987) argued that the most central component of teacher knowledge is the construct Pedagogical Content Knowledge (PCK). This knowledge differentiates the teacher from the expert. TPACK has since emerged as the amalgam of PCK and technology (Angeli & Valanides, 2009). Mishra and Koehler (2006) introduced the term technological pedagogical (and) content knowledge (TPCK) to describe the knowledge teachers need to effectively teach with technology. References to the concept of TPCK had been previously developed (Angeli & Valanides 2005; Niess, 2005; Pierson, 2001) all of which derived from Shulman’s (1987) work on pedagogical content knowledge (PCK).
Figure 2.1 presents the TPACK framework (Mishra & Koehler, 2006). It illustrates the connection between three main teaching components: pedagogy (knowledge of how to teach), content (knowledge of the subject matter) and technology (knowledge of the tools and their application). Mishra and Koehler (2006) argued that TPACK was a unique body of knowledge constructed from the intersection of these knowledge bases. The innermost part of the diagram represents TPACK, the specific knowledge required to teach with technology. While the TPACK model is not necessarily based on a constructivist paradigm, the technology component implies constructivist affordances.

As a framework for teacher knowledge, TPACK is critical for effective technology integration in that it highlights technology integration as requiring more than technical skills (An & Reigeluth, 2012; Sahin, 2011). The framework transcends these three components to include blends: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content
knowledge (TPCK) in addition to content knowledge (CK), pedagogical knowledge (PK) and technological knowledge (TK).

**Domain Definitions and their Application in the VET Sector**

Pedagogical knowledge refers to teachers’ knowledge about the processes of teaching and learning (with or without technology) and how it is realised to achieve educational purposes, values, and aims. A teacher with ‘deep pedagogical knowledge understands how students construct knowledge, acquire skills and develop habits of mind and positive dispositions toward learning’ (Mishra & Koehler, 2006, p. 1026-27).

The need to strengthen VET pedagogical practices has emerged for several key reasons. As the VET sector is called upon to deliver more ambitious government objectives, the need for more complex pedagogies to address the needs of diverse students from various backgrounds is paramount (Guthrie, Perkins & Nguyen, 2006; Wheelahan, 2010). The vocational sector’s close association with the workplace makes it more complex than academic teaching in that it involves working with multiple clients, in multiple contexts and across multiple learning sites. The VET teacher’s role has therefore extended to developing industry partnerships and working collaboratively with specialist service providers.

The nature of training packages, (the curriculum upon which VET teachers rely) requires teachers to contextualise sets of competency standards and apply these to the many contexts in which VET takes place (Mitchell, Chapman, Bateman & Roy, 2008). For teachers, there is as much responsibility as ever to decide what to teach, when and how to teach it (Hager, 2004). Guthrie (2009) however, expresses concern that VET teachers may lack the pedagogical knowledge needed to deliver effective training, assessment and workplace learning to work with such diversity as each of the contexts warrants different pedagogies. For example, teaching disengaged and disadvantaged students calls for higher level pedagogical knowledge and skills that teachers (experts from industry) may not have. This is despite the impression that there is little expectation when teachers are recruited as VET teachers that they will have more than content knowledge (Cornford, 1999).
Pressures to transform VET practice to better reflect the constructivist and social nature of the workplace means adapting existing teaching practices to become more learner-centred and aligned with constructive learning theories rather than transmissive learning theories. Both Darwin (2004) and Hodge (2009) argued that the base qualification for VET practitioners in Australia places little emphasis on constructivist learning theory and principles. The emphasis on overt and covert behaviourism within the course is reinforced by the fact that behaviourist principles are embedded in the VET system as an institution through competency-based training (CBT).

For McLoughlin and Lee (2008), the workplace is inherently ‘constructivist’ in that much of the learning takes place through guided and supported interaction in social settings. It provides students with active and authentic learning experiences, allowing them to construct new ideas and concepts based on tasks assigned and located within communities of practice (Lave & Wenger, 1991). On its own, the traditional teacher-centred pedagogical model in which knowledge is transmitted from the teacher to the student is not sustainable at a time when constructivist theory has become the main source of understanding contemporary teaching and learning practices. Adopting constructivist pedagogy focuses on the active construction of meaning by the student, thus there is the need to anchor learning in real-world or authentic contexts that make learning meaningful and purposeful (Herrington, Oliver & Reeves, 2003). The development of pedagogical knowledge is therefore critical for VET teachers. Not only is this knowledge required for teaching in diverse contexts, it is also required to teach effectively with technology.

Content knowledge is knowledge about what is being taught; the central facts, concepts, theories and procedures within a given field (Shulman, 1986). It is knowledge teachers bring to their work, their subject-expertise, their trade, knowledge and skills from their industry. It is independent of any pedagogical activities or any methods or strategies used in their teaching (Cox, 2008; Shulman, 1986). Teachers, who know their discipline well, think within it and apply it to real life situations. That which constitutes content knowledge changes from sector to sector (Fransson & Holmberg, 2012).
Teachers are recruited to the VET sector based on their content knowledge. It is assumed that teachers begin their teaching career with rich content knowledge of a particular trade or vocation bringing with them knowledge of the tools and the technology of that industry. Their content knowledge is often highly specialised vocational knowledge. Changes to the industry over time, signal the importance for VET teachers to regularly update their content knowledge (Toner, 2005; Wheelahan & Moodie, 2010). Many teachers may not have this required knowledge if they have been removed from that industry for many years (Cornford, 1999). Therefore, there is a pressing need for VET teachers to develop industry currency and apply this updated knowledge to their teaching (Corbel, 2013).

Teachers’ content knowledge (for industry) and teachers’ content knowledge (for teaching) presents certain pedagogical challenges specific to the VET teacher. It requires the VET teacher to re-contextualise their implicit content knowledge into explicit knowledge forms so that it can be taught (Robertson, 2010). According to Salter and Bound (2009), research on content knowledge in the VET sector is limited. While the TPACK model acknowledges the importance of content knowledge, the heavy involvement of industry in the VET sector may generate considerable epistemological debate as to who determines the content that is to be taught.

Technology knowledge will always be a moving target (Hofer & Swan, 2008). Yet it is the knowledge all teachers need for meaningful teaching and learning in the 21st century. Attempts to define this particular domain have created some debate (Voogt, Fisser, Pareja Roblin, Tondeur & van Braak, 2013). Mishra and Koehler’s (2006) original definition described it as knowledge about standard technologies and included books, chalk and blackboard as well as more advanced technologies such as the internet and digital video. They noted that this includes ‘the ability to learn and adapt to new technologies (irrespective of what the specific technologies are) will still be important’ (p. 1027-1028).

As most technologies are not developed for teaching or educational purposes, the teacher’s role is to repurpose them for educational purposes (Koehler, Mishra, Kereluik, Shin & Graham, 2014). Others have argued that to include traditional forms of technology as
technological knowledge (see Schmidt et al., 2009) clouds the focus (Chai et al., 2013). Others confine technological knowledge to computers as more appropriate and meaningful (see Cox & Graham, 2009). In the VET sector, the definition of technology needs to be expanded to include specific technology which refers to equipment and machines which are used to perform certain tasks in the workplace (Guthrie et al., 2009).

Among the various definitions, the most convincing is that forwarded by Finger, Jamieson-Proctor and Albion (2010). They described it as ‘a measure of competence with current digital technologies that affords individuals the ability to achieve both personal and professional goals with the available technologies’ (p. 11). This definition of technological knowledge closely approximates the need for knowledge of workplace technologies; however, this is not assumed by their definition. Therefore, there is a need to develop a model of TPACK to reflect domain definitions for the VET sector.

In VET, the process of learning, as opposed to the process of assessment, receives very little attention in policy discourse (Hodge, 2009). The process of learning with technology receives even less. As discussed in Chapter One, the need for VET teachers to develop technology knowledge is compelling. As the sector transitions from a manufacturing-based economy to a knowledge-based economy, new pedagogies are required (Bereiter & Scardamalia, 2006). In competitive, global markets, industries need skilled and knowledgeable workers to compete effectively (Figgis, 2007). New ways of teaching and thinking are needed, both of which depend on the development of higher-order thinking, problem solving and collaboration (Darwin, 2004; Dirkx et al., 2004; Doolittle & Camp, 1999; Robertson, 2009).

Technological resources are part of both the knowledge society and the knowledge economy, and are thus woven into established patterns of communication. The advent of information and computer technology has meant that the traditional pedagogical model of transmitting skills and knowledge is no longer valid and sustainable. The development of alternative pedagogies is therefore necessary in the VET sector, particularly in the move to offer more flexible forms of delivery. Clearly, then, there is a need to develop all three types of teacher knowledge and their intersections as represented by the TPACK model.
Research in the Malaysian Technical Vocational Education and Training (TVET) sector provides compelling evidence of the need for workers with high-level technology skills. Saud, Shu’aibu, Yahaya and Yasin (2011) viewed technology as a powerful medium to transform manual, skills-based work in developing countries to a technology-based workforce. They described technology education as, ‘one of the most distinguished fields of education from the Stone Age to the present era of industrial development’ in the way it develops infrastructure, industry, human and material resources (p. 6669).

The importance of technological knowledge for teachers and students in the Australian VET sector has remained largely undermined by government policy. Callan and Fergusson (2009) provided a glimpse at some of the projects funded by an earlier iteration of the Australian Flexible Learning Framework Strategy (2008-2011). In their study, they noted that the ongoing funding and support provided by the Australian Flexible Learning Framework was not consistent across the sector. Additionally, in their study, interviews with 21 key stakeholders revealed that while there are expectations from students for constructivist learning using technology, the actual drivers for innovative practice appear to have come from government and industry.

Pedagogical content knowledge is a blend of content and pedagogical knowledge. It ‘represents the blending of content and pedagogy into an understanding of how particular aspects of subject matter are organized, adapted, and represented for instruction’ (Mishra & Koehler, 2006, p. 1021). This knowledge includes ‘knowing how elements of the content can be arranged for better teaching’ (p. 1027). It is different from content knowledge and pedagogical knowledge, in that it is ‘concerned with the representation and formulation of concepts, pedagogical techniques, and knowledge of what makes concepts difficult or easy to learn, knowledge of students’ prior knowledge, and theories of epistemology’ (Mishra & Koehler, 2006, p. 1027). Pedagogical content knowledge emphasises the importance of teachers knowing about student learning and their environment (Fives & Buehl, 2008).

For Wheelahan (2010), content knowledge alone is no longer sufficient to work as a VET teacher. Teachers also need the pedagogical knowledge to teach the content. A recent
report into the quality of teaching in VET recommended the commissioning of research into the development of pedagogical content knowledge in different fields or disciplines to develop a distinct VET pedagogy (Wheelahan & Moodie, 2010).

Both Wheelahan (2010) and Robertson (2010) address the need for teachers to have strong pedagogical content knowledge. The calls have come from a renewed focus on the quality of VET teachers. In the case of Robertson (2008), findings from analyses of the Certificate IV in Training and Assessment and the Diploma in Vocational Education and Training qualifications, noted that pedagogical content knowledge develops over a period of time, through experience and reflection. It is possible also that this knowledge can be taught. Wheelahan (2010) proposed a model where all VET teachers receive the same preparation to teach:

All teachers need general pedagogic knowledge, knowledge about constructing curriculum, knowledge of their specialist area (content knowledge), knowledge of students and their characteristics, and of educational contexts and the broader social purposes of learning…. they also need specialist pedagogic content knowledge, which is knowledge about how to teach in their content area, and support to deepen the underpinning knowledge of their content area. (p. 10)

Robertson, likewise, addresses the knowledge base required for VET teacher education programs (Robertson, 2010). These are: subject and learners; curriculum, educational contexts, purposes and ends; general pedagogic knowledge; beliefs about subject, teaching and self; and pedagogical content knowledge.

Neither Wheelahan (2010) nor Robertson (2010) stated the importance of technological knowledge as important knowledge for VET teachers. It is possible that this knowledge is subsumed by pedagogical knowledge and perceived rather as a teaching resource, than a type of knowledge. By largely downplaying the role of technology in these descriptions of the kind of knowledge VET teachers need, raises the question as to whether such knowledge exists independently of pedagogy and content.
Technological pedagogical knowledge is the knowledge that teaching and learning changes when technology is applied, transforming the technology so as to teach with it. For Ferdig (2006), good technological pedagogical knowledge means using innovations that are steeped in good pedagogy. This might include an understanding that a ‘range of tools exist for a particular task, 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. 1029).

Technological content knowledge is knowledge about the manner in which technology and content are reciprocally related. ‘Although technology constrains the kinds of representations possible, newer technologies often afford newer and more varied representations and greater flexibility in navigating across these representations’ (Mishra & Koehler, 2006, p. 1028). Teachers, therefore, need to have the knowledge that the content knowledge they teach can be changed by the application of technology. Knowing content is critical but knowing how to enhance it with technology is even more so.

Technological pedagogical content knowledge is the core of the model and recognises that content-based educational technologies must be pedagogically sound (Ferdig, 2006). Essentially, TPACK is the basis of good teaching with technology (Mishra & Koehler, 2006). They argue that quality teaching requires a nuanced understanding of the complex interplay between technology, pedagogy, and content as well as the knowledge of how they play out in specific contexts (Mishra & Koehler, 2006; Koehler & Mishra, 2008).

**How Does The TPACK Framework Assist This Research?**

The TPACK framework has been used to explore the multiple ways to understand and assess teachers’ knowledge for technology integration (Hofer, Grandgenett, Harris & Swan, 2011). However, TPACK cannot be seen as the ‘proverbial panacea’ (Archambault & Barnett, 2010, p. 1657) for addressing the challenges of teaching with technology. It merely provides a framework for understanding how the three components of teaching knowledge need to sit, or what teachers need to work towards. The framework offers the potential for VET teachers to
transform pedagogy and content by leveraging the affordance of the Web 2.0 and digital technology.

Teacher preparation programs are often held accountable for failing to adequately prepare teachers to establish pedagogical connections between the pedagogy and the technology (Angeli & Valanides, 2009; Finger, Jamieson-Proctor & Albion, 2010; Lee, Tsang & Chang, 2008). There is extended research evidence that TPACK allows teachers and teacher educators to focus upon the connections among technology, content, and pedagogy as they correlate in real instructional-classroom contexts (Koehler & Mishra, 2009; So & Kim, 2009; Doering, Veletsianos, Scharber, & Miller, 2009; Lee & Tsai, 2009; Jimoyiannis, 2010).

**TPACK derivatives.** The universal significance of the TPACK framework as an instrument to examine specific uses of technology is manifested in a range of derivatives that have emerged over the last decade. For example, Angeli and Valanides (2009) used the term ICT-TPCK to indicate the importance of ICT; Lee & Tsai, (2010) used TPCK-W to focus on web technologies; Doehring & Veletsianos (2007) used G-TPACK as a specific content based model using geospatial technologies; Finger, Jamieson-Proctor and Albion’s (2010) Australian study adapted TPACK to audit teachers’ use of ICT by using the Teaching With ICT Audit Survey (TictAS). Jimoyiannis (2010) developed the TPASK framework for science education. TPACK 2.0 became a revised version of TPACK for use with Web 2.0 (Jimoyiannis et al., 2013). More recently, C-TPACK was coined to reflect a constructivist orientation (Koh, Chai & Tsai, 2014).

The framing of other constructs such as self-efficacy (Abbitt, 2011; Finger, Jamieson-Proctor & Albion, 2010; Graham, Burgoyne, Cantrell, Smith, St Clair & Harris, 2009) and epistemology (Chai, 2010; Kim, Kim, Lee, Spector & DeMeester, 2013; Tsai et al., 2013) has ensured the continued proliferation of TPACK theory. It would seem that there is vast potential to develop a model specifically for the VET sector, one which would reflect the nuances of teachers’ knowledge and beliefs and the complexities of the workplace for which VET students are groomed.
TPACK applications. In recent years, TPACK has become an internationally accepted conceptual model and guiding framework for teachers and teacher educators (See for example: Chai et al., 2013; Cox & Graham, 2009; Harris, Mishra, & Koehler, 2009; Jang & Tsai, 2012; Messina & Tabone, 2012; Pierson & Borthwick, 2010). The majority of the research undertaken derives from the United States (Jordan & Dinh, 2012) predominantly with pre-service teachers, although its application is evident across a vast geographical area in teacher training programs. For example: the United States (Abbitt, 2011; Graham, Borup & Smith, 2012; Schmidt, Baran, Thompson, Mishra, Koehler & Sahin, 2009; Brush & Saye, 2009; Ozgun-Koca, Meagher & Edwards, 2009); Kuwait (Alayyar, Fisser, & Voogt, 2012); Asia (Chai, Koh & Tsai, 2013); Turkey (Sahin, 2011; Yurdakul, Odabasi, Kilicer, Coklar, Birinci & Kurt, 2012); Ghana (Agyei & Voogt, 2012); Singapore (So & Kim, 2009; Chai et al., 2010; Chai, Koh, Ho, & Tsai, 2012); Finland (Valtonen, Pontinen, Kukkonen, Dillon, Väisänen & Hacklin, 2011); and Australia (Finger, Jamieson-Proctor & Albion, 2010; Holmes, 2009; Jamieson-Proctor, Albion, Finger, Cavanagh, Fitzgerald, Bond, & Grimbeek, 2013; Lloyd, M. (2013). Examples of TPACK studies with beginning teachers have been less common: Australia (Bates & Maor, 2010; Jordan, 2011) and Sweden (Fransson & Holmberg, 2012).

TPACK studies with practicing teachers in K-12 schools are also universal in appeal. Research has been reported from: Canada (Hechter & Vermette, 2013); Greece (Jimoyiannis et al., 2013); Italy (Messina & Tabone, 2012); Norway (Engelien, Giæver, Johannesen, Klevenberg, Knain & Nore, 2009); Finland (Valtonen et al., 2011); and the United States (Archambault & Crippen, 2009; Archambault & Barnett, 2010). Examples of research specific to the primary school sector include: Taiwan (Liu, 2011); United States (Bos, 2011; Graham et al., 2009) and Ethiopia (Getenet, Beswick & Callingham, 2014).

Research from the secondary school sector is more limited and has tended to focus on developing subject specific TPACK applications in a few subjects: science (Guzey & Roehrig, 2009); Jang & Tsai, 2013; Jimoyiannis, 2010); social studies (Hammond & Manfra, 2009b; Harris & Hofer, 2011; Niyomsap, Thongthew, & Rodpoothong, 2013); maths (Niess et al., 2009); geography (Doering & Veletsianos, 2008) and engineering (Nicholas & Ng, 2010). As Chai et
al. (2013) recommend, more studies in other content areas are needed, particularly subject specific technologies which tend to be more evident in some areas than others (Voogt et al., 2013).

Research on TPACK in higher education and university is less common (Anderson, Barham & Northcote, 2013). Examples of studies include: Australia (Finger, Jamieson-Proctor & Albion, 2010; Anderson et al., 2013; Maor & Roberts, 2011; Maor, 2013; Lock & Redmond, 2010); Turkey (Alsofyani, bin Aris, Eynon, & Abdul, 2012); Vietnam (Peerar & Van Petegem, 2012); United Kingdom (Kinchin, 2012); United States (Archambault, Wetzel & Foulger, 2010; Koehler, Mishra, Bouck, DeSchryver, Kereluik & Shin, 2011; Koehler, Mishra & Yahya, 2007) and The Netherlands (Rienties, Brouwer, & Lygo-Baker, 2013).

According to Anderson et al. (2013), the TPACK framework, ‘through its use across diverse settings represents a method by which themes, consistencies and discrepancies can be identified in a set of data to determine evidence of the teacher knowledge held (p. 551). With this data, one of the most common purposes for the application of the TPACK framework has been for the design and evaluation of teacher professional development (PD) courses.

The framework has been useful in identifying and addressing professional development needs as it integrates technology with the pedagogy and content rather than seeing it as being taught in isolation. (See for example; Angeli & Valanides, 2009; Archambault, Wetzel, Foulger, & Williams, 2010; Chai et al., 2013; Jang, 2010; Jimoyiannis, 2010; Mishra & Koehler, 2006; Tee & Lee, 2011; Yurdakul et al., 2012).

The TPACK framework has been the catalyst for research surrounding the problem of teaching technology in isolation from the subjects that are taught and the ways they are taught (Chai et al., 2013). Training teachers solely on how to use a specific technology is not likely to improve the practice of teaching and learning (Lock & Redmond, 2010; Mishra & Koehler, 2005; So & Kim, 2009; Tee & Lee, 2011). Many argue that teachers’ integrative knowledge of technology, pedagogy, and content (that goes beyond specific technology skills) should be emphasised in teacher professional development (e. g., Niess, 2005; Polly, McGee, & Sullivan, 2010).
TPACK and the VET sector. Neither the TPACK framework, nor the dialogue accompanying it, has been used to examine VET teachers’ practice in Australia, yet it presents a sufficiently universal framework with which to inform teacher education programs and plan professional development programs. TPACK provides the opportunity to examine the premises upon which teachers’ pedagogical assumptions rest (Messina & Tabone, 2012).

Although teachers’ TPACK is a strong enabler for effective technology integration, it does not explain why teachers use technology differently (Kim et al., 2013); why teachers’ beliefs do not always align with their instructional practices (Chen, 2008; Judson, 2006; Levin & Wadmany, 2006; Lawless & Pellegrino, 2007); and why there are differences between what teachers say or believe and what they do in practice. Enhancing teachers’ TPACK may not be sufficient (Chai et al., 2013; Voogt et al., 2013). A review of 55 peer-reviewed publications found that while there were different understandings of TPACK, it was beliefs about pedagogy and technology that determined whether or not a teacher might teach with technology (Voogt et al., 2013).

Several authors (Chai et al., 2013; Doering et al., 2009) suggest that the TPACK framework be extended to address different perspectives and educational paradigm shifts in other educational environments. Doering et al. (2009) recommend that TPACK be assessed from a range of different perspectives to provide a holistic assessment of TPACK to understand the complexity of the framework and the inconsistency between teachers’ perceptions and their classroom practices. Chen et al. (2013) recommend research which focuses on technological environments based on TPACK. A context such as VET, provides one such perspective. While many studies within the VET sector have explored the uptake and integration of technology, the TPACK framework has not been specifically applied (Alazam, Bakar, Hamzah & Asmiran, 2012; Bound & Salter, 2007; Marwan & Sweeney, 2010; Messina & Tabone, 2012).

Voogt et al. (2013) recommend research that would determine the knowledge base for subject domains to determine specifically the knowledge teachers need and what TPACK would look like. The way in which units of competency are written and the content contained in training packages, developed by Industry Skills Councils would provide this information (that
is, detailed required knowledge and required skills contained in each unit). The stipulated knowledge often makes reference to the required technology knowledge for that subject domain. Therefore, to examine VET teachers’ knowledge, beliefs and practices using this framework might be of value, especially in light of the need for subject-specific knowledge.

**TPACK and teachers’ beliefs.** The TPACK framework supports teachers to move beyond their traditional, pedagogical and epistemological practices towards more constructivist uses of technology in teaching (Chai et al., 2013). Examining teachers’ core beliefs about teaching, learning and knowing about technology may be just as important as they tend to shape their teaching knowledge and practices (Bates & Maor, 2010). A gap in the research reveals that teachers’ beliefs, in general, have received less attention than beliefs associated with technology. Fundamental beliefs about teaching and learning may shed more light on teachers’ technology integration practices than beliefs about the technology itself (Kim et al., 2013). Consistent with a large body of literature emphasising the stable and resistant nature of beliefs, teachers’ beliefs act as a filter through which new knowledge and experience is screened for meaning (Albion & Ertmer 2002; Kagan, 1992, Nespor, 1987; Pajares, 1992). According to Voogt et al. (2013), research on teachers’ TPACK related to beliefs is often discussed from several perspectives: technological beliefs (Niess 2005; Özgün-Koca et al., 2009; Abbitt 2011), self-efficacious beliefs (Abbitt, 2011), epistemological beliefs (Kim et al., 2013; Chai, 2010) and pedagogical beliefs (Niess, 2005; Manfra & Hammond 2008; Valtonen et al. 2006; So & Kim, 2009). These will be discussed in the following sections.

**Beliefs about Technology**

Teachers’ beliefs about technology have been reported as having a critical influence on their practices with technology (Inan & Lowther, 2010; Palak & Walls, 2009; van Braak, Tondeur & Valcke, 2004), in particular, their attitudes towards technology (Kotrlik & Redman, 2009). As technology has infiltrated social and cultural practices, recent research indicates that teachers who hold positive attitudes towards technology (An & Reigeluth, 2001; Chai et al., 2010; Ertmer & Ottenbreit-Leftwich, 2010; Lee, Tsai & Chang, 2008; Marwan & Sweeney,
2010; Orlando, 2013) and demonstrate confidence using it (Chai et al., 2010; Marwan & Sweeney, 2010) have a positive impact on students’ learning (Bebell, Rusell, & O’Dwyer, 2004). In fact as Zhao and Frank (2003) suggest, ‘unless a teacher holds a positive attitude towards technology, it is not likely that he or she will use it in teaching’ (p. 809). These attitudes tend to relate more to teachers’ confidence or self-efficacy in using technology than it does their students. If teachers decide to use technology to support their constructivist practice they do so, not because of the features inherent in the technology, but on the basis of their knowledge and expertise (Dexter, Anderson & Becker, 1999).

Beliefs about Self-efficacy

Teachers’ self-efficacious beliefs have also been found to influence their use of technology (Abbitt, 2011; Ertmer et al., 2010; Kagan, 1992: Windschitl & Sahl, 2002). Self-efficacy refers to the belief in one’s ability to execute a course of action (Bandura, 1997). While self-efficacious beliefs refer to an individuals’ belief in their own ability, vocational self-efficacy refers to individuals’ perceptions of their abilities required for their profession (Sahin, Akturk & Schmidt, 2009). Knowing and understanding what vocational teachers think, believe and do provides a useful starting point for analysis (Marsden and Piggott; 2012). Although this view is supported by numerous studies on teachers’ beliefs and their reportedly high levels of confidence and competence, this is not necessarily translated into pedagogically sound constructivist classroom practice (Finger, Jamieson-Proctor & Albion, 2010; Teo, 2009; Valtonen et al., 2011; Mumtaz, 2000; Bates & Maor, 2010).

For some researchers, teachers’ attitudes and self-efficacious beliefs are the most critical factors for determining whether or not teachers decide to adopt various technologies into their teaching (Inan & Lowther, 2010; van Braak et al., 2004). For example, Russell, Bebell and O’Dwyer (2005) found that the strongest predictor of teachers’ beliefs about technology was the positive impact of technology on student learning. Wachira and Keengwe (2011) found that most teachers in their study were positively disposed to using new tools. They all expressed a willingness to learn more and they expressed confidence to use the tools they were using. These
attitudes and beliefs appear to be closely related to teachers’ pedagogical practice (Kagan, 1992; Nespor, 1987; Pajares, 1992), thus highlighting the importance of self-efficacy in understanding teachers’ decisions about technology in teaching (Ertmer, 2005; Windschitl & Sahl, 2002).

**Beliefs about Epistemology**

Epistemology is a branch of philosophy that deals with the nature of knowledge and knowing. Etymologically, it is the study of knowledge, and how individuals come to know. In this study and elsewhere, understanding beliefs about knowledge and their influence on the teaching process are considered vital for teacher education and professional development programmes (Adams, 2012; Chan & Elliot, 2004; Kim et al., 2013). They are conceived as individuals’ basic assumptions about the nature of knowledge, both one’s own knowledge and that of others’ (Harteis, Gruber & Hertramph, 2010; Hofer & Pintrich, 2002; Schommer, 1990). As teachers often determine what counts as knowledge, they therefore cannot avoid engaging with issues relating to epistemology (Tsai et al., 2013). As noted by one of the few Australian researchers on teachers’ epistemological beliefs, ‘how teachers know can never be separated from the study of what and where teachers know in space and time’ (Adams, 2012, p. 23). Thus, epistemological beliefs may exert a powerful influence over teaching and learning.

Epistemological beliefs are important to this study because they are not normally addressed in vocational education discourses. As these beliefs are often held unconsciously (Jacobson, So, Teo, Lee, Pathak & Lossman, 2010), they are rarely examined (Park & Ertmer, 2008). Therefore, there may be a limited understanding of how these beliefs influence teaching practice. According to Billett (2009), vocational epistemology arises out of experiences of interaction in the social world, shaping how one engages with and learns through work activities, and interactions. Thus, they are more than beliefs because they shape an individuals’ construction of their social subjectivity (Brownlee & Berthelsen, 2006).

**Epistemological theory.** Four theoretical frameworks have been identified in the literature on personal epistemology. These have been conceived as the development of: epistemological thinking (Baxter Magolda, 1992; Perry, 1970), epistemological beliefs
(Schommer, 1990), epistemological theory (Hofer & Pintrich, 1997), or epistemological resources (Hammer & Elby, 2002).

Schommer-Aikens (2004) challenged the developmental perspective, instead proposing a five dimensional epistemic belief system. These dimensions constituted beliefs about the stability of knowledge, the structure of knowledge, the source of knowledge, the speed of learning and the ability to learn. These dimensions were conceptualised along a continuum from naive to sophisticated beliefs. The views ranged from there being one omniscient authority to impart knowledge to the sophisticated position that knowledge is acquired through experience. For example, a teacher who holds naive epistemologies would generally believe that knowledge is simple, clear and specific; it resides in authorities, is certain and unchanging; concepts are learned quickly or not at all; and learning ability is innate and fixed. Conversely, a teacher who holds sophisticated epistemologies along the dimensions might believe that knowledge is complex, uncertain and tentative; that it can be learned gradually through reasoning and that it can be constructed (Schommer, 1994). The assumption is that as individuals progress through education they develop more sophisticated beliefs. For the purposes of this study, sophisticated epistemologies will be herewith referred to as ‘constructivist epistemology’. Naive epistemologies will be referred to as ‘transmissivist epistemologies’.

In an effort to integrate these conceptual frameworks, Hofer (2001) defined epistemology as having four identifiable, interrelated dimensions that develop in reasonable, predictable directions (see also Hofer & Pintrich, 1997). As Hofer (2004) contends, the dimensions between the models proposed are consistent with general agreement about the nature of knowledge (what knowledge is) and the nature of knowing (how we come to know). Schraw and Olafson (2002) referred to these beliefs as teachers’ epistemological worldviews, defined as the collective attitudes of individuals about the nature and learning of knowledge.

Differences in teachers’ epistemological worldviews may provide some explanation as to why teachers adopt particular pedagogical approaches. Patrick and Pintrich (2001) argued that teachers with transmissivist epistemologies were less likely to change their teaching practice because their beliefs about teaching were grounded in their experiences as students,
rather than based on practice, evidence or evaluation, or contrasting alternative pedagogical models. In common with these differences is the agreement that only some epistemological beliefs impact upon teaching practice. These relate mainly to the source of knowledge.

This study addresses one of these dimensions. Understanding teachers’ beliefs about the source of knowledge is important in that technology has enabled the democratisation of knowledge (Harteis, Gruber & Hertramph, 2010). Moreover, technology has enabled much greater access to new sources of knowledge and information from which the VET teacher can draw and at the same time provide the means through which students acknowledge themselves as a source of knowledge.

**Epistemology studies.** Understanding teachers’ beliefs about the source of knowledge is important in understanding teachers’ technology integration practices. One recent study aimed at examining the source of teachers’ beliefs suggested that what teachers believed to be the source of their knowledge may have important implications for how they develop as teachers and consequently carry out their teaching practice (Buehl & Fives, 2009). At the same time, technology provides the means through which teachers acknowledge students as a source of knowledge and agents of their own subjectivity. Studies investigating the relationship between teachers’ epistemic beliefs and pedagogical beliefs reveal that while teachers’ beliefs are different, beliefs about the source of knowledge appear to be more resistant to change than others (Hofer & Pintrich, 1997; Kim et al., 2013; Sosu & Gray, 2012; Tanase & Wang, 2010).

**Pre-service teachers.** Some studies have shown that teachers who held traditional epistemological beliefs were more likely to view knowledge as that to be transmitted to the student (Many, Howard & Hope, 2002). Conversely, Cheng, Chan, Tang and Chen (2009) showed that pre-service teachers who held constructivist beliefs were more likely to adopt constructivist teaching practices. Similarly, Brownlee, Purdie and Boulton-Lewis’ (2001) Australian study revealed that teacher education students with evaluativistic (on the continuum, more constructivist than transmissivist) epistemological beliefs were more likely to describe learning as being about constructing meaning as opposed to consuming learning through transmission. Another Australian study of pre-service teachers claimed that ‘the most
epistemologically sophisticated teachers are those who can most fluidly contextualise, decontextualize and recontextualise their subjectivities’ (Adams, 2012, p. 14). His study revealed that the use of binary epistemic tools and pedagogies ‘catalyse awareness of the contextual and relational dynamics that characterise sophisticated epistemologies’ (p. 23). The importance of the relationship is therefore mediated by teachers’ epistemologies and framed by their subjectivity and context.

**Practicing teachers.** Studies with practicing teachers, although rare, illustrate intricate connections between epistemological beliefs and teaching practice (Chai & Tan, 2011; Chan & Elliot, 2004; Hashweh, 1996; Jacobson et al., 2010; Maggioni & Parkinson, 2008; Schraw & Olafson, 2002). For example, Stuck (1984) claimed that teachers with traditional epistemologies do not take students’ learning needs into consideration and have a limited repertoire of teaching strategies. Wallace and Kang (2004) revealed that teachers with naïve epistemic beliefs were more likely to adopt a transmissive teaching approach although teachers who had more developed beliefs did not necessarily make the connection with constructivist teaching practices. Maor and Taylor (1995) observed that the effectiveness of instruction in two science classrooms was related to the teachers’ epistemological beliefs rather than the programs themselves. That is, the teacher with constructivist epistemologies was able to invoke more critical thinking skills in students. Other studies show that teachers with more constructivist epistemological beliefs use cooperative learning strategies more effectively as a teaching practice (Brody & Hill, 1991) and tend to endorse student-centred constructivist approaches to teaching (Kim et al., 2013; Sinatra & Kardas, 2004). In addition, teachers with constructivist epistemological beliefs were amenable to students’ alternative conceptions, placing more emphasis on student discussion, interaction and problem solving than those holding naïve perspectives (Hashweh, 1996). It is therefore plausible that teachers’ epistemological beliefs may determine the rationale and justification for their pedagogical approach (Olafson & Schraw, 2006).

**Higher education teachers.** Studies with university teachers’ epistemologies are rare, despite many researchers proposing that tertiary education influences epistemological development (King & Kitchener, 1994; Perry, 1981; Schommer, 1998b). Stages of development
are therefore closely related to one’s educational level with only few people ever reaching the highly developed epistemologies (Hofer & Pintrich, 1997). According to Brownlee (2001), an individual’s progress through tertiary studies is likely to be strongly influenced by exposure to multiple epistemic perspectives resulting in cognitive conflict that would result in the development of a constructivist epistemology. One study in particular found that the more university teachers believed that knowledge was sure and clear, the more restricted their usage of technology in teaching (Harteis et al., 2006).

**Vocational teachers.** In preparing students for the workplace, understanding where and how knowledge exists is essential VET teacher knowledge. It is assumed that VET teachers possess constructivist epistemologies. As vocational teachers, they have to recontextualise their content knowledge, which has a productive function, into pedagogical knowledge which has a learning function when applied to teaching (Hordern, 2014).

Research on vocational teachers’ epistemologies is scarce. For the most part, studies have reported on students’ epistemological beliefs (Brownlee, Berthelsen, Dunbar, Boulton-Lewis & McGahey, 2008; Zinn, 2013). Zinn’s study from the German vocational sector revealed students’ most under-developed epistemological belief related to the ‘source of knowledge’. The study concluded that teachers were to view each other as valuable sources of knowledge. Developing epistemological beliefs would lead to greater and more complex forms of vocational knowledge (Zinn, 2013).

**Beliefs about Pedagogy**

Teachers’ pedagogical beliefs are often referred to as preferred ways of teaching and learning (Chan & Elliot, 2004; Teo, Chai, Hung, & Lee, 2008). They are normally associated with either a teacher-centred or learner-centred approach to teaching and learning and are often dichotomously classified according to a ‘knowledge transmission’ or a ‘knowledge construction’ model. The first perspective centres on traditional, transmissive instruction, where the teacher is the sole provider of knowledge and the students, as passive recipients of the content knowledge. In this model, for example, if a teacher views knowledge as content that is
to be transmitted; teaching will be conceived as a product to be delivered. The ‘knowledge construction’ perspective, on the other hand, takes the view that students actively make sense or personally construct meaning from learning experiences. Constructivist teachers design rich, meaningful learning experiences and scaffold their sense making for learners to construct their own (or shared) knowledge through critical thinking, discovery, and collaboration (Chai, 2010; Teo et al., 2008).

**How pedagogical beliefs are formed.** Research indicates the importance of one’s own experiences of teaching and learning as powerful drivers for the development of teachers’ pedagogical beliefs. Formed over many years of experience as a student, teachers tend to teach the way they were taught (Albion & Ertmer, 2002; Anderson & Maurice-Takerai, 2012; Baran, Chuang & Thompson, 2011; Kagan, 1992; Semiz & Ince, 2012) and consequently, may be resistant to change because they have been supported by strong authority and broad application. In the vocational context, Lawrence and Lentle-Keenan (2013) found that not only was there a tendency to teach as they were taught, but that teachers used their own personal experiences of technology, teaching and learning to explain their current practice. Left unexamined, these deeply held pedagogical beliefs may provide a powerful influence on how practicing teachers approach the task of learning to teach and the knowledge they construct from the experience (Fives & Buehl, 2008). As Kincheloe (2004) states, there is nothing new in asserting that the ways one teaches and the pedagogical purposes that one pursues are directly connected to the way teachers see themselves.

Many of the researchers who study epistemological beliefs share the assumption that these beliefs may affect their pedagogical practices (Hammer & Elby, 2002; Hofer, 2001; Pajares, 1992; Schraw & Olafson, 2002). Researchers also claim that teachers’ epistemological beliefs influence their pedagogical approach and teaching competence (Brownlee, 2001; Chan & Elliott, 2004; Cheng, Chan, Tang, & Cheng, 2009; Hashweh, 1996; Hofer & Pintrich, 1997; Olafson & Schraw, 2006). For example, Hofer and Pintrich (1997) argue that ‘beliefs about learning and teaching are related to how knowledge is acquired, and in terms of the
psychological reality of the network of individuals’ beliefs, beliefs about learning, teaching, and knowledge are probably intertwined’ (p. 116).

**Pedagogy and technology.** Research consistently indicates that teachers with constructivist beliefs tend to integrate technology more frequently in support of higher-level, challenging, student-centered learning and are more likely to adopt practices with technology that reflect their pedagogical beliefs (Judson, 2006; Lim & Chai, 2008; Lui, 2011; Tanase & Wang, 2010; Teo et al., 2008; Tondeur et al., 2008). Lim and Chai (2008) researched how the pedagogical beliefs of Singaporean teachers influenced their teaching with technology practice. Their findings revealed that teachers’ beliefs consisted of both constructivist and transmissive pedagogical orientations; however, teachers who espoused more constructivist orientations engaged students more meaningfully in activities relating to technology than the teachers who held traditional pedagogical beliefs. Teo et al. (2008) also found that that Singaporean teachers who hold constructivist pedagogical beliefs use technology in both constructivist and traditional ways. Conversely, teachers who hold traditional pedagogies use technology in traditional ways. A limitation of the quantitative method is that participants may practice differently from what they report in research situations, leading to inconsistencies between what teachers say they do and what they do in practice.

**Inconsistencies**

There is no shortage of studies which have reported inconsistencies between teachers’ pedagogical beliefs and their technology integration practices (Ertmer, 2001; Harris & Grandgenett, 1999; Lim & Chai, 2008; Palak & Walls, 2009; Levin & Wadmany, 2008; Zhao & Cziko, 2001). Judson (2006) and Levin and Wadmany (2006), for example explored this relationship and revealed inconsistencies between what teachers reported about their beliefs and their actual practice of technology use in the classroom. The disconnection between theory and practice suggests conflict between belief systems. Several findings have revealed that although teachers held student-centered beliefs, they did not practice constructivist teaching with technology (Chen, 2008; Liu 2011).
Orlando (2013) reported on a longitudinal study of the ICT practices of a small number of Australian teachers. Her findings showed that while ICT was integrated over time, it was teachers’ core beliefs about learning that mediated their teacher-centred practices. Her findings supported others’ in that teachers did not always aspire to constructivist practices (Albion & Ertmer, 2002; Maor & Taylor, 1995). Merely having constructivist beliefs is no guarantee of student-centred learning. An and Reigeluth (2011) suggested that lack of knowledge about constructivist and student-centred pedagogic practices might prevent teachers from actualising their beliefs in practice.

**Technology, Epistemology and Pedagogy**

Teo (2009) asserts that teachers’ epistemological beliefs have a major bearing on how technology is used. Studies of practicing teachers’ epistemic beliefs are rare (Feucht & Bendixen, 2010; Maggioni & Parkinson, 2008; Schraw & Olafsen, 2002). One US study (Kim et al., 2013) investigated the extent of the relationship between epistemological, pedagogical and technological beliefs. They found that teachers with constructivist epistemologies adopted student-centered approaches to teaching and used technology in ways that supported learning rather than in the ways it supported teaching. Like other researchers (Chan & Elliott, 2004; Hofer & Pintrich, 1997; Sosu & Gray; Tanase & Wang, 2010; Zinn, 2013), teachers’ beliefs about the speed of learning and the source of knowledge were most strongly related to their conceptions of teaching. They concluded that teachers’ epistemic beliefs influenced teachers’ decisions about teaching (in general) as well as decisions they made about teaching with technology. The self-reporting nature of the survey raises some doubt as to its reliability in accurately measuring teachers’ beliefs if inconsistencies are found to exist.

Another study involving US vocational teachers who worked in a technologically-rich environment explored the relationship between teachers’ epistemological and pedagogical beliefs and their technology use (Dirkx et al., 2004). They found that teachers’ epistemic beliefs were reflected in their perceptions of students. Teachers held largely transmissivist epistemologies, believing that knowledge was something to get through. It was external to the
learner. The role of technology was to foster the transfer of knowledge, enabling students to acquire the transferred knowledge rather than as a means for creating new knowledge.

**Concluding Comments**

The literature review suggests that it is important to explore the epistemological and pedagogical beliefs of vocational teachers. It is important to determine to what degree these beliefs impact on teachers’ use of technology. As Cuban (2001) argues, beliefs alone do not wholly explain how teachers are likely to use technology. It is also important to assess vocational teachers’ TPACK.

It is timely for teachers to challenge established notions of knowledge and learning by supporting students to enable new means of learning, thinking and being. As very little is known about the role of epistemology in the vocational context and even less about the influence of VET teachers’ epistemic beliefs on their teaching practice, it is an important site for exploration in that the epistemic assumptions about the nature of knowledge and how it is acquired are reflected in vocational discourse.
Chapter Three: Methodology

Chapter Overview

This chapter describes the research approach adopted for this study. It outlines how this study addressed the research questions and the methodology used to achieve it. Firstly, this chapter restates the problem articulated in Chapter One. Secondly, it restates the research questions formulated to confront the problem and the role of the researcher within the study. Thirdly, it describes how the study fits within the selected research paradigm. Next, the chapter describes the design, approach and methods used to collect and analyse data. Finally, it considers the limitations of the research and the ethical issues considered throughout the study.

The Problem

As discussed in Chapter One, the use of technology in vocational teachers’ practices has been characterised by a slow, but gradual uptake despite significant policy and organisational support. A number of reasons have been expounded; the most convincing of which seems to be related to teachers’ knowledge and beliefs about teaching, in general, and about teaching with technology in vocational educational contexts.

The lacklustre efforts of many teachers’ experiences in using technologies in pedagogically defensible ways is at odds with broader social and cultural trends which often focus upon the significant influence of technology in people’s lives (Prenksy, 2006; Tapscott, 2008). This thesis proposes that regional vocational teachers are a valuable cohort to study and investigate as they could provide a lens through which teaching with technology can be understood in preparing their students for work in competitive and complex workplaces.

My Personal Journey

No research is value free. A researcher needs to explicate any component of his/her background experiences that might influence the research, its findings and interpretations
(Merriam, 1998). Differences between researchers may create different perceptions and understandings of the same data (Denzin, 1989).

From multiple perspectives, I have developed awareness of the ways in which technology is being used in VET practice: as a remote student, as a teacher and as a senior lecturer in a regional VET organisation. Through these experiences, coupled with my knowledge and awareness of issues confronting the VET sector at large, I am aware of many of the barriers facing teachers as they journey towards adopting technology into their teaching practice.

My educational philosophy is that for teachers to be effective practitioners there is an imperative to remain abreast of change by maintaining currency within their industry. Vocational teachers need to be able to use technology that is available in the broader social and cultural sphere if they are to prepare students for the workplace. Personally, I enjoy using technology. While this enthusiasm has extended to my teaching practice, it has not always been met with the same response by my colleagues.

I was taught in a traditional, learning environment in which teaching was exclusively conducted through the transmission model. My experience suggests that despite the availability of new technological tools and resources, many vocational teachers have not changed their methods over the years. I am familiar and comfortable with a traditional educational paradigm and there are times where it is my only means of teaching practice.

From my university education courses, the transmission model of educational theory was not promoted. However, it was only in recent years, when technology expanded, that constructivist learning was promoted by the university as one of the means to ensure that distance and isolated students connected and formed peer networks and communities.

Prior to that, my experiences of university education are as an external student of a university located several hours’ drive from the small country town where I lived. Course information consisted of a unit study guide and one or two volumes of readings and was sent
through the post. The only communication was with my tutor twice a semester and through marked assignment feedback. At the time, it was all that I expected as I lived in a remote area. I enjoyed studying alone. I enjoyed reading and then writing critical essays about what I had read. I did not enjoy having to regularly post to discussion forums. For me, this defeated the purpose of external study, which provided the flexibility of learning anywhere, anytime and without the distraction of other people.

Clearly, these previous educational experiences promoted a traditional epistemology wherein I believed that the authority bequeathed to schools and the university would provide me with all the knowledge I needed.

In more recent years, technology, in the form of the university’s learning management system replaced hard copies of the reading materials. Study guides and assignments were emailed, lectures could be viewed online and posting on the discussion was either encouraged or mandated. Computer technology made the typing easy, assignments were more manageable and time was spent more efficiently in thought than in rewriting. Through the support and guidance of my lecturers and tutors, coupled with interesting and challenging course content, I became a highly metacognitive, driven and self-directed learner. On completing a Master of Education degree, I enrolled in a Doctor of Education. As my interest in teaching and technology had not waned over the years, I was encouraged to take an elective unit, Opportunities with E-learning, the only unit I was not allowed to take externally. It was delivered in a blended mode (requiring on-campus and off-campus participation), using a range of innovative uses of Web 2.0 technology based on the TPACK framework. The content was the driver for the pedagogy and the technology was the medium through which pedagogical content knowledge was activated. TPACK was later to become the framework I used to understand the ways vocational teachers could be supported to develop the skills to teach with technology.

Exposure to other teachers’ practices therefore sparked my enthusiasm and experimentation of the ways in which various technologies changed both teaching and learning. The teachers in my workplace did not appear to be experimenting or trialling newer and
emerging technologies, neither as tools, nor as resources. From there, I made the decision to measure teachers’ TPACK to gain a clearer picture of how teachers thought about technology and how it fitted within their practice. However, I was not sure how TPACK could be measured without an understanding of what ‘knowledge’ itself meant. Therefore, teachers’ epistemological beliefs and where they came from were as equally important as their technology, pedagogy and content knowledge.

**Research Questions**

For Erickson (1986), combining the research questions with data collection methods is an evolving relationship. It is possible to do so without fear of unconventionality. According to Erickson: ‘Framing research questions explicitly and seeking relevant data deliberately, enable and empower intuition, rather than stifle it’ (p. 140).

In response to this problem, five questions were designed to develop new understanding about vocational teachers’ knowledge and beliefs about knowledge, teaching with technology, the characteristics of teachers’ technology use and their attitudes towards technology. The research questions were:

1. How do VET teachers perceive their knowledge in relation to technology, pedagogy and content?

2. How do VET teachers’ epistemological and pedagogical beliefs relate to their beliefs about teaching with technology?

3. What are the characteristics of VET teachers’ technology use?

4. How do VET teachers’ attitudes towards technology shape their teaching practice?

5. How useful is the TPACK framework for understanding VET teachers’ technology integration practices?
Research Approach

While advocates of quantitative and qualitative research paradigms have debated and defended their respective research approaches (Johnson & Onwuegbuzie, 2004), good research must ultimately fit the questions asked (Goetz & le Compte, 1984). Combining these paradigms emphasises the strengths and the weaknesses of both research approaches. Patton (2002) describes quantitative research methods as ‘those that require the use of standardised measures so that the varying perspectives and experiences of people can be fitted into a limited number of predetermined response categories to which numbers are assigned’ (p. 14). On the other hand, qualitative research methods create a more detailed awareness of each participant’s thoughts and beliefs. This requires more comprehensive data collection for each participant. Qualitative methods can provide that depth (Patton, 2002), whereas quantitative methods are inadequate here. This study therefore aimed for an appropriate mix of quantitative and qualitative data to examine how vocational teachers’ knowledge and beliefs influenced their technology integration practices.

Mixed-methods research. The philosophy most associated with mixed-methods research is pragmatism. Pragmatism allows the researcher access to multiple research methods, different world views, different assumptions and different forms of data collection and analysis (Creswell, 2003). One of the most popular mixed-methods designs in educational research is the sequential explanatory mixed-methods design (Creswell, 2003). The use of mixed-methods in this study was decided by the nature of the research questions (Patton, 2002), the design of which enabled explanation, exploration and triangulation of findings. According to Johnson and Onwuegbuzie (2004), mixed-methods research is:

…inclusive, pluralistic and complementary, and it suggests that researchers take an eclectic approach to method selection and the thinking about and conduct of research. What is most fundamental is the research question-research methods should follow research questions in a way that offers the best chance to obtain useful answers. (p. 17)
Research Design

Mixed-methods research consists of at least two distinct phases: typically the quantitative phase is followed by a qualitative phase. As the design is predicated on beginning quantitatively, the researcher assumes a post positivist perspective. As the overall design changes, the philosophical assumptions behind the explanatory design, shifts towards acknowledging multiple perspectives (Ivankova, Creswell & Stick, 2006).

Research Model

The quantitative data provides a general understanding of the research problem whereas the qualitative data refines and explains the results by exploring participants’ views in more depth (Creswell, 2009; Tashakkori & Teddlie, 1998). This design was adopted because neither one nor the other approach would have been able to answer the research questions alone. As indicated in previous research, measuring TPACK using only self-reports might be inadequate (Archambault & Barnett, 2010). Incorporating different perspectives might reveal greater diversity of views, highlighting inconsistencies and contradictions that a single method could not. Figure 3.1 provides a visual model to explain the stages of the design. The model portrays the sequence of the research activities in this study. Capitalised letters and lower case letters designate priority of quantitative and qualitative data.
## Mixed-Methods Sequential Explanatory Design Procedure

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<thead>
<tr>
<th>Phase</th>
<th>Procedure</th>
<th>Product</th>
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<tr>
<td>Quantitative Data Collection</td>
<td>TPACK Survey</td>
<td>Numerical data</td>
</tr>
<tr>
<td>Quantitative Data Analysis</td>
<td>bi-variate correlations reliability analysis SPSS quantitative software v.11</td>
<td>Descriptive statistics for questions for subscales Correlation among subscales</td>
</tr>
<tr>
<td>Connecting Quantitative and Qualitative Phases</td>
<td>Purposefully selecting 5 participants from each group based on TPACK scores (high, mid and low scores) Developing interview questions based on TPACK constructs</td>
<td>Participants (n=14) Interview protocol</td>
</tr>
<tr>
<td>Qualitative Data Collection</td>
<td>Individual interviews (n=14) participants at workstation Demonstration of technology use by participants Teachers’ teaching and learning resources</td>
<td>Text data (Interview transcripts, documents)</td>
</tr>
<tr>
<td>Qualitative Data Analysis</td>
<td>Coding and thematic analysis NVIVO qualitative software</td>
<td>Codes and themes</td>
</tr>
<tr>
<td>Integration of the Quantitative and Qualitative Results</td>
<td>Interpretation and explanation of the quantitative and qualitative results</td>
<td>Assertions Implications Future research</td>
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**Figure 3.1**

**Research model (Adapted from Ivankova et al., 2006)**

According to Ivankova et al. (2006), when choosing a mixed-methods sequential explanatory design, three key procedural issues need to be considered. These decisions relate to
issues of priority, implementation and integration of the quantitative and qualitative approaches. Firstly, priority refers to the approach that carries more weight or emphasis through the data collection and analysis process (Ivankova et al., 2006). In this study, despite it being the second phase, priority was given to the qualitative data because it answered the majority of the research questions. This decision was influenced by the exploratory nature of the study. Although the quantitative phase focused primarily on participants’ self-reports, data collection was limited to one source and the data analysis only employed descriptive statistical techniques. Secondly, implementation refers to the sequencing of the data collection and analysis (Ivankova et al., 2006). Quantitative data was collected firstly as a means of providing a general understanding of teachers’ TPACK. The qualitative data collection and analysis then secured an explanation of the quantitative data that was required. Lastly, and characteristic of the mixed-methods design, integration is the point at which decisions about mixing occurs (Ivankova et al., 2006). In this study, the connection occurred on two occasions. The first point was when participants were selected from the first phase based on numerical data. The second connecting point was when interview questions were developed based on the TPACK constructs that the participants self-reported in the quantitative phases (Ivankova et al., 2006).

The inherent challenges in such a design were addressed in this research. Firstly, the researcher was not able to specify in advance who the participants might be. This challenge was addressed by informing participants of the possibility that they may be contacted again for further involvement in the study. Secondly, the researcher had to decide which of the quantitative results needed to be further explained as these results cannot be known until after the quantitative phase is complete. As the research was being designed, all of the TPACK domains were considered for further analysis. Finally, the decisions as to who to sample in the qualitative phase and the criteria for participant selection were made based on a spread of TPACK scores. Participants were selected based on the highest, mid and lowest scores.
Data Collection

Data collection techniques and their relationship to the study’s research questions are shown in Table 3.1.

Table 3.1

<table>
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<th>Data Collection Techniques</th>
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<tr>
<td>Phase</td>
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TPACK Limitations

TPACK is a powerful framework with potential generative uses in research and development related to the use of technology in education (Chai et al., 2013). While it has emerged in educational technology research as a theoretical framework, further clarity and precision in the way the constructs are defined are required before it can be recognised as theory (Angeli and Valanides 2009; Graham 2011). The overlapping nature of the framework and concerns about the confusion among the constructs have been highlighted by researchers (Cox & Graham 2009; Archambault & Barnett, 2010; Lee & Tsai, 2010) and considered to be more aspirational than real (Kinchin, 2012). Many researchers who have made serious attempts at measuring the TPACK constructs have been challenged by the difficulty the model presents in distinguishing boundaries between the constructs in the model (Angeli & Valanides, 2009, Archambault, 2009; Archambault & Barnett, 2010; Cox, 2008; Cox & Graham, 2009; Graham et al., 2009; Yurdakul, Odabasi, Kilicer, Coklar, Birinci & Kurt, 2012). Hu and Fyfe (2010) noted that the only clear domain seems to be technology, and after extended efforts to develop and validate an instrument to measure all the TPACK constructs, Archambault and Barnett (2010) were successful only in clearly identifying one factor that they identified as knowledge of technology. They concluded that although the TPACK framework is helpful ‘it faces the
same problems as that of pedagogical content knowledge in that it is difficult to separate out each of the domains, calling into question their existence in practice’ (p. 1659). For Archambault and Barnett, (2010), one of TPACK’s weaknesses is its inability to produce new knowledge, although they suggest it is possible to develop this model: ‘It seems that measuring each of the domains is complicated and convoluted, potentially due to the notion that they are not separate’ (p. 1661). Continued debate about the blurriness and fuzziness of boundaries between the domains tends to detract from the original concept of the TPACK as a complete body of knowledge (Voogt et al., 2013, p. 116).

Although Angeli and Valanides (2009) noted that TPACK was in fact a body of knowledge, it existed within teachers’ epistemological and pedagogical beliefs and practices. This highlighted the importance of further addressing teachers’ contextual constraints and their belief systems (Angeli & Valanides, 2009; Chai et al., 2013). Voogt et al. (2013) support the view that TPACK should be understood as a distinct body of knowledge, arguing that its value lies more in the way it supports students’ higher level learning than a model of technology integration. This is also the perspective that has been adopted for the purpose of the research reported here. However, TPACK, as it is represented in a Venn diagram, also provides a visual illustration of the connections between technology, pedagogy and content knowledge. The visual dimension lends itself well to signify a clear framework in which to conceptualise TPACK as a body of knowledge in the centre of the model.

The claim that there is minimal connection between their beliefs, knowledge and action (So & Kim, 2009) is also of concern in measuring teachers’ TPACK. It has become clear that self-report alone cannot provide an accurate picture of TPACK and technology integration as often teachers’ beliefs do not align with their practices (Agyei & Voogt, 2011; Bates & Maor, 2010; Chen, 2008; Ertmer & Ottenbreit-Leftwich, 2010; Jordan, 2011; Liu, 2011).

Given the lack of research to report on students’ academic achievement since the emergence and development of TPACK (Chai et al., 2013) and no clear method for its implementation and evaluation, despite it being textually and graphically simple, it would
appear that the TPACK framework in its present form does not take into consideration other factors beyond content, pedagogy, and technology. Angeli and Valanides (2009) emphasised the need to consider teachers’ epistemic beliefs and values about teaching as they are also ‘important to take into account’ (p. 57). Moreover, and according to Messina and Tabone (2013) as technology continuously evolves, teaching with technology is always a work in progress. It therefore becomes necessary to consider other factors such as individuals’ core beliefs in order to understand decisions teachers make about technology and the way these are adapted and sustained.

**TPACK survey questionnaire.** An inherent problem in measuring teachers’ TPACK is the variation in the way constructs are operationalised (Voogt et al., 2013). Several instruments have been developed to measure TPACK using self-report as the data collection method with multiple items keyed to each of the seven types of knowledge represented in the TPACK construct. Schmidt et al. (2009) designed a survey that could be repeated by pre-service teachers as they progressed through their teacher education programs. It was also found to be reliable and valid for pre and post surveys in technology integration courses. Archambault and Crippen’s (2009) survey instrument, designed for in-service teachers, was found to be reliable and valid with a nationally representative sample of approximately 600 K-12 online teachers.

More recently, several other instruments (Abbitt, 2011; Chai, Koh, & Tsai 2010) have been developed to measure perceived TPACK knowledge. However, these instruments are primarily applied among pre-service and in-service teachers in primary and secondary education.

Although, several surveys were reviewed (Finger, Jamieson-Proctor & Albion, 2010; Graham et al., 2009; Lee & Tsai, 2010; Schmidt et al., 2009), none were designed for the vocational sector. Archambault and Crippen’s (2009) survey instrument was selected given its support in the literature for in-service teachers for several reasons. Firstly, it was able to be modified to reflect a VET context. Secondly, several of the statements were constructivist-orientated. Thirdly, although the mixed-methods two phase data collection procedure can be
lengthy to implement (Creswell, 2009), the survey was administratively straightforward, easy to
describe and to report.

Archambault and Crippen’s (2006) original survey was developed for the teachers’
knowledge in three key domains, as described in the TPACK framework: technology,
pedagogy, content and their combinations. The version contained 24 items. Three to four items
were written in each TPACK domain based on definitions provided by Mishra and Koehler
(2006) and Shulman (1986). As with any self-report, the effectiveness is determined by the way
in which respondents assess their knowledge and respond appropriately. In this study, the 24-
item questionnaire was adapted from this model for the purpose of determining the relationship
between vocational teachers’ technology, pedagogical and content knowledge. See Appendix 1
for the modified VET TPACK survey.

The revised TPACK questionnaire was piloted with a convenience sample made up of
six of the researcher’s colleagues and a supervisor. Reliability analysis indicated that the
internal consistency of all seven subscales were in the Cronbach Alpha range between 0.72 and
0.93, an acceptable level of reliability. The advantage of using the survey in the first phase was
to provide a representation of teachers’ technology, pedagogy and content knowledge, from
which the second, qualitative phase could extend and elaborate in more depth.

**Semi-structured interview.** The purpose of the semi-structured interview was to
develop a deeper understanding of vocational teachers’ TPACK. Obtaining rich, thick
descriptions of teachers’ knowledge and beliefs in addition to the quantitative data served to
balance the self-reporting nature of the surveys (Merriam, 1998). As interviews are the most
prominent data collection tool in qualitative research, they are premised on the notion that
others’ perspectives are worthy of exploration and analysis (Patton, 2002), allowing participants
to reveal their values, beliefs and attitudes.

The structured component of the interview was based on the development of an
interview guide. This provided a clear set of instructions to focus the interview on specific
topics without constraining its natural, conversational flow. The interview questions were designed around the TPACK domains in such a way that teachers were able to articulate their beliefs about these constructs relating to teaching and learning with technology. As the goal of the qualitative data was to explore and elaborate on the results from the quantitative data, the researcher wanted to understand how these participants’ reported abilities were actualised in their practice. Thus, eighteen open questions in the interview protocol explored teachers’ beliefs, knowledge and attitudes relating to the seven constructs constituting the TPACK domains. See Chapter Four for a mapping of the research questions to the interview questions.

The interview was a standardised open-ended type where the words and sequences were prepared prior to the interview. The questions followed the same order and were worded in such a way as to allow open-ended responses (Patton, 2002). This technique suited this study in that individual responses to the same questions were being sought. The interview protocol was pilot tested with two colleagues, purposefully selected on the basis that these colleagues had pilot tested the survey questionnaire.

In addition, the semi-structured interviews were conducted at the teacher’s workstation or at a workstation to which they had access, to enter into the participant’s world of teaching. The use of probes such as: ‘Can you show me what you do? How do you that? Can you show me what you use? and Why are you using that?’ enabled teachers to demonstrate their teaching practice, the technology they were using and how they were being used.

All interviews were conducted by an external research assistant. As the researcher is a colleague of the participants, formal and informal relationships with the participants have developed over a period of time. To avoid the situation where participants’ responses might have been directed towards appeasing the researcher rather than a truthful expression of their beliefs and perceptions about their uses and practices with technology, an external researcher was engaged to avoid perceptions of unequal power relations between the researcher and the
Morse (1994) warns that ‘it is not wise for an investigator to conduct a qualitative study in a setting in which he or she is already employed and has a work role’ (p. 222).

The research assistant ensured that all participants were aware of the independence and impartiality of the research at the commencement of each interview. Assurances were also made in respect to confidentiality of participants’ responses to TPACK survey results and interview questions. When conducting the interviews, care was taken to ensure that the participants felt secure to express themselves freely through correct interview procedure of introduction and closure.

**Research Participants**

The research sought to gain an appreciation of vocational teachers’ beliefs, knowledge and attitudes in using technology in a regional vocational training organisation. As the research did not seek to narrow the participant base to teachers who were or were not using a range of technology, participation was sought from all teaching staff. The participants were vocational teachers, based at four different regional campuses of the institute, three campuses of which were within a radius of up to 150 kilometres from the main centre. In a show of support for the research to be undertaken within the organisation, the Managing Director emailed all staff asking for colleagues to participate in the research. To take part in the study, teachers were asked to complete a consent form. Consistent with a mixed-method explanatory design, participants were also asked to agree to be interviewed at a later date if required.

All academic staff were invited to participate in the TPACK survey. The survey was emailed to teaching staff (n=72). Potential participants were asked to complete and return the questionnaire and consent form by email or fax to the research assistant whose contact details were provided at the end of the survey. Twenty-five participants responded through this process, representing a response rate of almost 35%.

There are no strict or established guidelines in determining the selection of participants for the qualitative phase of a mixed-method design. The rationale upon which participants were
selected for the interview was based on the procedure of identifying typical participants from three different groups (Ivankova et al., 2006). Based on the 25 completed surveys during the quantitative phase, the scores for each participant were calculated and then ranked from highest to lowest. From this number, five participants from the high, middle and low ranges were contacted for a follow up interview. Where participants were not available for a follow up interview, the participant with the score closest was selected. Using these criteria, four participants represented the high range. One of the five selected for interview was not available as she was on long service leave. Five participants represented the middle band and five the low band.

The participants for the interviews represented various industries including: agriculture, automotive, education, child care, first aid, information technology, and multimedia, metal fabrication, nursing, retail and security. They taught in a variety of modes: face to face, flexible, blended, workshops and block release workshops. Training took place in various locations such as high schools, custodial settings, workplaces (hospitals, machinery workshops and farms).

**Data Collection**

Data was collected over a four month period and involved the implementation of both the survey and the interviews. The external researcher received the completed surveys which were then de-identified. The results from the de-identified survey were entered into a spreadsheet and then inputted into SPSS version for analysis.

Semi-structured interviews were conducted with 14 participants. Interviews were typically between 30 minutes and 45 minutes’ duration. The research assistant digitally recorded the interviews. The researcher then transcribed and coded all interviews into textual format using a word processor and imported into QSR NVivo for analysis.

The natural workplace setting enabled the researcher to elicit more detailed information about teachers’ technology use, uninterrupted by expectations to answer a set of linear and
sequenced interview questions. This environment allowed an insight into the general working environment and an opportunity to see how the participants used the technology they described.

It was important for participants to be able to demonstrate and articulate their uses and reasons for using technology. This was also useful for confirming and disconfirming what participants stated in the interviews and how this use was realised in practice. As a self-reporting mechanism, neither the survey nor interview responses may have effectively portrayed actual technology integration. Participants were provided with the opportunity to show the researcher how technology was being used and the ways it was being used. Answers to interview questions such as ‘Show me what you do?’ and ‘Let’s have a look’, were recorded. Descriptive responses to these questions were contained within the interview transcripts.

Data Analysis

Survey analysis. Analysis of the quantitative data was undertaken in two stages. The first stage involved scoring participant results from the TPACK survey which involved inputting results into a spreadsheet. The TPACK survey contained 24 items. To analyse the results, participants were ascribed a score for each item: 1 - Poor, 2 - Fair, 3 - Good, 4 - Very Good and 5 - Excellent. Overall scores were calculated for each participant. The maximum possible score was 120 and to register this, the participant would have excellent knowledge across all the TPACK domains. Profiles were prepared for each of the 25 participants, from which they were placed into three bands (high, medium or low). These profiles were used to select participants for the interview process.

The second stage involved importing the spreadsheet data into SPSS for both descriptive and inferential analysis. The descriptive measures including the mean and standard deviation were calculated for all 24 items and for each TPACK subscale. Inferential statistics were used to determine the relationship between participants’ ratings of their knowledge levels along the TPACK framework.
**Interview analysis.** All interviews were audio-taped. The researcher transcribed and coded all interviews. Transcriptions of the interviews were carried out using a word processor and then entered into NVivo software. As data were entered and coded, categories were created using the TPACK constructs as themes to help to describe teachers’ beliefs and their knowledge about teaching with technology.

A constant comparative method of data analysis (Strauss & Corbin, 1998) was used to determine themes other than the TPACK constructs which emerged during this phase. In this study, emergent themes were informed by qualitative data allowing the researcher to establish relationships between categories.

To reflect the situational nature of findings, researchers make assertions rather than conclusions (Erickson, 1986). In this study, a series of assertions were made at the point of data convergence (see Figure 3.1). Convergence is the point at which key linkages among different sources of data are made (Erikson, 1986). Assertions were made once sufficient evidence was established to warrant an assertion. This process involved reviewing the data for disconfirming and confirming evidence keeping in mind the need to reframe the assertions as the analysis proceeded (Erikson, 1986). Assertions were revised when the disconfirming evidence outnumbered the evidence to substantiate the assertion. The assertion is made when the key linkage is of central significance across the widest range of sources thus providing sufficient evidence for the assertions made (p. 147).

In writing up assertions for this study, evidence is provided of both specific and general descriptions (Erikson, 1986). Specific evidence of assertions is presented through quotes from the interviews to provide evidence that what the assertion claimed to have happened, did actually happen. General evidential descriptions are provided for the frequency in which the assertion could be made as well as the breadth of evidence that warranted an assertion (p. 149).
Trustworthiness of the Research

This study employed a number of strategies to enhance its trustworthiness. Guba and Lincoln (1982) argued that the terms ‘reliability’ and ‘validity’ used to determine rigour in quantitative enquiry, be substituted by a parallel concept of ‘trustworthiness’. Trustworthiness contains four aspects; credibility, transferability, dependability and confirmability. Within these aspects are specific methodological strategies for demonstrating rigour such as audit trails, member checking and peer debriefing (Morse, Barrett, Mayan, Olso & Spiers, 2002).

Johnson and Onwuegbuzie (2004) use the term ‘legitimation’ to assess the trustworthiness of quantitative and qualitative data. In this study, quantitative data is discussed in terms of its reliability and validity. As there is a greater emphasis on the qualitative rather than the quantitative component, trustworthiness is discussed broadly in term of the integrity of data analysis (Lincoln & Guba, 1986; Patton, 2002).

**Trustworthiness of Quantitative Data.** Reliability analysis indicated that the internal consistency of all seven TPACK subscales fell within the acceptable to excellent range, between 0.716 and 0.926. In quantitative research, validity refers to whether one can draw meaningful and useful inferences from scores on particular instruments (Creswell, 2009). The modified instrument was reviewed to ensure that content validity was established. Two colleagues, both of whom are involved in educational technology piloted the survey to ensure items were complete and in an appropriate format. Construct validity was determined by adapting a commonly used survey from prior research (Archambault & Crippen, 2009; Messina & Tabone, 2012).

**Trustworthiness of Qualitative data.** Denzin (1994) suggests that although research is fundamentally about the researcher, for it to be credible, it has to go beyond the researchers’ position. In this study, credibility is achieved through a number of techniques. As mentioned earlier, to enhance the trustworthiness of the data, a research assistant was used to conduct the interviews. The data was then analysed and interpreted by the researcher. The researcher
actively searched for confirming and disconfirming evidence in the data using the mixed-methods emergent design.

Secondly, credibility was achieved through member checks, the process whereby participants verify data and the interpretations made of the data (Lincoln & Guba, 1985). For Lincoln and Guba (1985), member checking is ‘the most critical technique for establishing credibility’ (p. 314) and can be both formal and informal in eliminating the possibility of misrepresentation and misinterpretation. Transcriptions of interviews were emailed to the participants as a record of the conversations that took place and as a way for participants to comment on, verify and confirm the details of the interview. At the conclusion of each interview, participants were asked if they wanted to add additional information.

Thirdly, findings were subjected to peer debrief. Lincoln and Guba (1985, p. 308) describe the role of the peer debriefer as the ‘devil’s advocate’, the person who keeps the researcher ‘honest’. The role involves asking difficult questions about the procedures, meanings, interpretations, and conclusions. It involves providing the researcher with cathartic opportunities of empathy with her feelings. Peer debriefing was used in two ways in this study. The first approach was undertaken after each interview by the research assistant with the researcher to help clarify thinking, revise questions, provide anecdotal observations and perspectives, and to discuss findings. A second, informal approach was in the context of discussions with the researcher’s supervisors who provided ongoing feedback before, during, and after data collection.

To ensure the dependability of the data collected, an audit trail was maintained. This involved maintaining extensive records and data stemming from the study so that such documentation could be retraced to its sources to ensure an auditable trail. All participants’ statements and raw data had a unique code to ensure that the identity, location and date of the data were traceable. Data was securely stored in electronic and hard-copy format.
One of the ways in which this study was strengthened was through the use of triangulation (Stake, 1994). Several mechanisms were used to promote triangulation. The research was based on a mixed-methods explanatory design. Participants’ self-reported TPACK was triangulated with a demonstration of their technology knowledge within the interview process and interview questions. This provided a better understanding of the nature, depth and application of teacher knowledge. The TPACK survey represents perceptions of knowledge and ability rather than evidence of demonstrated knowledge and ability. The extent to which this survey can represent actual knowledge is limited by the participants’ ability to conduct an honest self-appraisal of one’s own knowledge and belief (Abbitt, 2011). Therefore, to simply infer TPACK from surveys alone is not sufficient and needs to be assessed from different perspectives (Agyei & Keengwe, 2012; Doehring et al., 2009). These mechanisms ensured that opportunities for triangulation were identified and taken, thus contributing to the overall credibility of the research.

**Ethical Considerations**

In the collection of research data, relationships between the researcher/s and the participants are essentially based on a set of ethical standards. The conduct of this research study adhered to the Australian Association for Research in Education Code of Ethics (AARE, 2005) and followed the guidelines issued by the Murdoch University Human Research Ethics Committee. Permission to undertake this research was obtained through this research committee.

Permission to carry out the study in the researcher’s educational organisation was obtained from the Managing Director through a letter sent out outlining the research aims and the time requirements of the participants who would voluntarily participate. As stated previously, the Managing Director endorsed the research through an email sent to all stakeholders involved with the organisation requesting that the research be supported.

In both phases of the data collection, participants were provided with sufficient information and assured of the confidentiality of their responses at all times. Strict anonymity
was maintained throughout the study. Each interview participant was ascribed a numerical code. In Phase 1, participants were de-identified; pseudonyms were not used in this study. Participants were assured they could withdraw at any time throughout the research process. All participants agreed to their interviews being recorded and notes taken.

**Summary**

This chapter described the pragmatic and mixed-methods research paradigm that informed this study. Consistent with this approach, the research sought to contribute new knowledge that would be seen as reliable and credible due to the rigour of the study. It detailed the research design and the quantitative and qualitative methods used to collect and analyse the data. It also considered the role of the researcher and the research assistant, possible biases, the limitations of the research and the ethical considerations made during the study. The next chapter deals with the findings that emerged from the research.
Chapter Four: Vocational Teachers’ Knowledge, Beliefs, Attitudes and Perceptions

Introduction

This chapter presents findings that illustrate the integrative phase of the mixed-methods research design. SPSS statistical software was used to analyse the TPACK survey. The major themes that were identified emerged from the interview transcripts. These were based on the TPACK components and other ideas that participants mentioned.

Findings from the data are presented in two main sections. Phase 1 presents the survey results by TPACK domain and by TPACK item. Phase 2 describes the interview findings of (a) teachers’ beliefs as they relate to teaching and teaching with technology, (b) characteristics of teachers’ technology use and (c) teachers’ attitudes and perceptions about their uses of technology in relation to their teaching practice.

Quantitative Data: TPACK Survey

This section answers the first research question about the perceived knowledge of VET teachers in relation to technology, pedagogy and content knowledge. The overall purpose of the survey was to determine the relationship between teachers’ technological, pedagogical and content knowledge. To gain insight into this relationship, a survey was administered to teachers at the beginning of the data collection phase of the research. The survey was adapted from a similar instrument developed by Archambault and Crippen (2009). Appendix A shows the modified survey.

Teachers were asked to rate their ability to undertake a series of tasks associated with teaching with technology in a VET context. Twenty-four items addressed statements relating to the TPACK domains: technology, pedagogy and content. These items explored teachers’ beliefs about their teaching practice in relation to the TPACK components. Three items related to each of the following domains: pedagogical knowledge, technological knowledge, content
knowledge and technological content knowledge. Four items each related to pedagogical
content knowledge, technological pedagogical knowledge and technology, pedagogy and
content knowledge. To analyse the results, teachers were ascribed a score for each item: 1-Poor,
2-Fair, 3-Good, 4-Very Good and 5-Excellent. Overall scores were calculated for each teacher.
The maximum possible score was 120 and to register this, the teacher would have perceived
themselves to have had excellent knowledge across all the TPACK domains. Conversely, the
minimum possible score was 24 and the teachers would have perceived themselves to have had
poor knowledge across all TPACK domains. The survey was emailed to all VET teachers
(n=72) at the institute. Twenty-five teachers completed the survey, representing a response rate
of 34%.

Reliability. Modified from the original Archambault and Crippen (2009) instrument,
reliability testing for this study in the form of Cronbach’s alpha coefficient was conducted for
each of the subscales to determine the level of internal consistency. All seven subscales fell in
the acceptable to excellent range (between .72 and .93). The results of this analysis are
summarised in Table 4.1. Reliability is therefore consistent with Archambault and Crippen’s
(2009) survey, internal reliability ranging from alpha = .699 for the technological content
domain to alpha = .888 for the technology domain.

TPACK Results

TPACK Domains. Data from each of the 25 surveys was analysed in relation to the
teachers’ self-assessments in each of the seven domains of the TPACK framework. Descriptive
statistics were calculated for each TPACK subscale and are shown in Table 4.1: Pedagogical
Knowledge (PK), Technological Knowledge (TK), Content Knowledge (CK), Technological
Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), Pedagogical
Content Knowledge (PCK) and Technological Pedagogical Content Knowledge (TPACK).
Table 4.1 shows how teachers self-assessed their knowledge in each of the seven domains.
Table 4.1

Descriptive Statistics for each TPACK Domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>n</th>
<th>Range</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK</td>
<td>25</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>3.53</td>
<td>0.62</td>
<td>0.716</td>
</tr>
<tr>
<td>TK</td>
<td>25</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2.64</td>
<td>0.85</td>
<td>0.823</td>
</tr>
<tr>
<td>CK</td>
<td>25</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>3.47</td>
<td>0.57</td>
<td>0.768</td>
</tr>
<tr>
<td>PCK</td>
<td>25</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>3.41</td>
<td>0.61</td>
<td>0.769</td>
</tr>
<tr>
<td>TPK</td>
<td>25</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2.25</td>
<td>1.05</td>
<td>0.929</td>
</tr>
<tr>
<td>TCK</td>
<td>25</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2.69</td>
<td>0.94</td>
<td>0.774</td>
</tr>
<tr>
<td>TPCK</td>
<td>25</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2.61</td>
<td>0.81</td>
<td>0.831</td>
</tr>
</tbody>
</table>

Figure 4.1

Mean scores for each TPACK domain.

Figure 4.1 represents the mean scores for each TPACK Domain. There was a tendency to self-assess PK, CK and PCK higher than the other domains. Teachers’ TK (2.64) was significantly lower than both PK (3.53) and CK (3.47). The mean for the domains was 2.92. The range of responses was 4, with a minimum response of 1 and a maximum response of 5. Standard deviation is also reported for each domain. In examining all three domains, teachers rated their average TPACK score at 2.61 with a standard deviation of 0.81, translating between ‘Fair’ to
‘Good’ on the scale. Although the overall spread of results suggests that teachers self-assessed their knowledge higher in domains without technology, TCK was slightly higher (2.69) than the overall TPACK average (2.61).

Figure 4.2 provides a visual representation of the way teachers reported their TPACK. It is based on the TPACK framework described in Chapter Two. Compared to Mishra and Koehler’s diagram, the circles in the figure below are not represented evenly. Where there are unevenly sized intersections, this would indicate stronger or weaker self-reported knowledge. For instance, the TCK, TPK and TPACK components are presented as smaller intersections. Conversely, the PCK component presents a much larger intersection to reflect teachers’ strong PCK knowledge.

**Figure 4.2**

**VET teachers’ self-reported TPACK**

**TPACK items.** Descriptive statistics were calculated for each survey item. Using percentage figures, an analysis was made in relation to each of the individual items in each domain. The items were deconstructed to ascertain the relevance of the TPACK framework and its components, to the VET sector.
In interpreting the survey items below, the TPACK domain items were randomly assigned. Therefore, the alpha characters in parentheses do not correspond with the order in the actual TPACK survey. The highest rated individual item (item c) fell within the domain of PK, the ability to ‘use a variety of teaching strategies to relate various concepts to students’ with an average response of 3.64. The next highest rated individual item (item s) fell within the domain of PCK, the ability to ‘comfortably produce delivery plans with an appreciation for the topic’ with an average response of 3.60. The next two highest items (j and m), had a response of 3.56 which fell in the PK and CK domains respectively. The lowest rated individual items (items n and p) fell within the domain of TPK with average response rates of 2.08 and 2.20 respectively.

Overall, teachers self-assessed their CK, PK and PCK with confidence in their ability to undertake traditional teaching tasks. They were not as confident in tasks involving technology. Of particular interest is that teachers rated their TCK higher than their TK suggesting that TCK may not have been perceived as relating to teaching.

**Pedagogical knowledge.** Figure 4.3 shows teachers’ overall rating of their pedagogical knowledge. It suggests that teachers felt confident undertaking traditional teacher roles in what can only be described as teachers doing what they do as part of their working lives. Item (r) indicated the greatest spread of knowledge about teachers’ ability to adjust their teaching practice which was somewhat contradictory to teachers’ reported confidence with items (c) and (j) potentially denoting a weaker aspect of teachers’ pedagogy.

**Number of responses**

![Figure 4.3](image_url)

- c. determine a particular learning strategy best suited to teach a specific concept
- j. use a variety of teaching strategies to relate various concepts to students
- r. adjust teaching methodology based on student performance/feedback
Teachers’ rating of pedagogical knowledge

Teachers’ ability to determine and apply a range of teaching and learning strategies was not always evident from the interview data. This will be discussed in the next chapter. These results are consistent with previous studies of practicing teachers, in particular, Archambault and Crippen’s (2009) study from which this survey was adapted.

**Content knowledge.** In relation to the three items presented in Figure 4.4, results indicated that teachers felt relatively confident about creating resources that mapped to their units, planning and making decisions about what they can teach despite the prescriptive nature of units of competency in Training Packages.

*Number of responses*

![Figure 4.4](chart.png)

**Teachers’ rating of content knowledge**

It is not surprising that teachers rated their content knowledge highly, having been recruited to teach in the VET sector based on their subject expertise and industry knowledge. It is worth noting that only one teacher rated CK as ‘Excellent’. These results are not dissimilar to Jordan’s (2011) study of Australian beginning teachers who rated CK higher than any other TPACK domain.

**Technology knowledge.** Figure 4.5 shows how teachers self-assessed their TK in relation to three items between ‘Fair’ and ‘Good’. These results suggest that teachers did not feel confident about the technical aspects relating to hardware and software issues. It is possible that the survey items restricted teachers’ ability to report on their actual technology knowledge in that the items were limited to technical issues.
Number of responses

**Figure 4.5**

**Teachers’ rating of technology knowledge**

**Technological content knowledge.** Figure 4.6 shows how teachers rated their technological content knowledge. Item (o) ‘use technological representations’ may have indicated teachers’ familiarity with PowerPoint to present content. However, items (t) and (v) showed relative consistency across the scale from ‘Poor’ to ‘Very Good’ which indicated variance in teachers’ knowledge to teach units of competency using technology and use Blackboard, the institute’s Learning Management System (LMS). No teacher reported ‘Excellent’ in these two items.

Number of responses

**Figure 4.6**

**Teachers’ rating of technological content knowledge**
Pedagogical content knowledge. Figure 4.7 presents the items used to assess teachers’ PCK. For the most part, teachers’ responses fell into the ‘Good’ to ‘Very Good’ categories. In comparison to all other domains, all four items in the PCK domain received an ‘Excellent’ rating.

Number of responses

Figure 4.7

Teachers’ rating of pedagogical content knowledge

Teachers generally felt confident about their pedagogical content knowledge. It is possible that teachers may have interpreted the survey items, especially (f) and (i) as relating to their ability to assess students. This perspective might reflect teachers’ adherence to meeting the standards of the VET sector’s Australian Quality Training Framework (AQTF). Item ‘i’ was spread across the Fair to Very Good category. Item ‘s’ was rated the best, in the Very Good category and item ‘f’ was rated the best in the Good section. This would reflect teachers experience in planning for sessions. Item ‘u’ was spread across from Poor to Very Good.

Technological pedagogical knowledge. Figure 4.8 shows the four items used to self-assess teachers’ reported ability to teach with technology. More than one third of all teachers rated this knowledge as ‘Poor’. Unlike other scales, no participant reported having ‘Excellent’ knowledge across the four items.
Teachers’ rating of technological pedagogical knowledge

Items (h) and (l) were similar, referring to teachers’ knowledge to create and implement technology-enriched environments using technology. Items (n) and (p) referred to the knowledge to moderate and encourage interactivity. Although almost one third of all teachers rated these items in the ‘Poor’, category, others were confident in the traditional teaching roles that involved the use of technology. Being able to moderate interactivity among students was the lowest scoring item. In summary, most of the teachers did not report having sufficient knowledge to teach with technology.

Technological pedagogical content knowledge. Figure 4.9 shows how teachers assessed their TPACK. The highest rated item was the ability to ‘use technology to predict student’s skill/understanding of a particular topic’. The lowest rated item was (s), the knowledge to ‘meet the overall demands of teaching with technology’, assessed by more than half of the teachers as ‘Fair’. 
Figure 4.9

Teachers’ rating of technological pedagogical and content knowledge

The spread of scores indicates a wide range of reported TPACK. Overall, these results show that technology knowledge influenced teachers’ self-assessment across TPACK domains compared to their knowledge in the pedagogical and content domains. If teachers are true to these beliefs, they might be expected to reflect strong pedagogical and content knowledge and weaker levels of knowledge involving technology. These results corroborate teachers’ scores in the other TPACK domains.

Qualitative Data: Interview Findings

Fourteen teachers were interviewed at their work stations. Interviews ranged between half an hour to one hour. Teachers were selected for the interviews based on the scores gained from the TPACK knowledge about teachers’ technology integration practices. For this reason, five teachers with the highest score, five teachers with a middle score and five teachers with the lowest score were invited to participate in the semi-structured interviews. One participant from the lower scoring cohort was not available to participate in the interviews.

Anonymity was maintained in reporting findings from the qualitative data, by de-identifying responses at the point when surveys were returned. Codes were ascribed when each survey was returned. They begin with a 0 (zero) and are followed by a chronological numbering
For example, 001, 002, 003, and so on, were allocated and maintained for the qualitative phase. The fourteen participants interviewed are coded between 001-025.

To augment the quantitative data collected, the interview posed a series of open-ended questions which were developed for the purpose of the study. One question was derived from Buehl and Fives’ (2009) study about where teachers derive their knowledge about how to teach. Prompts were used by the interviewer if the question was not understood. The questions were designed to add richness to the study, providing teachers the opportunity to articulate their beliefs about knowledge, teaching and learning with technology, their reasons for using (and not using) technology, their attitudes and perceptions about their technology use and the contexts in which their teaching with technology was played out. These questions were mapped to the seven domains of the TPACK framework. Table 4.2 presents an overview of the questions asked in the interviews.
Table 4.2

Mapping of Interview Questions to TPACK Domains

<table>
<thead>
<tr>
<th>Question mapped to TPACK domain</th>
<th>TPACK domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you teach?</td>
<td>CK</td>
</tr>
<tr>
<td>What does teaching mean? (Belief about teaching)</td>
<td>PK/PCK</td>
</tr>
<tr>
<td>How do you think people learn? (Belief about learning)</td>
<td>PK</td>
</tr>
<tr>
<td>Where does knowledge of how to teach come from? (Belief about knowledge)</td>
<td>PK</td>
</tr>
<tr>
<td>Where does knowledge come from? (Belief about knowledge)</td>
<td>PK</td>
</tr>
<tr>
<td>How important is it for your students to be able to construct their own knowledge? (Belief about knowledge)</td>
<td>PK/PCK</td>
</tr>
<tr>
<td>What does online /elearning mean to you? (Belief about teaching with technology and learning)</td>
<td>PK</td>
</tr>
<tr>
<td>To what extent do you believe that technology enhances learning for your students? (Belief about technology and learning)</td>
<td>TPK</td>
</tr>
<tr>
<td>Do you think technology makes a difference to the way students learn? (Belief about technology and teaching)</td>
<td>TPK</td>
</tr>
<tr>
<td>Show me some of the technology you use and how you use them.</td>
<td>TPK/TCK</td>
</tr>
<tr>
<td>How effective do you perceive your current use of technology is?</td>
<td>TK</td>
</tr>
<tr>
<td>To what extent have your skills in using technology changed since you began teaching?</td>
<td>TK</td>
</tr>
<tr>
<td>What are the critical factors towards successful outcomes and quality of learning with technology?</td>
<td>TPACK</td>
</tr>
<tr>
<td>What do you believe are the major impediments to fully integrating technology?</td>
<td>TPACK</td>
</tr>
<tr>
<td>Does your institute support teaching and learning with technology?</td>
<td>TPACK</td>
</tr>
<tr>
<td>What is the best use of technology that you have ever seen in a teaching and learning context?</td>
<td>TPACK</td>
</tr>
</tbody>
</table>

Teachers’ Beliefs about Teaching, Learning, Knowing and Technology

This section presents the findings to Research Question 2 which is in response to the question- ‘How do VET teachers’ beliefs about teaching, learning and knowledge relate to their beliefs about teaching with technology’? Teachers’ views are presented for each interview question.
Beliefs about teaching. All teachers provided a response to the question relating to their beliefs about teaching in general, as opposed to beliefs about teaching with technology. Figure 4.10 presents the responses which were coded into six main themes.

Number of responses

Note: Teachers could provide more than one response

Figure 4.10

Conceptions of teaching

Eleven teachers who were interviewed, believed that teaching meant providing content to the student. As the interviews took place at the teachers’ workstation, it was evident that the ‘content’ provided referred to course information such as: emails of introduction to the course, a web link for logging onto the LMS, learning guides, text books, assessment information and other resource requirements, and borrowing instructions from the learning resource centre. This content, as expressed by the following participant is all the student needs: ‘As far as their learning goes, most of it is done from their textbooks’ (003).

Consistent with the teacher’s traditional role, teaching also meant imparting knowledge and skills. Teachers were confident with the role of ‘sage on the stage’ role, justified through students’ enjoyment with this teaching approach. For example, one teacher reported feeling guilty for transmitting content: ‘I feel guilty when I stand and lecture but the students just want more…sometimes it is the fastest way to learn’ (004). The timing of the imparted knowledge
was seen to be important: ‘To teach means to impart knowledge into a person so they can understand what it is they are going to be doing’ (018).

Nine of the teachers interviewed, acknowledged the need to make their teaching more interesting by providing engagement and interactivity, although it seemed that technology was required to make that happen: ‘You don’t want it to be boring. You need to use technology to make it interesting so they interact with other students’ (022). The use of discussion within the LMS was perceived to be one way to achieve this, although this particular teacher was not using the discussion tools in the LMS at the time.

Without technology, the role of the teacher in providing guidance and support became even more important. This involved guiding the student to find information and pointing them in the right direction: ‘Teaching does not mean necessarily to impart knowledge but to help them find it’ (022).

The level of guidance and support extended to the process of assessment, also featuring commonly in teachers’ conceptions of teaching. As one teacher explained, she gives students advice as to where to go and what to access as she helps to work them through their assessments: ‘For each unit there is a learning section and an assessment section and in the learning section they do assessments’ (020).

Half of the teachers believed that assessment was integral to their teaching role. Equally important was the teacher’s role as a facilitator of learning which was used in preference to the notion of ‘teaching’ as one participant explained: I don’t believe in ‘to teach’. I think it is ‘to learn’. When I talk about teaching, I don’t talk about my teaching practices, I talk about my students’ learning practices. The learning process is more important. (025)

**Beliefs about learning.** Teachers’ responses to the question about what learning means were coded into five main themes, illustrated in Figure 4.11.
Conceptions of learning

The importance of ‘watching and doing’, which refers to observation and demonstration in the figure above, represented the idea of learning as physically active and engaged, mediated by a strong, teacher-centred presence. The teacher’s authoritative role in providing the content knowledge, before executing the ‘physical’ task was illustrated by the following comment:

There are lots of ways of learning: by watching, by doing. Usually by doing, but the way we teach is we give them the underpinning knowledge first and then they know what they have to do by watching the teaching, modelling it and then doing it themselves. (004)

Practicing a skill and then reflecting on that practice constituted learner engagement; for example, ‘When they have these interests, they will then be open to listening more, looking more and searching out more information’ (023). The importance of the teacher is similarly conveyed where learning is conceived as involving ‘instruction’ by an authoritative other. As noted by this participant, ‘You still need a certain amount of authority needed to convey to the students that you are the one that can help them learn’ (016). The hands-on practical nature of vocational learning is reflected in the following comment:

People learn by doing and exploring concepts for themselves. They need to take in the knowledge, analyse or interpret it and then make sense of what it means to them and what they are trying to achieve. (003)
The ‘making sense of what it means’ as indicated by the above quote can be achieved through ‘practice’. For example:

Well one is to make sense of what they are doing, rather than just ‘type out this and show me the end result’, get them to practice it a bit so then they can know what to do with it firsthand …whereas if they just follow along with the book, pretty much everything will work as they’re doing, and if they start to personalise things then they get much more engagement with the material. (011)

Structuring the content was important for several of the teachers. One teacher reported the importance of a scaffolded approach to learning:

We have to structure our course starting off with little bits of information and over 18 months they build on it…and as they progress they learn more…to add on to what they have previously done. (023)

Learning, therefore, reflected an ‘actively’ engaged student, practicing a set of skills which would lead the student to greater independence. This is not surprising considering the emphasis on practical, vocational skills and knowledge in the VET sector. The teacher’s role was therefore central, providing the knowledge and an expert, skilled performance, which the student could reproduce.

**Beliefs about knowledge.** Teachers were invited to articulate their beliefs about knowledge. Knowledge in this context referred to teachers’ beliefs about where their knowledge of how to teach comes from (source of teaching knowledge), how one comes to know or how knowledge is acquired (the source of knowledge generally), and teachers’ beliefs about the importance for students to be able to construct their own knowledge (belief about the importance of constructivism).

The source of teaching knowledge. The interview question aimed at understanding teachers’ beliefs about the source of knowledge for teaching was posed: Where does your knowledge of how to teach come from? Responses were coded into three main sources: from
teachers’ previous experiences as a student, reflection on their existing teacher experience and
from a teacher education programme. Figure 4.12 presents this information.

Number of responses

![Bar chart showing beliefs about where teaching knowledge comes from]

**Figure 4.12**

**Beliefs about teaching knowledge**

Eleven teachers believed that knowledge of how to teach was derived from their previous
experience as students. Typical responses to the question which indicated ‘previous experiences
as a student’ are illustrated by the following comments: ‘My first encounter with the
constructivist teaching was as a student in 2001. It was a culture shock and a very exciting
learning experience. This is the way I teach today’ (010). For another: ‘My delivery style is
influenced by what I felt worked well in my own education, including the support and feedback
given by my teachers’ (025). Two teachers referred to the importance of reflecting on their
teaching experience as a means by which they have learned how to teach. For one of them, past
experiences as well as reflection were important sources of teacher knowledge:

> Good teachers continually question what they do, how they do it and why they do it—and that includes both what they have brought with them from the past and what they have learned since. (003)

One teacher referred to the importance of the Certificate IV in Training and Assessment in
providing them with knowledge of how to teach:
I guess from my Training and Assessment… I remember sessions that I have attended where the trainer inspired me … used methods that helped me to learn and I try to incorporate these things into my training. (017)

The source of knowledge (general). Figure 4.12 presents teachers’ responses to the question about where knowledge comes from. From the total number of respondents (14), 12 usable responses were allocated into one of three categories: knowledge was acquired from an external source, from an internal source or was socially constructed.

Number of responses

<table>
<thead>
<tr>
<th>Source of knowledge</th>
<th>Number of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>External source</td>
<td>9</td>
</tr>
<tr>
<td>Internal source</td>
<td>2</td>
</tr>
<tr>
<td>Socially constructed</td>
<td>1</td>
</tr>
</tbody>
</table>

**Figure 4.12**

Beliefs about the source of knowledge

Nine teachers believed that knowledge came from external sources, that is, from other people, texts and media as well as experienced through the senses (reading, viewing, watching and doing). The following comment represents beliefs about knowledge as being of the ‘right’ or ‘wrong’ kind:

Knowledge can be acquired through reading information, observing the practices of others, experiencing and practising the skills they are learning. Sometimes they need assistance from the lecturer to think through or express their thoughts so that they know they are on the right track. (003)

On the other hand, the three teachers who believed that knowledge was acquired through internal sources implied an active learner, capable of self-reflection and cognition. One teacher expressed her view this way: ‘Knowledge is acquired by self-reflection, connecting new ideas and concepts with each other and with existing knowledge’ (016). Only one teacher believed
that knowledge was acquired through social interaction that is, it involved communication and discussion. She described it as: ‘Practicing what they have learned, and discussing with others. Personal factors also play into this in terms of motivation and need, prior study experiences, existing knowledge and skills’ (011).

**Belief about Constructivism**

In response to the question about the importance for students to be able to construct their own knowledge, most participants interpreted ‘construct’ as meaning to ‘build’, referring to either acquiring, accumulating or developing knowledge in order that students will eventually become autonomous, independent learners. For the following teacher, a central role of the VET teacher in learning is to teach the knowledge and skills and guide the student to acquire that knowledge: ‘It is my responsibility to teach them some important knowledge and skills but also to guide them to become independent learners’ (011).

However, there was no explanation provided of how this happened or evidence that it did happen. For others, the importance of students constructing their own knowledge was perceived to be unimportant, particularly in the learning of practical skills such as operating a chainsaw: ‘For example, if it is a course in chainsaw operation delivered over two days, there is little time for students to become involved in creating knowledge’ (016). It is important to note that for these teachers, ‘constructing knowledge’ was synonymous with ‘increasing knowledge’ raising the possibility that an awareness of ‘constructivism’ as an alternative pedagogical approach was not part of their pedagogical or epistemological repertoire.

**Beliefs about Technology and Student Learning**

The following section presents teachers’ responses to two questions. As the questions were similar, the results have been condensed. The questions pertained to teachers’ beliefs about technology, teaching and learning. When asked whether teachers believed that technology made a difference to the way students learn, responses tended to refer to: source of information, engagement, learner support, connectivity, communication, collaboration, flexibility and independence, terms consistent with a student-centred and constructivist approach to learning.
As a source of information: ‘Technology is a great tool to assist constructivist learners. The vast amount of information accessible through technology opens up the world to users’ (010). As a means to engage students: ‘I think that it enhances learning because, well, when its very theory based you have to keep them entertained somehow using the colours and brightness’ (023). To support learning: ‘Yes, it helps with their investigation and research skills where before when you were teaching, you would tell them what they had to do but with the world wide web you can get your students to investigate and research’ (011). Its appeal to a range of learning styles: ‘I think that a lot of child carers are visual learners…they are practical people, doing things and using their hands so if we can get more visual things up and going, that helps. I see it taking off and exploding and as technology grows the glitches start to disappear’ (017). As a means of communication: ‘Technology connects people from all over the world and this interaction helps create knowledge’ (024). Technology also ‘provides a platform for worldwide collaboration which speeds up and magnifies knowledge exchange and learning’ (011). It was also seen to enhance flexibility: ‘I think in our regional area it gives people an opportunity to learn whereas once they couldn’t. If you were east of (town name), at least now you have an opportunity to learn with technology’ (025).

For the most part, teachers’ responses indicated their world view of technology as being the Internet, accessed through a computer. This included teachers who expressed some doubt about the value of technology in learning. One teacher indicated that technology was not important for learning basic skills: ‘I prefer to stand in front of the class and have them involved in discussions. I still believe that hardcopies and handwriting are very important for students and their LLN [Language, Literacy and Numeracy] skills’ (025).

It is important to observe that technology was not mentioned as a resource with which students could become producers of knowledge through the affordance of Web 2.0 technology. Caution is therefore needed in interpreting this data in that teachers were expressing their beliefs about how they imagined technology could transform their practice. In summary, teachers believed that technology can enhance teaching and learning by making a positive difference to the way people learned through the constructivist affordances it offered.
Beliefs about Technology and Teaching

Teachers were asked to articulate their beliefs about what teaching with technology meant to them. The terms ‘online’ and ‘elearning’ were used to guide the way the question might have been understood. Responses revealed wide disparity in terminology, definition and knowledge of online and elearning pedagogy. There was a tendency to focus either on an understanding that teaching with technology provided an alternative to teachers’ traditional teaching practice or the digitalisation of their manual practice.

Teachers’ responses to what elearning/online means as an alternative pedagogy tended to refer to it as an optional choice. One teacher considered it as a means of developing student confidence to use technology: ‘Last year with my face to face class, I enrolled them in a unit online just so they had the confidence to use it for one hour per week and I would sit in my office while they accessed it.’ (025). Another teacher perceived the use of discussion through the LMS to be of little value:

We pride ourselves on flexible, open learning but the more students we get the more difficult it is to keep track of them… it is time consuming reading the discussions on Blackboard and following them is really difficult. (004)

Several teachers understood teaching with technology as the digitalisation of their manual practice. One teacher commented that: ‘Online learning to me involves putting content online rather than having paper based copies. It is a platform for our information and we are available by email or phone all the time’ (017). For another, ‘online learning to me is what one of our lecturers do well…try to keep as many things electronics (files and stuff) as possible’ (020).

While responses revealed wide disparity in terminology, definition and knowledge of online and elearning pedagogy, these findings were supported by the major findings from the 2013 E-learning Benchmarking Survey (2013). The survey acknowledged discrepancies and misconceptions about definitions of e-learning.
Beliefs about Content and Technology

In some content areas, three teachers did not believe they could teach their subject matter using technology. These teachers emphasised the need for a physical presence. As explained by one teacher, the VET sector ‘is all about physical activity, it’s a hands-on thing’ (012). Skills such as welding, farming and security were courses teachers believed could not be taught or learnt through technology. One teacher explained, ‘Clearly there are units you cannot do online such as conducting bomb searches. You have to be able to perform a search and address the real security issues’ (006).

Three teachers’ responses indicated some misunderstanding of the affordances of the technology to teach their content or a perception that to teach with technology meant online learning. For instance, one teacher reported that students needed to be taught basic computer skills to develop their confidence and independence to learn online. Another teacher reported providing advice to a colleague on how he could use technology in art:

He said it couldn’t be done and I said you just have to be a bit more flexible and creative. He asked how he could see the work if it was online and then I suggested a webcam as we all have webcams on our computers. (022)

Eight teachers were teaching their courses using technology, implying that their content could be taught using technology. However, there was very little evidence of specific technology from particular industry or vocational areas that was used to transform the content or to transform teaching or learning. The responses overall revealed teachers’ different understandings of what teaching with technology involved.

Characteristics of VET Teachers’ Technology Use

This section presents the findings of Research Question 3 which sought to identify the characteristics of VET teachers’ technology use. Teachers were provided the opportunity to articulate and demonstrate the technology they were using or not using, how and why (or why not) they were used it.
Teachers’ technology use. Table 4.3 presents the technology teachers used and how they used it. It shows the frequency (as a percentage) of the 14 teachers interviewed who used these technologies and their most commonly observed applications. These findings are consistent with teachers’ use of technology nationally, as reported by the E-learning Benchmarking Survey (2013).

From this table, it is clear that most teachers used computers, with which they could access email, the internet and software applications. It is also clear that many teachers did not use digital technologies. These results possibly correlate with teachers who scored highly and those teachers with low scores in the TPACK survey. In this study, TPACK scores were de-identified so it was not possible to match the teachers who were interviewed with their survey results.
### Table 4.3

**Teachers’ use of technology and its applications**

<table>
<thead>
<tr>
<th>Technology used by teachers</th>
<th>n=14 (%)</th>
<th>Most common applications of the technology by teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers (laptop, desktop or iPad)</td>
<td>14 (100%)</td>
<td>To access the Internet, To access the LMS, To enable administrative processes such as checking work emails and enrolling students</td>
</tr>
<tr>
<td>Email</td>
<td>14 (100%)</td>
<td>Communicating with management and colleagues, Communication with students</td>
</tr>
<tr>
<td>Mobile Phone</td>
<td>13 (93%)</td>
<td>Maintain contact with students on and off campus, Maintain contact with colleagues (voice and text)</td>
</tr>
<tr>
<td>Internet (web links, research and social media access)</td>
<td>13 (93%)</td>
<td>Research activities, View ‘YouTube’ video clips, Find learning content, Find multimedia content to upload to the LMS, Using social media (Facebook) to message students</td>
</tr>
<tr>
<td>Software applications (Word, PowerPoint, Excel)</td>
<td>12 (86%)</td>
<td>As a word processor, Keeping student records, Developing resources for learning and assessment, Presenting information/content through PowerPoint</td>
</tr>
<tr>
<td>Learning Management System (Blackboard, Catapult and Rural Skills Australia)</td>
<td>10 (71%)</td>
<td>Upload course content, Repository for learning content and assessment for pre-reading and content revision, Upload assessments, Receiving assessments</td>
</tr>
<tr>
<td>Data Projector</td>
<td>10 (71%)</td>
<td>Present content in face to face classes, As learning resource for face to face classes, Held in main library and borrowed, Create videos to upload into the LMS</td>
</tr>
<tr>
<td>Video/DVD/CD</td>
<td>6 (43%)</td>
<td>As learning resource for face to face classes, Held in main library and borrowed</td>
</tr>
<tr>
<td>Web-based software</td>
<td>4 (29%)</td>
<td>SlideShare- to provide Study Tips, Articulate/Hot Potatoes-to develop LMS content</td>
</tr>
<tr>
<td>Digital Camera</td>
<td>4 (29%)</td>
<td>Capturing evidence of student work</td>
</tr>
<tr>
<td>Virtual classroom (Blackboard Collaborate)</td>
<td>2 (14%)</td>
<td>Teach in virtual time, Upload recording of face to face classes</td>
</tr>
<tr>
<td>Electronic, portable scanner</td>
<td>2 (14%)</td>
<td>For scanning workplace documents as evidence of student work completed</td>
</tr>
<tr>
<td>Voice Recorder</td>
<td>2 (14%)</td>
<td>Recording student’s assessment evidence</td>
</tr>
</tbody>
</table>

*Note: For the most part, teachers used more than one type of technology.*
Teachers’ Reasons for Using Technology

Teachers reported a range of reasons why they were using particular technology. These reasons are represented in Figure 4.14.

![Reasons teachers use technology](image)

Note: Teachers may have provided more than one reason.

**Figure 4.14**

Teachers’ reasons for using technology

Consistent with teachers’ conceptions of technology, (previously discussed as referring to the Internet), it was reasoned that technology opened up the student’s world by providing a rich source of knowledge and information. In common with many teachers’ responses, it was believed that, ‘Technology opens up a world of new ideas and perspectives that can be gained through research’ (022). Implicit in this comment is an independent, self-directed student faced with a world of opportunity for gaining new knowledge and perspectives.

Similarly, as a source of information for both the teacher and the student, technology provided choice. Access to teaching and learning resources was immediate, easy and free. For this teacher, it is: ‘The immediacy of accessing whatever you want. You can access a lot of stuff, it’s simple, and it’s free’ (020).
Other teachers provided reasons relating to the way technology supported their current practice by enabling more efficient administrative and organisational processes such as cost and time efficiency, issues of sustainability and employee occupational health and safety. For one teacher, ‘We have actually been able to lower the resource cost for each unit from about $14 to $2 per unit’ (004). For another, ‘I think it is great because it has cut down on a lot of photocopying and paper’ (004). The following comment accepts cost and time efficiencies as legitimate reasons for using technology but notes the advantage of using webinars to conduct meetings and professional development workshops to reduce employees need to travel long distances between campuses:

The value is that it is cost effective and you don’t have to get everyone in the one room together, so it is cost effective and time effective and I think it works well for both reasons but also for the employees’ fatigue management. (025)

As a regional institute, it was not surprising to find that teachers cited accessibility and flexibility as reasons for using technology. The following comments indicated that technology not only provided accessible and flexible learning, but also provided for a range of learning styles and delivery options:

It provides access where it normally wouldn’t. If I was an external student and someone gave me books I wouldn’t read them. This way, as a visual learner it is good. It gives them the flexibility to do it anywhere. (017)

It is a different way of learning compared with like, ten years ago. Basically we used to work out of hard copy—it was all books and it was printed and as cohorts changed over time…but by being flexible we have managed to keep it full time. (023)

Five teachers noted that they understood the organisational mandate to develop and promote online learning. Equally, they acknowledged some pressure to participate in a technological world as the way of the future, for both teachers and students, particularly in regional areas, as illustrated by one teacher: ‘It will be in their face and we have to prepare our students to use it’ (022). For others, reasons for teaching with technology were for personal enjoyment:
I guess I enjoy technology. I have a responsibility to work with my organisation’s priorities but also I don’t want not to be savvy for my own self pride. I like technology and I am not a trouble-shooter but I understand the software and I don’t have an interest in fixing it. (024)

Almost half of the teachers stated an intention to further develop their assessment practice through technology. The understanding that technology and online learning referred to the ease with which assignments were submitted, marked and returned to the student appeared to be the driving force behind teachers’ intentions:

We need to follow and keep up…and that is why the online [assessment] submission has to go down that line and we have all these reasons why we don’t want to. You just need to keep up with what is happening. (004)

It is important to note that findings from the 2013 E-learning Benchmarking Survey also indicated increased online assessment activity by VET teachers who reported using online submission of assessments. Teachers’ explanations for the reasons why technology was not being used were linked to the delivery structure and their technological knowledge. As the following teacher explained, trying to create a synchronous, virtual classroom using Blackboard Collaborate in a self-paced learning context is difficult:

If they [online learning classes] were structured, we could all talk about an item at the same time. The flexible, self-paced delivery mode certainly stops us from using technology in a more interactive way. (003)

In summary, teachers provided a range of reasons for using technology. These reasons were consistent with perfunctory uses of technology to support traditional teaching practices, rather than allowing greater pedagogical freedom.

**Teachers’ Attitudes towards Technology**

Teachers articulated their attitudes and perceptions about teaching with technology in response to the following questions: How effective do you perceive your current use of technology? To what extent have your skills in using technology changed since you began
teaching? and What is the best use of technology that you have ever seen in a teaching and learning context?

Teachers reported feeling confident about their use of technology. Many expressed an intention to integrate more communication and interactivity into their teaching practice, suggesting that they enjoyed using technology; they saw the pedagogical affordances technology offers; but they needed more time to develop their knowledge and skills. With this general confidence and enthusiasm, they acknowledged that their knowledge was limited, which, in effect restricted the amount of technology that could be integrated. This optimism is shared by the following representative comment: ‘People who don’t enjoy it [technology] have a barrier against learning it and it is difficult as they don’t pass enthusiasm onto their students’ (004).

Teachers agreed that their technology knowledge and skill was developing, although some were more cautious than others for fear of ‘technological determinism’ overshadowing its pedagogical application. Inherent in the comment below is a perceived pressure to integrate more technology as it was not being used to its greatest capacity;

Well I have always tried to embrace it [technology] but I’m not one of the ones who would race off and go and buy it. I’d want to see it before and actually have proven history on the ground. I think I do need to improve my own knowledge. I’ll do an intensive course or something. (020)

Another teacher felt limited by his context, and while perceiving his technology knowledge as strong, he described it as such:

I am not getting as much out of technology as I would like. Probably not because a lot of things like podcasts and recording stuff with a mobile phone or camera is just something that I can’t do within a prison environment like I’m not allowed to take a mobile phone in. (011)

These findings are consistent with the E-learning Benchmarking Survey 2013 whereby most of the respondents felt confident about using technology, yet only 25 % felt highly confident.
Teachers’ Attitudes towards Developing Technological Knowledge and Skill

Teachers reported that their technology and skills had developed as a requirement of their roles as VET teachers, many of them noting that their skills had developed in their current workplace. One participant explained: ‘I always thought technology was hard but to be successful in the trades I knew I had to learn it and so when I joined TAFE I had a head start. I can use basic computer skills’ (020).

Several teachers expressed the need to develop their skills before their students so that they could support them. For example, one teacher said: ‘I want to be confident, even with Blackboard, until I know exactly what I am doing. I don’t want my students on it, because I want to be able to help and support them’ (020).

It is noteworthy that many of the teachers expressed an intention to use more technology in the future. They spoke in futuristic terms of what they will be doing and how they will be doing it, especially as it relates to more sustained use of the LMS; creating more online assessments; incorporating more YouTube videos; and providing more opportunities for discussion. As the following comment indicates, the electronic submission of assessments appeared to be a major goal of Blackboard functionality: ‘Assignment drop boxes will be set up within the LMS because printing out assignment is a little old fashioned’ (017).

Most illustrative of the teachers’ beliefs about their technology knowledge is that, ‘My knowledge is limited so I would suppose that that would stop me integrating technology as much as I would like to…the more my knowledge increases the more I will be integrating it.’ (003) Teachers who were not using technologies beyond the computer, the Internet and the mobile phone were in the process of developing an awareness of other tools. The little knowledge they had created two problems. Firstly, it restricted the amount of technology they could use; and secondly, it indicated that they could not use technology that they were unaware existed. Therefore, it is not surprising that they gave the technology domain and its blends a low rating in the survey.
Exposure to Best Use of Technology

Five teachers responded to the question about the best use of technology they had seen in a teaching and learning context. Teachers’ responses to the best use of technology seen in a teaching and learning content were limited to the use of Blackboard as a platform for a virtual hospital, Blackboard Collaborate as a virtual classroom, communicating with students through Skype and the Internet in providing access to games and videos.

As indicated by these teachers, limited exposure to the use of technology in teaching was evident. That very few teachers provided responses to the question suggests they may not have seen examples of what they consider to be best practices of technology use in teaching; or if they did, they may not have valued what they saw. It is noteworthy that best practice models of teaching and learning with technology did not make reference to the use of Web 2.0 technologies that could support students as producers of knowledge.

Perceptions of Critical Factors Affecting Successful Outcomes of Teaching with Technology

The way in which teachers perceived successful teaching with technology related specifically to students and the need to develop technology knowledge to teach effectively with it. Emphasis on the importance of ensuring and maintaining regular feedback and communication with students, designing and creating visually appealing, easily navigable and relevant course materials and the need to create an engaging and interactive learning environment, characterised many of the teachers’ responses. The following teacher illustrated this focus:

Students say that they like to learn through us because we get back to them straight away. Feedback will help with their learning. It needs to be easy for them to access, to log in and needs to work. It needs to be appealing and attractive and easy to navigate. It needs to mean something. (003)

Other teachers believed that students needed an ongoing, communicative and supportive relationship with the teacher. However, the need to ensure that learning was engaging.
meaningful and interactive was cited as critical for five of the teachers. As one participant stated, ‘You need interactivity, otherwise it is just looking at the computer and reading from it’ (024).

To achieve a student-centred, technologically-rich environment, technology knowledge was considered critical. This same knowledge was required to be able to solve student technology issues. According to one teacher, many of her students are fearful of learning with new technologies. She described the importance for teachers having at least minimal technology knowledge because students may ring up to say they cannot access the course and as the teacher you have to have the skills to help them: ‘As adult learners their biggest fear is not being able to operate the technology and not to be afraid’ (024). Many of the teachers cited students’ technology knowledge to operate in an online environment as a critical factor for successful learning with technology. The following quote is representative:

High school does not prepare students well enough to enter into another different learning environment. They don’t know little things like how to resize photos, how to attach documents to an email, how to change settings on printers. They can upload photos on Facebook but lack knowledge in basic things. (10)

**Impediments to Technology Integration**

Teachers’ responses to the question about the major impediments they faced integrating technology into their teaching practice are shown in Table 4.4. The frequency of barriers are cited (as a percentage) of the 14 teachers interviewed.
Table 4.4

Impediments to Fully Integrating Technology into Teaching Practice

<table>
<thead>
<tr>
<th>Barriers</th>
<th>N=14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fears about student ability to cope in an online environment</td>
<td>13 (93%)</td>
</tr>
<tr>
<td>Time required to develop course</td>
<td>13 (93%)</td>
</tr>
<tr>
<td>Reliable Internet connection and speed</td>
<td>13 (93%)</td>
</tr>
<tr>
<td>Insufficient teacher technology knowledge and skill</td>
<td>12 (86%)</td>
</tr>
<tr>
<td>Access to technology</td>
<td>8 (57%)</td>
</tr>
<tr>
<td>Insufficient student technology knowledge and skill</td>
<td>7 (50%)</td>
</tr>
<tr>
<td>Internet access</td>
<td>4 (36%)</td>
</tr>
<tr>
<td>Compatibility of technology device</td>
<td>3 (29%)</td>
</tr>
<tr>
<td>Legislative controls</td>
<td>2 (14%)</td>
</tr>
<tr>
<td>Fear about using technology</td>
<td>2 (14%)</td>
</tr>
</tbody>
</table>

Note: Some teachers cited more than one barrier.

Four of the most commonly cited barriers related to fear about students’ ability to cope in an online environment, the time required to develop courses, having a reliable Internet connection, and insufficient teacher technology knowledge and skill. Fears that students did not possess basic digital literacy, effective time management or study skills, and adequate literacy and numeracy levels, posed a significant impediment. One teacher stated:

Students are coming from high school to me lacking basic literacy and numeracy skills. The online learning environment would disadvantage them greatly, as for example, the learning guides cannot be tailored online to students having trouble understanding them. (010)

Time also was considered to be a significant impediment, especially time to develop their own technological skills, time to support students to develop their skills, to prepare delivery and assessment resources as well as the time to prepare courses for online delivery. Continuous changes to versions of the LMS required constant updating of course material: ‘I
have put a lot of time into this… and I just heard the other day that this one runs out at the end of the year’ (023).

Thirteen teachers cited student access to a reliable Internet connection and an adequate download speed as a major impediment to teaching with technology (93%). According to one teacher, Internet access and slow download speed were considered barriers in the past. Now, for many of her students, the newer technology available slows the Internet down considerably, most of the time dropping out completely, even though she is only three kilometres from the town. She recalls: ‘The first question the students ask is if the online course works with ‘dial up’ Internet connections’ (024). Insufficient technology knowledge and skill also presented a significant impediment by the majority of the teachers. One teacher wished for a few months of professional development with an IT specialist to put a course together, ‘Just give me the time and the knowledge required to put a course together to make it happen’ (018).

It is interesting to note that the impediments teachers faced appear to relate to both external and internal barriers—a theme consistent with findings that emerged from the E-learning Benchmarking Survey (2013).

**Perceptions of Institutional Support**

Different responses were reported about how teachers perceived the level of support that their institution offered to develop teaching and learning with technology. For the most part, teachers felt supported, despite their organisation’s expectation that they should work towards a culture of online teaching and learning. Teachers acknowledged that while it was part of the institute’s strategic direction to become an open learning provider, there was also an element of personal interest: ‘It is a strategic plan of the college to go online but it is also a personal passion of our lecturers’ (023). Others commented that adequate professional development was important and was provided by the institute; ‘…they are supportive and we get opportunities to go and do PD on online learning’ (012).

Awareness of the institute’s strategic direction served to create a level of angst for this teacher: ‘Well, there was a big push from management to go online and if you didn’t, you were
going to be in trouble or left behind’ (020). Being left behind was a fear expressed by another who concluded, ‘The institute has pushed it a little bit, but it is the way to go’ (003). And for another: ‘It is the way the world is heading’ (025).

Wanting to keep up with changes in technology meant that often teachers discovered their own professional development: ‘Yes, we do our own PD. If you don’t, you don’t know what is happening’ (022). Although teachers generally felt supported by the institute, access to time and technical expertise was missing. As one participant commented: ‘Start with me and it would be nice to turn off for a few months and work with an IT specialist to get it all together’ (018).

**Chapter Summary**

Teachers in this study reported their pedagogy knowledge, content knowledge and its amalgam, pedagogical content knowledge highest out of the seven TPACK domains. The results showed that teachers self-assessed their knowledge lower in domains with technology. Technological pedagogical knowledge was rated the lowest of all domains.

Teachers articulated traditional transmissive beliefs about teaching, learning and knowledge. These beliefs were reflected in teachers’ actual classroom practice with and without the use of technology. Teachers’ reasons for using technology reflected their transmissivist beliefs.

In relation to teaching with technology, teachers expressed constructivist beliefs about learning with technology and transmissive beliefs about teaching with technology. These beliefs were consistent with what teachers thought were the critical factors required for successful teaching with technology. Teachers’ beliefs about teaching with technology revealed widespread misconceptions of terminology as related to teaching with technology. These tended to focus either on an understanding that teaching with technology provided an alternative to teachers’ traditional teaching practice or the digitalisation of their manual practice. These beliefs were consistent with teachers’ beliefs and conceptions of teaching (without technology).
Teachers used technology to support traditional teaching practices. Actual technology use was limited to a range of ubiquitous technologies which were being used in traditional ways. Firstly, use of technology was inconsistent with how teachers believed technology enhanced learning. Secondly, actual technology use was consistent with teachers’ beliefs about teaching. Teachers’ reasons for using technology were consistent with how technology was being used. Their use of technology was inconsistent with how teachers believed technology could enhance learning.

The characteristics of teachers’ attitudes about teaching with technology are that they expressed positive attitudes towards technology use, although they were not using it to the extent they would have liked. They also expressed the intention to develop further skills so they could use more technology in their teaching.

Finally, teachers expressed a range of perceptions relating to the level of organisational support they received, the factors required for quality teaching with technology, the impediments they faced and their beliefs about students. Embedded in these perceptions is a need for both teachers and students to develop technology knowledge. These needs are framed within a traditional teaching and learning paradigm. The next two chapters discuss these findings in the form of a series of assertions. Chapter Five discusses the findings related to VET teachers’ beliefs and practices. Chapter Six discusses the findings related to VET teachers’ attitudes and their understanding of TPACK.
Chapter Five: Teachers’ Beliefs and Practices

Overview

This chapter discusses the findings from the TPACK survey questionnaire and the semi-structured interviews. The findings are reported in the form of assertions and are supported by quotes from the teachers. The assertions were developed based on substantiated evidence from the multiple data sources and pertain only to this study although they might inform the reader about more general situations and contexts. The following research questions provided the focus for the chapter:

- How do VET teachers’ beliefs about teaching, learning and knowing relate to their beliefs about teaching and about teaching with technology? (Assertions One and Two)
- What are the characteristics of VET teachers’ technology use? (Assertion Three)

Teachers’ beliefs about knowledge, teaching and learning in general, outside any specific technology use, were deemed important, particularly as they have been conceived in the VET sector. In this study, it was especially important to understand teachers’ epistemological and pedagogical beliefs regardless of how teachers rated their TPACK. It was expected that teachers with traditional pedagogical beliefs might also have held traditional epistemological beliefs. These were considered teachers’ core beliefs. Left unchallenged, they might indicate reluctance on the teacher’s part to consider modifying practice once technology was introduced. That being the case, the decision to integrate technology into teaching might signal the need for a shift towards pedagogy more aligned with the constructivist paradigm.

This assertion (Assertion One) therefore provides evidence of the ways in which teachers expressed traditional beliefs about teaching, learning and knowledge. Firstly, teachers’ beliefs about teaching and learning are presented. The beliefs are characterised by a transmissive orientation. In common with the traditional paradigm, evidence of a teacher-
centred practice, issues of teacher identity and their understanding of individual cognition are presented. Secondly, and connected with individual cognition, teachers’ conceptions of constructivism are described. Finally, teachers’ beliefs about knowledge are presented, including the source of their teacher knowledge and the source of their generic knowledge.

**Assertion One: VET teachers expressed traditional, transmissive beliefs about teaching, learning and knowledge.**

It is not unusual that teachers in this study expressed beliefs about teaching that reflected a traditional, transmissive teacher-centred approach to teaching (Levin & Wadmany, 2008). Recent observations of a group of Australian teachers indicated that teachers’ actual practices were more likely to be teacher-centred, despite the expectation that teachers would make a shift to constructivist practice once technology was introduced (Orlando, 2013).

The nature of VET practice requires multiple pedagogical approaches. As Doolittle and Camp (1999) explained, vocational teaching is based on specific solutions to specific problems. For example, to teach wiring of an electrical device reflects how electricity works. It is not necessary to construct knowledge about how the wiring is done. It will work or it will not work. Constructivist approaches are therefore not appropriate in all instances. Operating machinery is another example. This is described by the following teacher: ‘There is little time for students to become involved in creating knowledge. There is a skill set that has to be internalised’ (016). For another teacher, rote learning was perfectly acceptable for teaching anatomical terminology: ‘Some of our units, like anatomy requires a lot of rote learning and you have to go over it and over it’ (023). For another:

…to learn practical skills, rote learning takes place…until it is imprinted on the brain and can be done automatically. Examples can be found in learning a musical instrument, driving a car and assembly line work. (016)

Relying on a singular pedagogical approach would be insufficient to prepare students for complex and competitive workplaces.
In this study, teachers believed that their role was to provide a range of resources for their students. This included imparting knowledge: ‘Knowledge is acquired through the instruction process’ (017); imparting skills: ‘My skills are given to my students’ (012); imparting content: ‘In Blackboard…we have all the information the students need’ (004); and interaction: ‘We need to think how to get the students to interact more’ (003). Implicit in this role was a belief about the student: one characterised by passivity, the responsibility of the teacher of which was to activate, provide knowledge and to nourish. Teachers’ practice was characterised by the transmission of both knowledge and skill from the teacher, or some other external authority (as expert) to the student (as passive recipient). Teachers believed that technology was useful as it allowed the student ‘to be instructed from a distance’ (017).

Instructing from a distance involved taking the students through the following guided process: ‘We take them through the Assessment Plan to pass the cluster…we show where the PowerPoints are…We give advice as to where to go and what to do and work them through their assignments and what to access’ (004). Replacing the traditional external and distance delivery modes with an electronic version of the hard copy from within the LMS reproduced the knowledge transmission paradigm. From this perspective, it would be hard to conceive of students as knowledge producers.

Characteristic also of the transmission approach to teaching was the notion of the teacher at the front, telling students what they need to know: ‘I feel guilty when I stand and lecture but the students want more. Sometimes, it is the fastest way to learn’ (004). On receiving this transmission, the sense-making on the student’s part depended on their level of self-direction, an approach clearly at odds with what teachers believed about the nature and the characteristics of VET students in this research and that of other studies (Choy & Delahoye, 2002; Smith; 2010; Subramaniam, 2006). This is discussed further in Assertion Five.

Teachers also believed that their role was to demonstrate skills which students reproduced and practiced. Skill transmission involved observing an expert, or some other authority such as a teacher, execute the physical performance, coupled with explanation, demonstration and rehearsal. The VET teachers in this study described this as typical practice. It
was clear that teachers believed students learned their skills through active participation, as indicated by the following comments:

There are lots of ways of learning, by watching, by doing…the way we teach is we give them the underpinning knowledge first, then…by watching the teacher modelling and then doing it themselves. (004)

…by watching someone demonstrate, or listening to someone relate information. (018)

…observing the practices of others, experiencing and practising the skills they are learning. (003)

Implicit in these responses was the importance of an authority figure demonstrating the skill. The student was then required to replicate the performance under the tutelage of the teacher: ‘You still need a certain amount of authority to convey to the students that you are the one that can help them learn’ (016).

It is possible that teachers were familiar with the traditional apprentice/master model from their own trade training. Critics of this model might suggest limited exposure to expert performance from a range of different workplaces. For teachers in this study, their expertise served to establish their authority: ‘It is my responsibility to teach them some important knowledge and skills but also to guide them to become independent learners’ (003).

Teachers, who were using various technologies, viewed the internet as a valuable resource, in particular, as a source of knowledge. It provided a wealth of information for students, particularly in the way it was seen to extend their knowledge: ‘…they gain insight into new ideas and stumble across useful web sites consolidating and extending their underpinning knowledge’ (022). The internet therefore was perceived to provide content knowledge rather than content skills. Generally, teachers did not demonstrate how they used the internet to provide students with alternative perspectives of a skilled performance. Although one teacher described using a mobile phone for that purpose: ‘I tell them to find the timing of a fuel system, now I can just tell them to YouTube it’ (020).
Teachers acknowledged the importance of technological knowledge; however, due to their limited knowledge, some admitted that they needed to learn more about the technology used in their system before they could support students’ learning. Several teachers described the importance of learning about technology before they taught students. These descriptions illustrated deeply held transmissive epistemologies regarding the source of authoritative knowledge. Teachers’ privileged knowledge was expressed in these comments:

I want to be confident, even with Blackboard, until I know exactly what I am doing. I don’t want my students on it, because I want to be able to help and support them. (004)

My technology was limited and then when I turned up at TAFE, they told me I would be teaching IT. I spent the next two weeks teaching myself and then went into class. You either fake it or make it. (025)

It is possible that these perceptions reflected teachers’ own educational backgrounds. As VET teachers in Australia tend to have had minimal educational experiences beyond their own learning history (Kilpatrick & Bound, 2003), they often fall back on models from their experiences as students (Kotrlik & Redmond, 2004). Such limited pedagogical experiences are unlikely to equip VET teachers to adopt constructivist pedagogy (Hodge, 2009) without some form of professional development.

**Conceptions of learning.** Teachers’ beliefs about learning reflected their beliefs about teaching. In addition, teachers’ practices were consistent with their beliefs about teaching, learning and knowing. These practices were reflected in the language teachers used to describe how learning happened (observing, demonstrating, engaging and practice). The emphasis was on an ‘actively’ engaged student. For one teacher, the way she liked to be taught was how she believed others would learn: ‘I like things to be explained to me and shown how to do something’ (003). For others, learning involved: ‘observing the practices of others, experiencing and practising the skills they are learning’ (004) although ‘real life is usually the most successful way’ (017).
These beliefs are not surprising considering the importance of the practical and vocational nature of skills and knowledge in the VET sector. For these teachers, student learning was therefore very much dependent on the teacher.

**Teacher-centred practice.** Teacher-centred practices were intricately connected to teachers’ transmissive pedagogy. In this study, teachers adopted a teacher-centred pedagogy despite espousing a student-centred and constructivist orientation to teaching with technology. In response to the interviewers’ prompt about the need to provide interactivity for distance students, one teacher commented: ‘As far as their learning goes, most of it is done from their textbooks’ (016). For another: ‘I prefer to stand in front of the class and have them involved in discussions’ (012). While the following teacher understood the principles behind constructivist teaching, she nevertheless described it as a ‘fluffy’ approach: ‘I am a firm believer that you can still learn by being told. I think there is still a place for the lecturer to disseminate information. I don’t think you need to turn into something fluffy’ (025).

One teacher acknowledged that her teaching was somewhat too directed and considered making changes: ‘Students still have to read their textbook; so I suppose that’s where I think we need to make some changes. All we have on there are instructions, word documents’ (004). These approaches were in fact teacher-directed, teacher-guided and teacher-driven. The teachers believed they were the authority responsible for controlling teaching and learning processes.

Teacher-centred teaching was often characterised by a passive student. Interestingly, teachers in this study considered it important for students to become independent. This was an important goal of vocational education for many teachers as they felt that students need, ‘to expand their knowledge and the places they obtain it as it promotes autonomy’ (003). Similarly, ‘it is important for students to be able to develop their own learning and be responsible for it. We work remotely so each student has to be responsible’ (024).

However, students were not generally perceived to be able to take responsibility for their own learning. In the following examples, students were heavily dependent on the teacher to provide support. One teacher explained: ‘You need to teach them every step; you sit down next to them’ (010). Another teacher asserted: ‘Learners need to be self-motivated and
independent, which all students are not’ (016). For example: ‘Our Indigenous students… we know from the past that independent, flexible, self-paced learning is not successful with that group’ (040).

Perceiving students in this light might make it more difficult for teachers to relinquish control. This deficit model of the student that emerged in this study (discussed further in Chapter Six) justified the teacher-centred approach. A strong teacher-centred practice was also evident in the ways teachers used technology. Teachers did not describe students using technology to perform high level cognitive activities such as creating, designing, analysing and problem solving. In vocational practice this is not surprising (Marsden & Piggot-Irvine, 2012). Uses of technology were not to enhance learning for the student but rather as a means for supporting teachers’ practice. The expectation that Web 2.0 tools would transform teaching and learning was not fulfilled. Teachers did not describe using Web 2.0 in their practice. There did not appear to be any expectation that students would be involved in Web 2.0 activities, either as producers or as consumers. The teacher-centred practices of the teachers in this study were sustained by their perceptions of students as well as their knowledge about teaching with technology.

Teacher identity. VET teachers’ identities are formed by their content expertise (Chappell, 2004) and workplace roles (Brennan, Kemmis & Green, 2013). Their identities as teachers, however, develop once they begin teaching. In light of these dual identities, coupled with traditional conceptions of teacher-centred teaching, teachers’ identities in this study were inextricably bound to a sense of authority. To illustrate the dual identity, one teacher reported: ‘My skills are given to my students’ (012).

Like most teachers, teachers teach how they themselves were taught. Adopting new ways of teaching and learning presents challenges to teachers’ fundamental beliefs and assumptions about their practice. New approaches involving technology for these VET teachers were characterised by greater student-control. In the following quote, not only did the teacher lament the loss of the face to face classroom, at stake also were issues of teacher identity and control:
Sometimes I feel a bit redundant as they read books and do assignments… I wish that I was in front of them in a face to face class so that I can be teaching things, explaining…and answering questions. (003)

A teacher-centred approach was associated with direct ‘teaching’, ‘explaining’ and ‘answering questions’. In this example, the student in the online environment was not passive or wholly dependent on the teacher. This was despite the fact that many of the teachers’ goals were to develop their students’ independence. For this teacher, the different pedagogical approach required of the online environment was not acknowledged. It is likely that this particular teacher had never taught using technology, having come from an industry that is practical, hands-on and skill-based. The online environment provided a greater, much richer source of knowledge. Subsequently, teachers felt the loss of identity that their content expertise had constructed. Teachers feared losing control.

**Individual cognition.** Under the traditional, transmissive knowledge paradigm, knowledge existed in the minds the teacher as the authority. Teachers valued the importance of transmitting legitimate, conceptual and procedural knowledge, rather than perceiving the student as capable of producing knowledge through interaction with others. One teacher explained: ‘To teach means to impart knowledge and share knowledge. It is the expert, or industry, who has great credibility in sharing their knowledge’ (024). In the VET sector, the notion of transmitting or imparting ‘credible’ knowledge does not rest solely with the teacher. Characteristic of VET practice, external authorities, such as industry experts and workplace supervisors play a key role in training students. This study did not examine this aspect of VET practice.

Opportunities for sharing knowledge were available. Teachers demonstrated the ways they were using the LMS, which could provide collaborative learning through its various features. Many of the assessments were based on tasks which were to be completed in the workplace. Group assessments were possible in these locations. Teachers who preferred face to face teaching to online teaching cited group discussion as the key difference: ‘If we had a class and treated it as a face to face class, you could have heaps of discussion’ (004). Clearly then, discussion was valued. Teachers in face to face environments reported a wider range of teaching
strategies. Discussion in the following example was used to provide a nurturing learning environment for a group of Indigenous males, rather than knowledge construction: ‘In the classroom, it is all about group work and discussion…making people feel safe…looking after their needs’ (025).

The means through which discussion and dialogue enabled the sharing of knowledge was not clear. Very little evidence was found to suggest that students were encouraged or guided to create and produce knowledge for themselves or their peers. Facilitated and collaborative learning was not evident. Teachers transmitted the content. Typical learning activities for students was reading their learning guide or text book and completing the activities. Assessments were then developed, based on having read these resources. Students were then required to complete a series of workplace tasks. More often than not students worked individually. Their learning was therefore perceived as ‘individual cognition’ (Chappell, 2004) despite the fact that learning in the VET sector requires interaction in social contexts rather than in isolation (Salter & Bound, 2009).

Constructivist practice. Over half of the teachers in this study used concepts consistent with constructivist pedagogy. In the following quotes, the ways in which teachers described the importance for students to be able to construct knowledge, raised the possibility that an awareness of ‘constructivism’ as a pedagogical referent had not emerged. The construction of knowledge was synonymous with either ‘developing’ or ‘increasing knowledge’. This belief was consistent with teachers’ beliefs about teaching and learning. They believed that their role was to impart and transmit knowledge so that students acquired, increased or developed it.

If students can develop their own knowledge then they are not relying on me for all of their learning needs. (003)

It is important that our students undertake their own research…acquiring knowledge through links and resources given to them…consolidating and extending underpinning knowledge. (004)

It is my responsibility to teach them some important knowledge and skills but also to guide them to become independent learners. (011)
Neither teachers’ descriptions nor demonstrations of their practices reflected a constructivist pedagogy. This suggested an inherent contradiction between teachers’ beliefs and their practices. They did not explain how students acquired, increased or developed their knowledge. As teachers typically reported, ‘students only need the learning guides (010).

The use of terms such as ‘engagement’, ‘exploration’ and ‘interactivity’ were often used, all of which suggest constructive practices. As one teacher reported: ‘People learn by doing and exploring concepts…take in the knowledge, analyse or interpret it and then make sense of what it means to them and what they are trying to achieve’ (004). Another explained how people learn unconsciously: ‘People learn through experiences…exploratory learning where you don’t think you’re learning…doing things’ (025).

Constructivist language was used to describe the strategies teachers in this study would adopt in the future. As the following comments denote, technology was the proverbial panacea for realising these intentions:

…they don’t have a lot of feedback from the lecturers. We will have to take this into consideration when we start marking electronically. (004)

Hopefully with Blackboard I want to use discussion…I want to use it as a learning tool where I can ask them to go away and research and allow others to comment upon…you feel that you have a community. (017)

I want to make Blackboard a bit more interactive…when I have the skills as…this is very new to us as well. I will be able to put more things in there…more discussion that they have to contribute to…I just want to make it more so that they want to go on from there. (003)

…newer technology…has to be interactive. (004)

Technology connects people from all over the world and this interaction helps create knowledge. It opens up a world of new ideas and perspectives that can be gained through research. (016)

These plans for the future involved creating interactive learning experiences for students separated by distance. It is significant that teachers were thinking about changing their practice,
suggesting that some internal shift was taking place. This would mean that making the transition to online pedagogy might be easy.

It is not surprising that VET teachers expressed limited awareness of constructivist theory. Teachers have had little exposure to constructivist models of teaching and learning. The Certificate IV in Training and Assessment addresses a range of learning theories; yet it makes little mention of constructivism as a potentially transformative learning paradigm. According to Hodge (2009), it is not a goal subscribed by VET policy and practice. Rather, the behavioural paradigm upon which the Certificate IV in Training and Assessment is based serves to transmit and reproduce the dominant political and economic landscape. Empowering students and their learning is clearly not part of this vision. Teachers believed that this landscape would become a reality once they developed further technology knowledge and learned how to use it to teach. Evidence of the ways in which technology achieved this will be presented in Assertion 2.

Epistemological beliefs. Teachers’ fundamental beliefs about knowing were considered to be central to their teaching practice. This study explored teachers’ beliefs about the source of their teaching knowledge, that is, how they learned to teach. It also explored teachers’ beliefs about where knowledge came from generally, that is, how one comes to know anything. Teachers’ responses to both of these questions revealed the source of knowledge as existing externally to them and to their teaching practice. Teachers believed that knowledge was fixed and stable, transmitted from one with more knowledge to one with less, unquestionably and incontestably.

Such traditional conceptions of knowledge are supported by other research on teachers’ epistemic beliefs (Dirkx et al., 2004; Zinn, 2013). Knowledge viewed through this lens will only ever be transmitted. These explanations were similar to how teachers conceived of learning, which, for the most part was described as the reproduction of a skill from an observation of one more authoritative expert to another less skilled. The conviction with which teachers held these beliefs paralleled the strong pedagogical content knowledge teachers reported in the survey.

Source of teacher knowledge. Most teachers reported that the source of their teaching knowledge came from their experiences as learners, more so than from their experiences as
students in the vocational teacher’s education preparation course, namely, the Certificate IV in Training and Assessment. These results corroborate Feucht and Bendixen’s (2010) findings that teacher education programs are not often helpful in preparing teachers to teach. These results also illustrate the need to further develop the Certificate IV in Training and Assessment to prepare vocational teachers for diverse teaching contexts. One teacher described how her experiences as a learner influenced her practice: ‘My delivery style is influenced by what I felt worked well in my own education, including the support and feedback given by my teachers’ (025). However, this finding is not consistent with another study (Buehl & Fives, 2009) that reported how teachers derived knowledge from a variety of sources. One teacher from this study supported the latter study, suggesting that life experiences added to her early knowledge formation: ‘Good teachers continually question what they do, how they do it and why they do it – and that includes both what they have brought with them from the past and what they have learned since’ (003).

It is possible that if constructivism were introduced in professional development courses, then some of the teachers in this study would be ready to embrace it. Others would more than likely resist it because they were still coming to terms with the introduction of new technologies that could be used for teaching purposes. These findings, therefore, are interesting for several reasons. Firstly, because most of the teachers do not believe that they have been formally prepared for teaching means they are not equipped with the teaching skills and knowledge required for vocational teaching in the 21st century, much less so, with technology. Secondly, teachers in this study reported that they are more likely to teach as they were taught. This finding is commonly supported by the literature (Semiz & Ince, 2012; Baran, Chuang & Thompson, 2011). Teachers may have assumed that teaching practice has not changed over the years, leading to the belief that there is no need to seek out new teaching knowledge. As Buehl and Fives (2009) noted, teachers who accept that knowledge is changing, may be more open to new teaching methods and practices. Thirdly, on the whole, the finding that teachers’ exposure to teaching has derived from their experiences as learners, rather than from academic experiences, potentially means limited access to diagnosing, interpreting and identifying
teaching problems as they arise (Buehl & Fives, 2009). This might mean that teachers will be less equipped to deal with new paradigms and new technologies that emerge in the course of their teaching. It is important to note that the majority of the teachers in this research were not taught by teachers who would have used a range of different technologies.

**Source of general knowledge.** As discussed earlier in this section, teachers perceived their role as providers and transmitters of knowledge. Their identity as content knowledge-expert was connected to this role. The learner’s role was to accept and replicate the teacher’s performance. This relationship was based on the assumption that the teacher was the authority on an external body of facts that was to be passed down. Teachers’ descriptions of their practice illuminated these beliefs.

Significant findings from this study revealed that teachers did not draw on their own epistemic resources to provide the content. Instead, they relied on sources that they deemed to be more authoritative than they were. They reported using learning guides, text books and other readymade, commercial resources. Despite many years in an industry, one teacher reported using an online resource because it was the only content available for distance students: ‘It is a change from using the book’ (024).

Despite reporting that the students did not have the necessary computer skills to manage their learning, there was no evidence of teachers creating resources to teach their content, or of evaluating the content they were using. As one teacher said, ‘In six months we are supposed to be doing validation across the users and provide feedback’ (024). This would suggest that either, teachers did not perceive creating and locating resources to teach their content as their role, or they did not have the pedagogical content knowledge and confidence to do so. It might also mean that teachers did not have the time to create resources. The first reason is more plausible in that teachers rated their content knowledge high in the survey.

Reliance on these external sources of information failed to recognise the types of knowledge that can be constructed and co-created by the teacher and the student through interaction and dialogue with others (Zinn, 2013). The following teachers provided evidence for the sources of knowledge from which students learn:
People hear information, see a demonstration…in the case of practical work, repeat the action until they grasp how to do it to…the required proficiency as dictated by a supervisor, or a workplace, lecturer etc. (003)

…from texts, manuals etc. (016)

…through instruction and repetition (020)

…from other people, internet, books, radio and TV (004)

…from reading books or by observing others (018)

…completing tasks associated with the learning (024)

As can be seen from these examples, most of these sources are external to the student. For most of the teachers, it was untenable that knowledge could come from within the student’s own epistemic repertoire. As discussed previously, teachers did not view students as capable of creating knowledge.

If teachers believed that knowledge could be constructed, there would be a greater expectation that the students would be involved in creating and producing knowledge. Perceived this way, there was every reason to expect that teachers would rely on their own knowledge and authority. Zinn, (2013) recommended that it might be more constructive for vocational teachers to see themselves and their students as critical sources of knowledge. Together they could make a valuable contribution to vocational knowledge.

Assertion Two: VET teachers valued the constructivist affordances of technology but lacked the means to harness its potential to transform their teaching practice.

Having ascertained teachers’ pedagogical and epistemological beliefs about teaching without technology, it was important to explore how these beliefs related to teaching and learning with technology. If teachers did not subscribe to the belief that technology enhanced learning, there would be no guarantee of integrating it (Polly, Mims, Shepherd & Inan, 2010). If teachers believed that technology enhanced student learning, then they would be more inclined to integrate it into their teaching more innovatively and promote it because it was valued. On the other hand, if teachers believed it made no difference to the way students learn, then there
would be no need to add technology to their practice. In the end, teachers would not be
motivated to tackle the challenges associated with integrating technology unless there was a
vision for how it could change their teaching and students’ learning.

Teachers in this study envisaged that technology would enhance learning. However, they were not sure how to teach with it. This section provides evidence to substantiate the assertion that VET teachers valued the constructivist affordances of technology but lacked the means to harness its potential to transform teaching practice. Although teachers generally felt confident and positive about the way in which technology supported learning, their beliefs were not enacted in their practice. Beliefs about teaching with technology were, however, consistent with the survey results.

Based on constructivist philosophy, teachers described the ways in which technology provided a student-centred learning environment, meeting the needs of diverse learners and offering additional support. Implicit in teachers’ responses was a yearning for a type of teaching that signalled greater levels of student engagement and motivation. Social constructivist beliefs about learning with technology were included as a separate heading because the teachers in this study advocated it as a goal worth pursuing for their isolated and regional students. Inconsistent nomenclature relating to e-learning/online pedagogy was deemed to be part of the problem. Misunderstandings about terminology and the lack of awareness of alternative pedagogies are evident in the teachers’ interview responses.

The value of technology. Teachers described the impact of technology on learning, shedding light on how they understood constructivist pedagogy. The descriptions that follow are similar to the way teachers described constructivist teaching and learning without technology. Consistent with a student-centred, learning approach, technology supported engagement, connectivity, communication, collaboration, flexibility and independence. Technology was equated with the computer, internet, a LMS or software application. As one teacher undeniably claimed, ‘Technology is a great tool to assist constructivist learners. The vast amount of information accessible through technology opens up the world to users’ (010).
Technology was believed to accommodate a diversity of learning styles and learning needs. For instance, student ‘engagement’ referred to students’ sensory perception, of ‘colours and brightness’ (023) or, ‘getting a buzz from the technology’ (004) rather than any deep immersion in a learning activity which would engage the mind. For another, ‘changing colours and headings, so one will be green and the other red, appealed to visual learners’ (022).

Technology was believed to accommodate students’ individual needs. This theme is consistent with teachers’ beliefs about students in their teaching practices. This theme will be explored in the next chapter.

One teacher who was comfortable using different technology described how she used it to accommodate a range of learner styles:

…technology matches a linguistic teaching style…Their learning style is reading, watching and viewing DVD and CDs…and probably doesn’t help with the person who likes hands on…the requirements for this course are highly developed reading and writing skills. (022)

Another teacher planned how she would develop interactivity by addressing different learning styles: ‘Maybe if they have to watch something and then answer questions, it would be good for visual learners, for those that really don’t like reading’ (003). Theories about learning styles are a major focus of the Certificate IV in Training and Assessment. VET teacher candidates are assessed on their understanding of VET students, their diverse characteristics, needs and their learning styles. Learning programs have to be designed and developed with a diversity of learning styles in mind. Teachers believed that technology allowed them to present more colourful and attractive courses to promote student engagement.

Technology was also believed to support student learning. It enabled students to access, research and investigate the wealth of information available through the Internet. Consistent with their beliefs about teaching, teachers believed that the internet helped students to acquire knowledge:
...it helps with investigation and research skills…when you were teaching you would tell them what they had to do…with the web you can get your students to investigate the world. It educates you without your knowing. (024)

As a valuable source of ‘free’ information, the Internet also enabled students to acquire knowledge by ‘opening up the student’s world’ (017), which it was believed, would lead students to independent learning.

Despite the fact that many VET students cannot undertake independent learning (Choy & Delahaye, 2003), without some guidance and facilitation, student autonomy was unlikely to develop. Self-direction was referred to expanding knowledge ‘and the places they obtain it as it promotes autonomy’ (020). As the following teachers noted:

Students have…a broader capacity to acquire knowledge through use of the internet and other technology… (003)

The ability to source information is powerful; a lot of information on the internet is free. (020)

Technology was also believed to create more participatory and interactive learning. In relation to technology, it was ‘definitely more participatory and active…the learner has an obligation to take some responsibility and control of their learning’ (025). Technology also provided a ‘platform for worldwide collaboration which speeds up and magnifies knowledge exchange and learning’ (011), ‘connecting people from all over the world’ (025). Collaborative learning meant working with others to find answers: ‘You need to be able to find answers to questions. It is not good enough to walk away and not be able to answer the question…you have to be comfortable in asking for others for help’ (022).

Teachers described technology as enabling collaboration. For these teachers it was too difficult to manage as the flexible delivery option limited student engagement in one activity or task at any one time. One teacher described how technology provided the opportunity to enable students to become self-directed which it was believed, would increase their motivation to learn:

It provides many more opportunities to develop their own learning, than when they would just sit in a classroom and listen to the teacher or lecturer. The student often
feels more motivated when they are responsible for their own learning and choices.

(003)

Web-based technologies might have provided teachers with the means to support students to develop the self-direction, autonomy, and independence they believed technology afforded. Students could have created, produced and shared their knowledge. Students might have been able to produce a video of a skill, upload it onto YouTube and share it with their peers. In this study, a teacher spoke about creating a video and uploading it for students to view: ‘I want to start using some YouTube clips … upload it straight away on Blackboard. We can even make our own videos’ (003).

To transition to these student-centred uses of technology may require teachers to shift their epistemological positions towards the belief that students can be a source of knowledge as well as active producers, co-producers and creators of knowledge. In this case, it would seem that teachers’ epistemological beliefs constrained their technological pedagogical knowledge. Some teachers however, seemed ready to change their beliefs.

It is interesting that only two people claimed that technology provided access to learning which was previously not available. One teacher stated: ‘I think in our regional area it gives people an opportunity to learn whereas once they didn’t have it’ (025). The technology referred to in this teachers’ case was the television: ‘I use lots of Australian Story with this group to show them stories which happen outside of [town name] to show them successful Indigenous people because in [town name], there’s not a lot of them’ (024). Technology, therefore, provides access to learning in regional areas. As importantly, it also provides more immediate access to peers and teachers. The next section describes the social interaction that technology permits.

**Social constructivism and technology.** Technology was heralded as the means to communicate with isolated students. In this study, teachers focussed on the affective aspect of learning through technology. This was considered more important than the cognitive aspect. One teacher explained that although communication through the discussion board was not
mandatory, it was the way to remove isolation in ways that the students did not realise that it would:

I know that they don’t do it a lot. It needs to be compulsory and linked to assessment…once they have to go in there and communicate they may quite like it. It would benefit those isolated ones…although they don’t realise it. (003)

For the most part, teachers did not explicitly draw on the cognitive aspects of learning through social interaction with peers. One teacher believed that communication involved emailing students their assessments:

On the communication side I mostly transfer information via email. I have asked students to send me assessments electronically, but that was a failure so they just hand them into me. (016)

For another, students did not seem to enjoy it. Instead, they preferred to access the course content on the LMS and hand in their assignments without having to communicate with anyone. One teacher described it this way:

Honestly, I think a lot of the time students just want to come in and do their work…it is becoming legislation now that they have to have a certificate to work in child care so some are doing it under sufferance.’ (003)

Although teachers wanted to be able to use the discussion board to enable communication between students, this was not realised. Discussion was rarely used because as one teacher observed, ‘You have to be mindful of going in and checking and commenting on what they have discussed’ (004). This teacher may not have understood the ways in which the discussion board could be used for teaching. In the context of this study, it was more than likely that the teacher intuitively realised that her students had no interest in contributing to a discussion. Her students wanted the qualification that industry required without feeling the need to discuss anything with anyone. For many of the teachers, it seems that the promotion of constructivist learning is incongruent with the reality and the needs of many of the VET students.
Related to the need for collaboration and communication, teachers cited the importance of interaction in an online environment. To not provide the means for interaction would be a simple replacement of one sensory experience for another: ‘You need interactivity otherwise it is just looking at the computer and reading from it …’ (025).

As discussed in Assertion One, teachers planned for ways they would teach differently. Using technology was one of the planned changes related to incorporating the use of discussion in the LMS. The need for interactivity was something teachers reported to be working on:

One thing we think about in our planning is how we can get the students to interact more as at the moment they don’t really have much contact with each other than message or email. (024)

Constructivism has been promoted in the VET sector for many years (Robertson, 2007). It was possible that while teachers used the language of constructivism and heard the concept promoted, they may not have understood the concept in the context of a learning theory or pedagogical approach. The teachers, nevertheless, valued what technology could potentially do for student learning. This was the primary concern for the teachers in this study.

Teachers recognised and acknowledged the transformative potential of technology for teaching and learning based on their interpretation of what students need. Technology was the means to transcend geographical distance through communication.

**Technology and terminology.** It was expected that teachers’ understanding of e-learning and online learning would add both clarity and insight into how and why technology was being used, or not being used for teaching. Teachers’ understanding of these terms would therefore influence how technology was being used, if at all. This part of the assertion presents evidence that teachers’ beliefs about teaching with technology (as opposed to learning with technology) were related to maintaining the traditional teacher-centred approach discussed in Assertion One.

As Holt and Challis (2007) caution, the differences in meaning and definitions between delivery modes (flexible, online, elearning, blended, external and distance), and the associated pedagogical approaches to support these modes, do nothing to mobilise teachers’ experiences in
adopting new technologies. Programs aimed at developing and supporting VET teachers to transition to alternative pedagogies will not be successful as long as teachers, both in this study and the broader VET sector, speak a different language.

Inconsistent language and understanding about teachers’ use of technology in VET practice appeared to be a source of great consternation. Findings from this study were similar to the findings of the 2013 E-learning Benchmarking Survey. Both surveys acknowledged continuing misconceptions about definitions and the terminology used to describe teaching and learning with technology in the VET sector. Many teachers believed that teaching with technology meant going online.

**Technology as alternative pedagogy.** Teachers in this study referred to ‘online ‘and ‘elearning’ as an alternative to their current teaching practice. The following comments highlight teachers’ different conceptions of teaching and technology. Common to all is the notion of choice between an electronic version and a paper-based version. Online/elearning:

- “…is what one of our lecturers does well. It’s a tracking tool, assessment plan, delivery tool all in one. Yeah, I try to keep as many things electronic... as possible. (020)
- “…involves putting content online rather than having paper-based copies. It is a platform for our information and we are available by email or phone all the time. (017)
- …means using WebCT and using Elluminate. I see it as external as they still get a hard copy of things. They get a user guide, handouts’. (019)

Teachers’ perceptions about teaching with technology added weight to their beliefs about teaching as transmissive practice. Perceived this way, teachers would be more likely to view technology as an adjunct to their existing practices. This theme will be addressed in Assertion Three. The existence of any other approach would be inconceivable, suggesting that teachers may only ever perceive technology as a resource to support their current practice rather than a medium through which to change their practice.

That teachers perceived there was a choice might mean that they neither felt the pressure, nor succumbed to the pressure to change what they were doing. Without the understanding that teaching changes when technology is used, teachers conceived the LMS as a
repository for course information, rather than as a means to provide engaging, interactive learning experiences for distant and remote students. Teaching with technology appeared to be more about making teaching easier than making learning better. For instance, the discussion board in the LMS was difficult and time consuming for one teacher in that she had to read and follow the thread:

We pride ourselves on flexible, open learning but the more students we get the more difficult it is to keep track of them…it is time consuming reading the discussions on Blackboard…following them is really difficult. (004)

This comment highlights teachers’ limited awareness of the value of discussion as an important sociocultural activity for distance and remote students. It is also possible that there was resistance on the part of the teacher in opening up learning to large numbers of students as she was having trouble coping with the number she already had.

Survey data corroborated these findings. One third of the teachers scored low in the teaching with technological pedagogical knowledge domain, the lowest of all the domains. Rather than draw conclusions about the inadequacy of teachers’ beliefs and knowledge about online/elearning pedagogy, it is fair to suggest that these understandings may be related more to their technology knowledge than to their pedagogical knowledge, particular because they felt confident about their pedagogical knowledge, content knowledge and pedagogical content knowledge.

Teachers have had little exposure to constructivist models of teaching and learning either with or without technology. Teachers cannot do what they do not know and where beliefs do not align there is less likelihood of integration technology to enhance learning (Angeli and Valanides, 2009; Ertmer, 2005; Koehler & Mishra, 2009; Liu, 2011; Lawrence & Lentle-Keenan, 2013). The inconsistencies between what teachers’ believe about teaching and learning with technology and their actual technology use will be explored in the next assertion (Assertion Three).
Assertion Three: VET teachers used technology to support traditional teaching practices.

To provide a broader understanding of teachers’ knowledge and beliefs about teaching and learning with technology, it was important to explore the types of technology/ies they were currently using and their reasons for choosing it. The questions did not extend to whether the teachers felt that what they were using was working. It was expected that understanding VET teachers’ use of technology might determine their pedagogical rationale for their decisions to use or not to use technology. The findings led to the assertion that VET teachers used technology to support their traditional practice. This assertion (Assertion Three) was quantified by the survey data, which showed low scores in domains related to technological pedagogical knowledge, and from the interview responses.

This overview provides structure for the assertion that VET teachers use technology to support traditional teaching practices. Firstly, links to findings from previously consistent research findings add weight to the assertion. Secondly, an overview of teachers’ actual technology use, followed by an overview of what teachers were not using (non-technology use and practice) is presented. A discussion then follows of the reasons why teachers used technology.

Teachers used a narrow range of technology in a limited number of ways and this is of interest for several reasons. Firstly, the findings revealed that teachers’ actual technology use was not consistent with how they believed technology enhanced and supported teaching and learning, although their actual use was consistent with their beliefs about teaching and learning (without the use of technology). This finding is supported by research which shows that if a teacher believes in traditional teaching, there is a strong likelihood that technology will be used in a traditional way (Chen, 2008; Teo et al., 2008). Secondly, teachers’ actual technology use mirrored how teachers understood teaching with technology as discussed in the second part of Assertion Two.
Technology use. Teachers used technology for the purposes for which it was designed. They did not use technologies of which they had no knowledge. The ubiquity of the computer, email, mobile phone and the internet was compatible with teachers’ existing uses and practices (Robertson, 2007). The computer was used for a range of purposes: to access software applications; to access the LMS through the internet; and to enable participants to undertake regular administrative tasks, such as checking emails and enrolling students. Emails and mobile phones were primarily used for communicating with management and colleagues more so than with students. The Internet was used by most of the teachers as a source of information. It was used for locating content such as YouTube videos and other multimedia, researching student activities and for one teacher, monitoring students through social networking:

I have started using Facebook to message my students…it is amazing because they respond…I can message and ask why they aren’t in class and they respond…if I rang or texted they would ignore it. (025)

Software applications (e.g. Word, Excel, and PowerPoint) were used for maintaining student records, developing learning and assessment resources and presenting information. Most of the teachers were using a LMS (Blackboard, Catapult or Rural Skills Australia) to disseminate course information. Some teachers reported using older technologies such as the data projector, DVDs/CDs, digital camera and video to support their teaching practice.

There was evidence of emerging web-based software. The teachers who were more confident using technology employed Slide Share to present study tips for students in the LMS; Articulate and Hot Potatoes were used to develop LMS content; and iSpring was used to develop interactive presentations. A couple of teachers used virtual classrooms (Blackboard Collaborate) and one teacher used the digital scanner. Teachers’ technology knowledge was not reflected in their teaching practice, although all teachers had the skills and knowledge to use computers and to search the internet. Like in Marwan and Sweeney’s study (2010), it appears that the majority of the teachers’ energy was expended on developing their technological knowledge rather than concerned with the impact of the technology on students’ learning.
What teachers believed they were doing was in fact using technology in ways that allowed them to continue transmitting content. It became apparent that while teachers explored different types of technology, its pedagogical implications eluded these teachers. Despite seeing the virtual classroom as an instance of best practice, the following teacher understood its redeeming feature as the ability to passively listen to a recorded teaching session: ‘I could use Elluminate [Blackboard Collaborate]…its best use would be for students who joined later to listen to the recordings’ (018).

The way in which teachers were using technology in this study falls short of recommended best practice (Lawless & Pellegrino, 2007). Technology was not being used to promote cognitive growth or social interaction.

**Non-use of technology.** Consistent with previous studies of VET teachers’ technology use, teachers in this study, generally did not use, or experiment with a range of technology, despite their ubiquity and availability for teaching and learning purposes (E-learning Benchmarking Survey, 2013).

There was no discussion or evidence of relatively recent educational technology resources such as: Massive Open Online Courses, Open Educational Resources, Second Life or gaming, Virtual worlds or ePortfolios; nor was there any mention of learning objects or digital repositories (Hedberg, 2006). The use of blogs and wikis, widely recognised forms of digital communication, were notable by their absence for this group of teachers (Marsden & Piggot-Irvine, 2012). Although there was evidence of newer, emerging technologies (indicated above) being used, these were teacher-led and teacher-directed. The use of the student-centred, constructivist use of technology which teachers believed possible was not apparent.

It may be the case that teachers have had little experience themselves in using Web 2.0 tools. As they were not designed for educational purposes, they require extra time to restructure for educational purposes (Jimoyiannis et al., 2013; Levin & Wadmany, 2008). In this study, one teacher who reported gaining value from the discussion board as a university student, indicated that she did not use discussion in her online teaching, although she valued it in her face to face
classroom: ‘The lecturer didn’t have chats but the discussion board was where you could make contact and comment with your fellow students. I found that valuable’ (025).

Therefore, it would appear that teachers were not always aware of how technology could change aspects of the nature of content knowledge and the ways in which students could access this knowledge. As indicated by the findings, teachers for the most part, used older forms of technology in traditionally transmissive ways. It is therefore reasonable to suggest that teachers were less receptive to the learning opportunities offered by Web 2.0 tools than their students might be. In this study, teachers adopted decidedly Web 1.0 tools, with social networking far less typical of their reported practice (Marshall & Rossett, 2011).

**Reasons teachers used technology.** According to So and Kim, (2009) teachers make decisions to use technology when they see its potential as congruent with their beliefs about learning. Teachers reported a range of reasons for using particular technology/ies, the most common ones were: technology as a source of knowledge and information; as a means to support administrative and pedagogic practice; and as the way of the future. Less common reasons related to: organisational directives, cost and time efficiencies, accessibility and flexibility and to prepare students for the workplace. These will be discussed in the following sections. As the evidence for Assertion Two demonstrated, teachers’ understanding of technology was equated with the internet and the use of a LMS; therefore, responses to questions relating to their technology use for the most part, refers to these tools.

**A source of knowledge and information.** The internet was predominantly used as a source of knowledge and information, for locating teaching and learning resources, finding YouTube videos and other multimedia content to upload to a LMS. The following comments summarise the value of the internet for the teachers in this study:

The immediacy of accessing whatever you want…it’s simple, it’s free…look it up on YouTube and work it out, talk about, learn about it and fix it. Previously you would have to find a tech manual…call a library…that just takes time…technology is immediate and it just happens. (018)
Technology allows us to have the answers to questions…in a matter of seconds.

Before technology…it took a long time and possibly lots of resources to find out an answer so we tended not to look for more that we needed to know. (023)

Understood in this way, the internet replaced traditional information and knowledge sources, such as text books, learning guides, reference books and manuals. As a valuable source of information, the web in and of itself is not sufficient if there is an absence of guided facilitation as to what to do with that knowledge once it is discovered. Like the VET teachers in Bound and Salter’s (2007) study, they were not too sure that having access to such a wealth of information had anything to do with supporting higher level cognition.

As the teachers above indicated, the internet was used primarily as a means to find answers to questions. Its value lay in the immediacy in which it could provide the answer rather than in its value as a tool to support constructivist practice. For some teachers, the internet was seen as enabling opportunities for sharing content and resources, enabling self-direction and collaboration. Rarely though was it used in these constructivist ways (Jimoyiannis et al, 2013):

You can go to other sites…access other perspectives and…compare them. Being able to compare perspectives and ask them to share their findings could enhance knowledge…using discussion (017)

As discussed in the next chapter, these affordances of technology are aspirations for the future. It was not surprising that teachers’ use of technology for working with information was similar to how they worked with information in paper-based teaching. According to Liu (2013), while many teachers have technology skills and abilities for technology integration, they implemented lectured-based teaching activities when using technology.

Support traditional administrative practice. Research often refers to technology as enabling teachers to do their job quicker and easier rather than as a means of transforming learning and teaching practice (Jordan, 2011). In this study, although teachers believed that technology supported their administrative and pedagogical practices by making it easier, they did not incorporate these tools into their practice. This may have been because they did not have
the knowledge (Lawless & Pellegrino, 2007), the confidence (Kotrlik & Redman, 2009) or the belief systems that would support teacher change (Ertmer, 2005; Hew & Brush, 2007).

Teachers described their use of technology as enabling greater efficiencies within the system. Popular reasons for using technology were: cost and time efficiencies, employee health and safety reasons and sustainability which was heavily promoted. These reasons are legitimate uses of technology. Research frequently refers to technology as assisting teachers to do their job quicker and easier rather than a means for transforming practice (Graham et al., 2009; Jordan, 2011). However, beliefs about using technology in teaching from this perspective will only ever be seen politically, as an economic and environmental mandate rather than a pedagogical choice intended to transform teaching and learning.

Support traditional pedagogic practice. Teachers explained the ways they used technology as an adjunct to their current practice. Technology provided additional resources, flexibility for distance students and encouraged interactivity and communication. One teacher pointed out her reasons for using Blackboard: ‘… it has a range of features. It has assignments in and out; it has chat, discussion…’ (022). When asked if she used these features, she reported having used only one. The importance of electronic assessment submission was important, especially in that it reduced the need for marking:

We have got them to do their first assessment online…Their task is to complete this as it covers my whole course…they type their answers in. Our aim is to ensure more assessments go online. You can set them to mark it for you. (022)

Presenting materials. Teachers used software applications for presenting learning resources as a supplement to their traditional transmission paradigm rather than as a learning device to support active learning. This is not uncommon (Chen, 2008; Hermans, Tondeur, van Braak, & Valcke, 2008; Jimoyiannis et al, 2013; Lawless & Pellegrino, 2007; Marwan & Sweeney, 2010; Palak & Walls, 2009; Salter & Bound, 2009).

Teachers’ pedagogical practices in this study did not change with the use of technology. For example, PowerPoint was referred to often as a means of presenting content, merely
replacing the blackboard, whiteboard and overhead projector. Interactive Whiteboards were not used. According to Polly et al. (2010) teachers often rely primarily on presentation technologies when there has been lack of expertise in modelling of effective technology use. It is also possible that teachers have seen their own teachers and trainers use presentation software in their learning. The pressure to participate in the technological/digital revolution may have encouraged the replication of traditional models of teaching.

Essentially, teachers used technology for working with information similar to how they worked with information in paper-based resources (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur, van Braak, & Valcke, 2007b). The consequence was that technology was related more to maintaining teachers’ existing pedagogical practices than to transforming or reconstructing pedagogy or content knowledge.

Support a teacher-centred pedagogy. The way in which teachers used technology in this study served to strengthen their teacher-centred practice. This is not uncommon as teachers, across educational sectors tend not to transform teaching with technology into student-centred practices (Cuban, 2001; Cuban, Kirkpatrick, & Peck, 2001; Palak & Walls; Windschitl & Sahl, 2002). Nor is there any expectation that their students will use technology (van Braak, et al., 2004).

Although these VET teachers expressed intentions to use the discussion board more often (as evidenced in Assertion Two) the ways in which it was being used were teacher-generated and teacher-controlled (Bound, 2011; Robertson, 2007). The teacher’s pedagogical understanding of discussion as a cognitive tool has been lost in its teacher-centred administration. In the following comment, the teacher asserts some control of the discussion board functionality:

I want to use discussion…I want to use it as a learning tool where I can ask them to go away and research and allow others to comment upon…you have to be mindful of going in and checking and commenting on what they have discussed. (017)
The transmission of course information reflected a teacher-controlled pedagogy. The student passively accepts the terms and the conditions upon which the teaching strategy has been developed. Seen from this perspective, traditional practice, such as using the LMS, manages students, rather than students managing themselves (Bonk, cited in Holt and Challis, 2007). The following teacher illustrated how she managed her new students:

Well our first contact with students is with speaking with them…we take them through the information they will need to pass the cluster…we take them to TGA and they see the units they have enrolled in. We take them on a tour and show them where the power points are…We give advice as to where to go and what to do…and what to access. (003)

Although these current practices have enabled efficient recording and transmission to learners in many different contexts (Hedberg, 2006) teachers’ adoption of transmissive pedagogical approaches using technology is often undertaken to support and cover the syllabus (Jacobsen et al., 2010). It is possible, and as Billett (2006) indicated, both competency-based training and training packages have contributed to the maintenance of the teacher-centred transmissive approach described above.

This model of education is not incompatible with how teachers described learning with technology. The factory model of teacher-centred education practiced by this group of teachers (An & Reigeluth, 2011) is not dissimilar to VET teachers’ practices with technology described elsewhere in the research (Dirkx, 2004; Kilpatrick and Bound, 2003; Marsden & Piggot-Irvine, 2012; Marwan & Sweeney, 2010; Salter & Bound, 2009; Bound, 2011; Robertson, 2007). Congruence between teachers who hold student-centered beliefs and their use of technology that supports student-centered practices is uncommon and atypical of teachers’ practices generally (Palak & Walls, 2009).

Teachers did not mention using technology as a means of enabling students to create and produce their own knowledge. Although teachers were considering ways to include technology, these intentions were described in teacher-centred ways: ‘…we talked about making
videos...we need to say to the students watch this and then answer these five questions because I think they won’t take the time to watch it’ (003).

Chapter Summary

This chapter presented three assertions. Assertion One provided evidence that VET teachers expressed traditional beliefs about teaching, learning and knowledge. Teachers’ views were elicited independently of any technology that was used or not used in order to substantiate the assertion. Evidence for this assertion was provided through two data sources: the TPACK survey and the interview. An interpretation of these findings led to the assertion.

Teachers’ beliefs and knowledge about teaching, learning and knowledge mirrored a traditional educational paradigm. Teachers’ pedagogical practice was for the most part teacher-centred which served to maintain a strong, central teacher presence. This practice was couched in teachers’ traditional epistemologies, which viewed that the source of knowledge existed in authoritative agencies. Teachers’ goal for students was the pursuit of individual cognition. Teachers, however, intended to change their pedagogical approach. This intention was based on a plan for integrating technology in the future. Teachers’ constructivist learning theory was not a significant part of teachers’ pedagogical awareness or practice.

Assertion Two provided evidence that VET teachers expressed constructivist beliefs about learning with technology and transmissive beliefs about teaching with technology. The first section presented the evidence to substantiate the first clause of the assertion. Based on constructivist philosophy, teachers described the ways in which technology provided a student-centred learning environment. They described how it met the needs of different learners and the type of support it provided for students. With technology, teachers imagined greater levels of student engagement and motivation. Social constructivist beliefs were advocated as a goal worth pursuing for regional and isolated students. The second part of the assertion presented the evidence to substantiate the second clause of the assertion. VET teachers expressed transmissivist beliefs about teaching with technology. Firstly, the evidence was derived, from teachers’ various understandings of what online/e-learning meant. Secondly, these
understandings influenced how teachers imagined teaching with technology or how they taught. Teaching with technology provided teachers with an electronic alternative. Finally, teachers’ understanding of how they could teach their content using technology was constrained by inconsistencies in their definitions about technology and teaching.

Assertion Three provided evidence that VET teachers used technology to support traditional teaching practices. Teachers used older, ubiquitous technologies in ways consistent with their traditional practices. This suggests that teachers do not have the understanding that technology in teaching requires a different pedagogical approach. Evidence was presented to indicate that there was little awareness of the pedagogical affordances of the tools being used and how these tools could change their teaching and learning. Teachers’ reasons for using technology, for the most part, related to teachers’ knowledge and beliefs. Technology provided a source of knowledge and information. It provided administrative support in that it enabled efficiencies. It supported teaching practice insofar as it provided access to the LMS and helped them to present materials. In the end, technology was used to support a teacher-centred pedagogy.
Chapter Six: Teachers’ Attitudes and Understandings

Overview

This chapter discusses the findings from the TPACK survey and the interview data relating to VET teachers’ attitudes and understanding of technology as it relates to their teaching practices. The previous chapter presented three assertions relating to VET teachers’ beliefs and practices relating to technology. The findings are reported in the form of assertions supported by quotes from the transcripts. These assertions were developed based on substantiated evidence from the data sources. They pertain only to this study although they might inform the reader about more general situations and contexts.

The following research questions provided the focus for the chapter:

- Research Question 4: How do VET teachers’ attitudes towards technology shape their teaching practices? This led to Assertion Four and Assertion Five.
- Research Question 5: How useful is the TPACK framework for understanding teachers’ technology integration practices? (This led to Assertion Six)

Exploring vocational teachers’ attitudes towards technology was expected to provide a deeper understanding of their TPACK awareness. As teachers’ attitudes were not measured by the TPACK survey, the interviews provided a richer understanding of the role of technology in their lives. For example, if teachers did not feel confident that they had sufficient technology knowledge and skill, then they might have been reluctant to use it for teaching. If teachers enjoyed using technology in their personal lives, then it would be expected they would share this enthusiasm with their students. Similarly, if teachers believed that technology knowledge was important, then they would try to learn it for themselves as part of their professional knowledge. Or, if teachers did not feel supported by the organisation, there would be less of a community of practice in which to share and learn. This is especially important in rural areas, where people are isolated and separated by vast distances. Teachers’ dispositions were therefore considered important in the decisions they made about teaching with technology.
Assertion Four: VET teachers expressed positive attitudes towards technology.

Teachers’ intentions to develop technology knowledge for personal and professional purposes were of greater importance than their intentions to develop and transform pedagogical knowledge.

Evidence to substantiate this assertion will be presented. The first section discusses teachers’ attitudes towards technology using the following headings: confidence using technology, pressure to participate in a digital world and intentions for the future. The second section presents evidence of teachers’ TPACK awareness using the following subheadings: perceptions of quality teaching with technology and perceptions of best practice. How teachers perceived the level of organisational support provided will also be presented.

Interview data revealed that teachers held positive attitudes about the use of technology for teaching: they were confident, they enjoyed it, their skills had improved over time and they expressed a willingness to learn more. Most of the teachers agreed that technology was the way of the future for themselves and for their students. These findings are congruent with much of the recent research into teachers’ attitudes about technology in teaching and learning (An & Reigeluth, 2011; Chai et al., 2010; Lee, Tsai & Chang, 2008; Wachira & Keengwe, 2011). They were also consistent with the 2013 E-learning Benchmarking Survey which showed that teachers’ confidence to teach with technology was gradually increasing.

Yet, these findings were somewhat surprising considering teachers’ low TPACK scores, especially the domains containing a technology blend. However, the optimism teachers expressed was related more to teachers’ than to students’ needs. That is, they were confident using technology they were familiar with; they were pleased with the extent to which their skills had changed over time; and they wanted to keep up with changing workplaces. Incongruently, Salter and Bound (2009) found that VET teachers’ positivity and confidence related more to students. In their study, technology provided students with the means to develop the required knowledge and skills that encouraged independent learning. As discussed in Chapter 5 (Assertion 2), technology in this study was reported to enable self-direction.
Teacher confidence. Having the confidence to use technology does not necessarily mean that one knows how to teach with it (So & Kim, 2009). Teachers’ confidence tended to be associated with the knowledge and skills they had developed over time, correlating with the ubiquity of the technology (Robertson, 2006). Familiarity with technology led to its acceptance and the expectation that it would be promoted as a normal part of teaching. One teacher explained it this way: ‘Because I am comfortable with technology, I am positive…I encourage students to use it whereas another lecturer in our team is not so confident…if you’re comfortable you are going to promote it’ (022).

Teachers were confident solving technical problems. The ability to troubleshoot was perceived as valuable knowledge, serving to distinguish between teachers with high and low technical skill. As one teacher shared, ‘I am confident but if [name] takes over my class, she wouldn’t be able to do it. She can operate a computer, but if anything went wrong she wouldn’t be able to fix it’ (023). In this study, teachers’ confidence was described in relation to their basic skills, represented by the following quote:

Well, the office suites; word processing to type up all these documents and spreadsheets for basic presentation. Using internet, email and things like that, but online delivery stuff, I’ve done a little bit of it but I don’t really know much about Blackboard. (011)

This is not uncommon (Finger, Jamieson-Proctor & Albion, 2011; Lock & Redmond, 2010). Teachers’ conceptions of technology were directly linked to software applications and the computer (internet). It is probable that these skills and knowledge were developed as part of their job role and were therefore connected to their workplace performance. This might explain why teachers did not use content-specific technology (discussed in Assertion Six) as part of their teaching as it was assumed that this knowledge was acquired in the workplace. Many teachers were either self-taught or they learned on the job: ‘Well I have been here at TAFE for ten years and I hadn’t even sent an email before starting here’ (004). Therefore, teachers’ confidence resided more in their ability to use common technological tools.

As emerging knowledge, teachers showed acceptance of technology and its affordances; yet they did not acknowledge the need to adapt, modify or change their pedagogy when
technology was applied. The confidence teachers expressed was not translated into effective applications of technology. Although plans to develop constructivist approaches to teaching were touted, it was to extend their practices rather than transform it.

**Pressure to participate in a digital world.** The same level of positivity and enthusiasm was grounded in teachers’ beliefs that technology knowledge was essential to participate in a digital society. Although some teachers did not feel prepared or confident to use technology to optimise learning, they generally agreed that their own technological knowledge and skill was developing. Their enthusiasm meant that they looked for opportunities to expand their understanding of technology integration, indicating that they felt they already had some knowledge to build upon. One teacher expressed the importance of updating her teaching practices, describing the need to continually develop skills and knowledge as part of an ongoing change process, informed possibly by her digital nativity:

> I am one of the lucky ones as I have grown up with it [technology]. I have always used it in my teaching, but more recently so, because of the changes…we have to move with the times. You can’t just stay with what you did 20 years ago. I am quite open to trying things. (022)

Teachers seemed to value technological knowledge from the perspective of the teacher’s role. They saw its potential but only enough to perform tasks in the workplace rather than transform their teaching. Another teacher indicated that, ‘To be successful in the trades I knew I had to learn the technology and so when I joined TAFE I had a head start. I can use basic computer skills’ (020).

Teachers acknowledged the importance of technology as a life skill that was needed to participate in a digital society. That is, they were cognisant of industrial change as well as broader societal and cultural trends. In the following quote, both industry and the student were key drivers:

> Yes, I keep up with industry changes. When I visit a student in the workplace…I want to see their monitoring system practice…I’m picking it up too. Or how the laptop works; how you are going to diagnose this fault. (020)
Teachers also viewed technology as valuable, professional knowledge. It is possible that many teachers’ motivation to keep up came from the need to update their work skills:

I am the generation that didn’t grow up with computers…I bought a computer and we have had to self-teach…technology change has been huge. (003)

I tell my students the technology that they are learning will be different in the future.

We need to learn how to learn, to be self-learners to survive in the future. (010)

What the teachers did not explicitly mention was the need to develop further technology knowledge to support student learning. Technology was nevertheless seen as valuable professional knowledge that made teachers’ working lives easier. Teachers’ needs to remain abreast of technological change were motivated more by an individual need to remain current in the industry for fear of being left behind. This seemed more important than the will to update knowledge about current pedagogical theory and practices.

Interestingly, these motivations were inconsistent with how teachers believed technology enhanced teaching. Teachers’ beliefs about the way technology enhanced learning highlighted the promises it held for students. They believed that it created the possibility for an enriched, supportive and engaging environment filled with the promise of global interaction. Moreover, it was believed that this new environment would create independent, self-directed individuals, well prepared, connected and groomed for new competitive workplaces. This incongruence indicated gaps in both technological and pedagogical knowledge, both of which require urgent redress.

Although teachers held positive beliefs about teaching with technology, their knowledge and skills were far from what was needed, suggesting that teachers overestimated their confidence. Abbitt (2011) noted that self-efficacious beliefs are likely to increase the success of technology integration. In this study, self-efficacy was more likely to increase the success of the teacher’s ability to remain current in a changing world of industry and education. Teachers’ optimism might mean that in the future and with professional development support, they might be able to use technology in more pedagogically defensible ways.
**Future intentions.** Teachers, in this study, frequently stated their intentions to use more technology in the future; paralleling the way they believed that technology would enhance learning. Their language was couched in terms of how they would extend the applications they currently used. The promise was shrouded in a commitment to realise these beliefs. Yet, teachers did not describe being interested in or learning about new technologies. Curiously, these intentions were based on the assumption that they would develop further knowledge. Less clear, was how teachers in this study believed that their new knowledge would bring about the paradigmatic shift necessary so that their beliefs about technology might better align with their practices.

Of particular significance is that these intentions were orientated towards supporting traditional conceptions of teaching. For example, some teachers intended to develop discussion in their LMS course. Rather than see the discussion board as a cognitive tool, it was seen more practically as a means for providing support for students studying at a distance; ‘The benefits are that you feel that you have a community and that you are not on your own and you don’t feel so isolated’ (023).

Admirable as it is for regional students, it is likely that the discussion tool would be used affectively. That is, it could be used to remove students’ sense of isolation, therefore enabling greater social interaction. The teacher might not facilitate the interaction or necessarily follow the posts. As one teacher described, following posts was difficult: ‘It is time consuming going back into discussions, looking at them. Following them is really difficult’ (004).

The ability to design assessments and have students submit them electronically appeared to be a major objective of the LMS. Electronic submission of assessments provides a faster response rate, more timely feedback and most importantly a means to monitor learning progress. For the following teacher, the purpose of enabling electronic submission of assessment was to provide an electronic version of a manual system: ‘Assignment drop boxes will be set up within the LMS because printing out assignments is a little old fashioned’ (017). Monitoring learning and providing timely feedback were not mentioned.
Although teachers’ future intentions were framed within the affordances of the LMS, the teacher in the following example is somewhat more ambitious. She intends to create more discussion, add YouTube videos and make her own video to upload into the LMS: ‘We can even make our own videos’ (003). Of particular significance is the intention to make videos. From a constructivist learning perspective, it would be of greater value for the students to create their own videos and upload them to YouTube. For another teacher, her goal for the future was to put a course online to promote sustainability. This goal aligned well with the organisation’s plan to become more sustainable; ‘I hope to do an online course next year… use different technology. I think we have to move to this for sustainability’ (024). Teachers intended to use technology because they valued what it promised. However, it was evident they were constrained by knowledge of how it transformed teaching.

**Perceptions of Quality Teaching with Technology**

Teachers believed that quality teaching with technology involved providing positive learning experiences. The components of this experience emphasised the importance of providing: regular feedback and communication; relevant and visually appealing course materials and creating an engaging and interactive environment. Of particular significance was that these factors constituted what teachers described as a positive teaching experience with, or without technology. They were consistent with how teachers believed technology enhanced learning. These perceptions served to remove any doubt that teachers were not aware of what effective teaching was or how it should look.

Teachers also believed that technological knowledge was a critical factor for quality teaching with technology. They did not mention that they needed to review or reflect on their pedagogical knowledge to enable successful teaching with technology. Like Chen’s (2008), this study showed that teachers were often left up to their own devices, choosing technologies they were familiar with and that were consistent with their current practices.

**Perceptions of best practice.** Teachers’ descriptions of best practice exemplars of teaching with technology were limited by the few responses provided to the interviewer. These
examples described how teachers had seen their peers’ practices. Exposure to exemplary technology use, outside of the organisation, was based on observations of what they had seen their children use. Teachers, therefore, were influenced by their peers and the younger generation.

Why teachers mentioned the internet, Skype, Blackboard and Blackboard Collaborate as best practice is significant. The internet was considered best practice because it was a valuable resource. It provided: ‘…a world of information for learning…the videos and stuff on YouTube are quite handy because you can look up anything you want to know or see how to do it’ (011). For teachers with apprentices spread across vast geographical distances, Skype was perceived to be an effective means for creating dialogue between the teacher, employer and apprentice. One teacher described Skype as something he had not done but had seen his son do in his personal life. He valued it as a potentially important tool for bringing together several remote parties to monitor apprentices’ progress. He explained: ‘…you could just put a webcam on a computer…from the office…the boss can sit in on the meeting…and then we can all have some interaction’ (020). Best practice was therefore conceived as what other people do. Although Blackboard has been previously discussed, its value in the next example was in its affordance as a virtual hospital. For one teacher, it functioned as a valuable resource: ‘It is all through animation so they obviously have someone very good in there. You just click into it and then there is a case study…you click on ‘assess the client’ and then you go into an assessment room’ (022).

According to Bound (2011) and Callan and Fergusson (2009), it is commonplace for VET teachers to have had limited exposure to a range of examples of best practice of teaching with technology. Providing teachers with the means to adapt their teaching practices to include innovative uses of technology seems overdue.

What teachers understood as good teaching with technology appeared to have been filtered by their traditional epistemological stances. Very few teachers were able to reflect on examples of effective teaching with technology. It is possible that teachers may not have seen examples of what they individually considered to be best practice. Acknowledging that the concept of ‘best practice’ is subjective, some teachers viewed it as neither constructivism nor
technology. The following explanation illustrated one teacher’s attitude towards constructivist learning. She explained how teaching should happen: ‘I have been at PD sessions where they ask you to bring out the butcher’s paper and I am thinking why they don’t just tell me, just give me the information’ (004).

Based on these examples of traditional practices, most teachers’ responses viewed best practice technology as teacher-led and teacher-controlled. Alternatively, teachers might have been constrained by the lack of measures with which to make decisions about effective technology integration.

**Perceptions of organisational support.** Not having an organisational policy or strategy is often reported as an obstacle in the development of a shared vision to work towards adopting technology in teaching (Hechter & Vermette, 2013; Marwan & Sweeney, 2010; Tondeur, Van Keer, van Braak, & Valcke, 2008b). Having a policy was an important driver for teachers to develop online courses for the teachers, especially when they felt supported. Historically, the lack of institutional support for online teaching and learning in regional Australia has created a significant barrier for the development of online learning (Kilpatrick & Bound, 2003).

In this particular study, lack of institutional support was not a barrier because teachers felt adequately supported. However, and consistent with Bound (2009), this did not always translate to teachers accepting the support offered. The ways in which teachers in this study perceived organisational support ranged from heavily supported to feeling a sense of angst at having to comply with an organisational directive to become a provider of open learning.

Teachers shared an understanding that the organisational directive was motivated by competitive, local, national and global training markets. Therefore, they may have sensed the imperative to create an online presence to compete in thin markets. It is possible that teachers felt a duty to support this plan. Adding to the pressure, institutional policy dictated the kinds of technologies that were available for use and the kinds of pedagogic practices that were privileged (Lawrence & Lentle-Keenan, 2013). For example, Blackboard and the LMS were implicitly encouraged. There was an expectation that teachers would put their courses online so as to create an online presence. One teacher described it this way: ‘Yes it is an absolute priority.'
If you wanted to go online, there would be PD every week’ (025). Teachers, therefore, were generally satisfied with the professional development they received: ‘…they are supportive and we get opportunities to do PD on online learning’ (012).

For some, pressure from peers and students provided the catalyst to integrate technology into teaching practices. This pressure, however, was subverted by a will to remain abreast of rapid technological change. Teachers were motivated to learn more, sourcing professional development externally, despite reporting that there was an adequate level of support available: 'If you don’t, you don’t know what is happening’ (022).

It is also possible that teachers acknowledged the importance of an online presence and the pressure to participate coming from the changing world of education, training and work. To retain their positions as teachers in the 21st century, teachers had little choice. Fear of being left behind emerged as a recurrent theme. As several teachers commented, ‘The institute has pushed it a little bit but it is the way to go’ (003) and it is, ‘the way the world is heading’ (025).

In summary, teachers intentions to use more technology for personal and professional purposes as well as for the pedagogical purpose of sustaining their current practices appears to be of greater importance than their intentions to transform teaching.

**Assertion Five: VET teachers’ technology use was largely shaped by their perceptions of students.**

The previous assertion presented substantial evidence to claim that VET teachers were positive about technology, they expressed the intention to further develop their uses of technology for a range of teaching purposes and they felt supported by their organisation. Although this study did not seek to examine teachers’ beliefs about students, a series of perceptions towards and attitudes about students emerged in conversations with the interviewer. A brief summary of aspects of the emphasis on the student will be reviewed as they appeared previously; both in Chapter Four and in the previous assertions.

As presented in Assertion One, beliefs about teaching referred to the importance of providing students with a set of skills and knowledge from which they were expected to
reproduce. Assertion Two presented a discussion of teachers’ beliefs about how technology enhanced students’ learning. Assertion Three presented evidence that technology was used as an additional source of knowledge where it was believed that it would enable students to develop independence. Assertion Four presented evidence of the importance of providing students with a positive, rewarding learning experience. Additionally, most teachers reported that one of the greatest barriers they faced integrating technology was a perception that their students would be unable to cope in a technologically-rich environment. Further evidence to support these findings is presented below. It adds weight to the assertion that VET teachers’ technology use was largely shaped by perceptions of their students. These perceptions are represented in this chapter as they created a connection between teachers’ beliefs and attitudes towards technology and their technology integration practices.

**Perceptions of students.** The plethora of individual perceptions and beliefs that emerged about students tended to be predicated on a notion that their knowledge and skills were deficient, lacking or inadequate. For example, implicit in the following comment was a belief that students did not have the attitude or motivation to study online, quite contradictory to the belief that technology would create independent, autonomous students:

> My experience is that high school students are very happy to get online and do the things that they want to do like social networking but when it comes to online study… they seem to be less interested. (17)

**Attitudes.** Students’ disinterest, as expressed in the comment above, implies the absence of an engaging and meaningful learning experience. It was apparent that this teacher’s understanding of technology, that is, used for entertainment rather than for educational purposes reflected a traditional conception of teaching. The potential to enhance engagement and motivation by combining students’ enjoyment of technology with their learning was not acknowledged. Citing student disinterest might sustain the belief that it is a deficiency relating to students rather than anything to with teachers’ pedagogical awareness and reasoning. It is possible that these perceptions are held unconsciously. Nevertheless, they are an implicit characteristic of teacher-centred practice and serve to sustain a transmissive epistemology.
In the previous quote, the teacher did not consider or reflect on the need for change. Even more significant was the possibility that the teacher was less likely to use technology he/she was unfamiliar with and consequently, less likely to use technology that was familiar to the student. This would lead to a potential for ‘epistemological incongruency’ between the teacher and the student (Fruge & Ropers-Huilman, 2008).

**Technology knowledge and skill.** For as long as teachers believe that students do not have sufficient technology knowledge, teaching with technology will only ever be seen as optional. To introduce students to technology who have not previously had access in regional areas would seem to be an important goal. Comments made by two teachers registered this concern. One teacher cautiously remarked: ‘Our students are middle-aged women with few experiences with technology’ (003). For another: ‘With disengaged youth, they wouldn’t have the skills to operate a computer’ (025).

Choosing not to teach with technology as indicated in the above examples may serve to further marginalise these minority groups. It would seem more compelling that regional, disengaged youth and older women would especially benefit from learning to use technology as an intricate part of their vocational learning experience. Therefore, the choice of continuing to adopt traditional teaching methods and practices reveals more about teachers’ not having the technology knowledge, technological content knowledge and technological pedagogical knowledge, than it does students not having this knowledge and skill.

While the previous comments indicated a lack of basic technology knowledge and skill, the following comment highlights students’ lack of software knowledge. Students did not know how to save files, upload or download them: ‘Most didn’t know how or where they had saved their work. I made the assumption that this generation coming through knew how to’ (024). Inherent in this comment is an assumption that the younger generation has a broad range of technology skills in a broad number of applications; yet a common issue relating to students is computer illiteracy (Maor & Volet, 2007). That being the case, there is less likelihood that teachers will see the need to explicitly teach basic technology skills, believing instead that it is the
role of the IT teacher. Again, what is perceived as a deficiency in the student, may relate more to gaps in teachers’ knowledge.

**Support needs.** Teachers in this study believed that students needed intensive support. Many VET students are not academically inclined and instead apply to undertake trades-related study. Other students return to study, having spent time away from formal education. As such, they are not yet quite ready for self-direction, flexible learning (Salter & Bound, 2010) or independent study. The nature and the intensity of support students require is described by two teachers: ‘They need close, structured mentoring …they need fairly intensive support’ (025). Another teacher explained that she needed: ‘to teach them every step’ (010).

These perceptions of students indicated the need for teachers to design their courses in such a way so that students felt supported and successful. The online learning environment is inherently complex and often difficult to navigate for students new to learning and new to learning with technology. Although many assumptions are made about VET students in that they are motivated, literary and highly cognitive (Brennan et al., 2003), many are not. As one teacher reports: ‘Online learners need to be self-motivated and independent, which all students are not’ (016).

As discussed in Assertion 3, technology was used to support teachers’ traditional practices. The intensive and structured mentoring and support teachers believed that students needed was provided through traditional means: face to face, email and telephone communication. Neither the teachers nor their students were using the communication tools available in the LMS. Support was provided in traditional ways because the perception was that students needed it to make sense of the online environment. It is possible that teachers adopted traditional, teacher-centred approaches to accommodate their perceptions of the preferred learning styles of their students (Robertson, 2007). There is sufficient evidence to suggest that that VET students were inclined towards teacher-directed learning (Choy & Delahaye, 2000; Pratt & Collins, 2000; Smith, 2000). It is also possible that the belief that students cannot cope in an online environment reflected teachers’ own fears about not being able to teach comfortably in an online environment.
**Self-regulation.** Teachers involved in this study believed that technology helped students to become independent. Self-regulation was highly valued. For one teacher: ‘It is important that they expand their knowledge and the places they obtain it as it promotes autonomy’ (018). For another: ‘It is important for the student to be able to develop their own learning and be responsible. We work remotely so the student has to be responsible’ (024).

VET students, however, are not inherently self-regulated (Robertson, 2007; Warner, Christie & Choy, 1998). Leaving students free to explore and research the internet, itself a rich source of knowledge was highly valued. This online freedom is somewhat contradictory to the level of support these students require. This suggests that the paradox exists more with the teacher than the student. The ability to design rich and effective learning experiences online requires a high level of technological pedagogical knowledge and skill. It also requires technology knowledge to engage students in meaningful communication with others using the available tools for these interactions. Teachers had a goal for where they wanted their students to be.

**Goals and motivation.** Implicit in the following comments are the belief that students’ goals and motivation are not aligned with that of the VET teacher. In this first comment, students were reported to have enjoyed the flexibility of online learning as they worked around their family responsibilities: ‘If we said to come online at 7.00 pm and their children are sick they won’t turn up because children are their priority. They don’t want scheduled classes’ (004). In the second comment, the teacher laments the fact that her students are extrinsically motivated. The students need to complete a mandatory qualification for employment in some jurisdictions and are therefore not motivated to learn:

> I think a lot of time students just want to come in, do their work and get out. It is becoming legislation … to have a certificate to work in the industry so some are doing it under sufferance. We have to make it interesting…they think they know everything but they don’t. (003)

In the quote above, the students’ perceptions of their knowledge were challenged. Unsurprisingly, students were believed to lack content knowledge. Such beliefs further sustain
the teacher’s role as the authority to impart knowledge. It is also possible that what these teachers perceived about their students reflects their own epistemological beliefs. The inherent difficulty in deciding to use technology more innovatively and in more content-specific ways was thwarted by differences in teacher and student goals for learning. Alone, this factor might militate against teachers’ decisions to integrate technology more purposefully.

**Behaviour.** In the following instances, technology was used to manage behaviour, either as a reward for positive behaviour or as a tool to monitor potentially poor behaviour. Technology conceived this way suggested it was not a resource for teaching. Consequently, students’ technology use was perceived as inadequate. As a reward: ‘I have an online learning program classroom but they are not allowed to go there if the kids have been mucking around’ (012). As a distraction: ‘Of course, you can reprimand so much but you have to be on the ball and be asking individuals questions all the time to see if they are still participating’ (016). One teacher reported feeling ‘loss of control’, at least from a generational perspective: ‘…it can also be distracting… they wander off to YouTube and Facebook and I don’t have control… Mature students don’t usually get distracted this way’ (010). These uses of technology in vocational education and training were seen to be untenable.

**Language, literacy and numeracy skills.** Many teachers referred to students’ low level of language, literacy and numeracy skills (LLN) as a reason for not teaching online. For example, one teacher said: ‘Some of our students struggle to read our books and there seems to be more and more students coming through who don’t like the reading’ (003). The following comment not only reflects this dilemma, but provides a glimpse of how one teacher understands online learning: ‘The learning guides cannot be tailored online to students having trouble understanding them’ (010).

It was not acknowledged that students with low LLN skills might need more encouragement and support to develop technology knowledge as a life skill for this cohort. Insufficient knowledge to design online learning experiences for these students, at an appropriate level, appears more the issue than their students’ limited LLN skills.
**Access to technology.** The diverse nature of students in the VET sector means that students do not always have internet access. In the regional context of this study, internet connections were slow, unreliable and intermittent. It is often assumed that first-order barriers relating to technology used for teaching have been overcome. In the case of one teacher, ‘I was quite surprised initially as a lot of our students are in rural areas and had problems with the Internet’ (003). Custodial contexts such as a prison, where one teacher worked, reported students having: ‘…no Internet access’ (011). Limited technological infrastructure therefore constrained students and teachers’ access to a range of technology.

Teachers’ beliefs and perceptions about students are worthy of further exploration. Teachers articulated a depth of awareness and compassion for students, their background experiences and contexts. However, they did not mention the skills, the background knowledge and experiences that students bring to the teaching and learning process in order that they be shared, validated and co-constructed. The perception that students were held in a deficit light perpetuated the notion of a passive student and might explain why teachers felt it in their best interest to retain a teacher-centred approach.

It would also appear that teachers’ reluctance to integrate technology was guided by their underlying system of beliefs regarding students as well as teachers (Palak & Walls, 2009: Windschitl & Sahl, 2002). Teachers’ decisions to use or not use technology were mediated and motivated by what they thought students needed. The following example epitomised what some teachers felt students needed:

I say to them…if you plan on doing this externally you need to have access to the computer, access to the internet and be able to move around… I don’t want to set my students up for failure. I would rather say stop, let’s just step back a bit. (022)

The obvious care and support provided to students, in response to what teachers thought their students needed, were filtered through their traditional epistemological and pedagogical perspectives. These perspectives are inconsistent with the complexity and demands of the workplace (Dirkx et al., 2004).
Vocational teachers’ technology use was largely shaped by perceptions of their students. It could be masking a belief that teachers had of themselves as students. As Kincheloe (2004) maintains, ‘There is nothing new in asserting that the way one teaches, the pedagogical purposes one pursues is directly connected to the way teachers see themselves’ (p. 58).

**Assertion Six: TPACK is a useful framework for understanding how teachers teach with technology. However, applying it to VET teachers’ practices requires significant change.**

The TPACK framework was applied in a unique VET context, distinct from the various other educational contexts that were previously reported. As discussed in Chapter 2, TPACK was proposed as a ‘body of knowledge’ which existed independently of its domains and intersections (Voogt et al., 2013). Deconstructing the domains enabled the researcher to identify teachers’ beliefs and knowledge about their teaching practices and their technology use. Additionally, exploring teachers’ attitudes towards technology enabled deeper insights into their TPACK awareness.

Evidence to substantiate this assertion was derived from the survey and interview data sources. The survey provided an overview of how teachers’ self-reported their TPACK. On its own, it would not have been able to produce the same depth of data as it did when combined with the interviews. For example, the survey did not investigate teachers’ beliefs that sat behind their decisions to use technology. Nor did it examine the contextual issues surrounding teachers’ practices such as, why some teachers do and do not use technology, why there are inconsistencies between what teachers believe and what they do in practice. The TPACK framework presupposed that educational contexts were educational institutions. The workplace therefore was not part of the model as it was originally conceived. The interviews, on the other hand, provided a qualitatively richer, picture of teachers’ practices as they were performed within an educational institution and within workplaces. Moreover, the interviews allowed greater understanding of the relationship between teachers’ beliefs and their teaching practices.
A description of the differences between the domains and the data sources are presented as evidence to substantiate the assertion that TPACK is a useful framework for understanding how teachers teach with technology. However, applying it to VET teachers’ practices requires modification to reflect its vocational nature and context. Figure 6.1 provides a visual representation of teachers’ TPACK based on the interview findings. Similar to Figure 4.2, the diagram below illustrates intersections between the TPACK domains, especially in the domains relating to technology. The most significant change in how teachers self-reported their TPACK in Figure 4.2 in comparison to Figure 6.1, relates to teachers’ PCK.

![Figure 6.1: VET Teachers’ TPACK based on interviews](image)

**Figure 6.1**

**VET Teachers’ TPACK based on interviews**

Compared to Figure 4.2 (p.75) the relationship between the domains was not as closely connected as teachers reported in the survey. In this study, the TPACK framework highlighted inconsistencies between teachers’ knowledge, their beliefs and their teaching practices. Figures 4.2 and 6.1 showed that teachers’ reported their TPACK higher than was evident from the interviews and from the interview transcripts. This is not uncommon (Agyei & Keengwe, 2012; Chen, 2008; Ertmer et al., 2012; Harris, Grandgenett & Hofer, 2010; Jordan, 2011; Messina & Tabone, 2012) and undoubtedly signals the complexity involved in measuring TPACK.

The following example illustrates one instance of the type of inconsistencies that emerged. In the first place, the teacher did not use a wide range of technology: ‘As much as I
would like to, I don’t use tablets, phones etcetera as I would have to buy them’ (016). The teacher reported that technology: ‘isn’t really conducive to my interactive mode of delivery’. In describing the way he used technology, images of constructivist practice were conjured: ‘I have found tons of stuff online … resources … I share them with the students and I tell them that we will discuss it next week…when that time comes I am left with a heap of blank faces’ (016).

The same constructivist approach was evident in the next comment: ‘To enable students to create and develop their own knowledge is central to my style of teaching’. He explained how knowledge was constructed, couching it in transmissive language: ‘They repeat the action until they grasp how to do it…to achieve the required proficiency as dictated by a supervisor’ (016).

The inconsistency between beliefs and practices, at least for this teacher, revealed limited TPACK awareness. One possible reason may have been that knowledge in the three main components: technology, pedagogy and content derived from three distinctive sources. As discussed previously (Assertion One), teachers’ pedagogical knowledge came from their experience as learners and as workers. Teachers’ technological knowledge was for the most part self-taught. Content knowledge was acquired from the workplaces and industry. In other educational sectors, technological, pedagogical and content knowledge derived from immersion in formal educational experiences. Aligning several sources of knowledge requires sound pedagogical reasoning and consistency in teachers’ belief systems.

**Pedagogical knowledge.** The pedagogical knowledge component of the TPACK framework is significant knowledge required by VET teachers. As discussed in Chapter 1, pedagogy in the VET sector is not often discussed alongside technology. This could be due to the fact that technology is a type of pedagogy (Chai et al., 2013) or simply a resource to teach with. Previous research noted that teachers with less experience or weaker pedagogical knowledge were less able to make connections between domains (Niess et al., 2009; Pierson, 2001). Where pedagogical knowledge is weak, it would therefore have greater impact on one’s TPACK, than technological knowledge (Liu, 2013). Pedagogical knowledge, in this study also had the highest impact on TPACK. Most teachers’ pedagogical knowledge derived from their experiences as learners, rather than from teacher preparation programs. Thus, it limited the ways
technology could be integrated meaningfully. The gaps in the development of pedagogical knowledge in the Certificate IV in Training and Assessment were identified in Chapter 2 (Robertson, 2008; Smith, 2010). Technology knowledge therefore was not highlighted as the most critical teacher knowledge.

Teachers typically reported their pedagogical, content and pedagogical content knowledge highly (Jang & Tsai, 2012; Jordan, 2011; Messina & Tabone, 2012). Teachers self-reported their ability to develop and create teaching and learning strategies for various concepts, contexts and students suggesting that they possessed a broad range of pedagogical strategies from which they could draw. As Jordan (2011) optimistically contends, if teachers self-assessed their pedagogical knowledge highly, it might mean they can concentrate on developing other knowledge bases.

However, interview data suggested that some teachers were not inclined to change their teaching practices. Findings also revealed that teachers’ practices were informed and constrained by traditional epistemologies and pedagogies. Therefore, what teachers thought they knew did not align with what they did in practice. Findings from previous research show that this is quite normal (Agyei & Keengwe, 2012; Agyei & Voogt, 2012; Doehring, Veletsianos, Scharber & Miller, 2009; Jordan, 2011; So & Kim, 2009). Teachers’ pedagogical beliefs were held in stark contrast to the constructivist pedagogy required to realise the full potential that technology affords. These were discussed previously (Assertions One and Two). In Assertion Three, teachers’ practices were characterised by a teacher-centred transmission model. Constructivism was limited to an understanding that it meant acquiring knowledge. However, constructivist language was used only as it pertained to technology. Teachers planned for teaching in the future that would be more constructivist-orientated. That such teaching was more idealistic than real, revealed that teachers did not have a sufficiently strong pedagogical background with which to attempt to make the shift. Therefore, teachers were not unfamiliar with pedagogical approaches other than the transmissive approach. Therefore, the TPACK model’s pedagogical knowledge domain exposed the need to develop awareness of alternative pedagogical approaches for the teachers in this study.
Technological knowledge. This is the single-most knowledge required to integrate technology for meaningful teaching and learning in the 21st century. Teachers in this study rated their technological knowledge as ‘Fair’. Consequently, knowledge in the other domains containing this type of knowledge showed the same result. Increasing this knowledge may simultaneously increase pedagogical knowledge where it is limited (Liu, 2013) as well as extend technological pedagogical knowledge and technological content knowledge (Tee & Lee, 2011).

Interviews with teachers, however, showed that technology knowledge was much higher than they had reported. The reason for this anomaly may be due to the nature of the survey items. These referred to the technical aspects of the technology such as hardware, software and troubleshooting ability. Teachers were careful to point out that the technical aspects of technology were not valued: ‘I like technology…I am not a trouble-shooter. With software, I have no issues whatsoever but when it comes to fixing computers, I am not interested in understanding how to’ (025).

It is also possible that the confusion over terminology relating to online/e-learning teaching discussed previously (Assertion Two) may have confined teachers’ understanding of technology to computers and the internet. As workplaces and industry use technology specific to a trade or discipline, computer knowledge alone is insufficient. Therefore, teachers’ actual technology knowledge may have been misrepresented.

Teachers demonstrated their knowledge of a range of ubiquitous technologies, skills to operate them and an attitude to learn and adapt to new technologies. Teachers who had the knowledge were integrating it in ways they knew how to, although this was to support the content more so than the pedagogy. Those who had limited or minimal technology knowledge used technology for routine tasks such as booking cars or booking leave: ‘We have a Blackboard page where our student results are held. We have a normal webpage and a staff extension list…car bookings’ (016).

Although technology was used to support teachers’ current teaching practices, they used technologies they were familiar with. Once they became commonplace it may no longer have
been seen as technology, morphing instead into pedagogical knowledge (Graham, 2011). One teacher admitted: ‘This [LMS] is the only technology I have taught with so far but I text message a lot with students’ (020). As Robertson (2006) noted, the more ubiquitous the technology, the more knowledge the teacher had. However, knowing about technology and knowing how to use technology is insufficient for teaching in the 21st century (Finger, Jamieson-Proctor & Albion, 2010). For vocational teachers, keeping up with emerging industry-specific technologies and learning to teach with generic technologies present significant challenges on several levels: the individual, organisation and institution (Fransson & Holmberg, 2012).

Technology knowledge, therefore, requires special attention in the model. TPACK is sufficiently generic for thinking about any new tool that is introduced into teaching. To be usable for the VET sector, the framework needs further contextualisation to reflect the role of technology in the workplace. Only then, will it provide a meaningful connection for teachers to prepare students for technology-rich workplaces.

**Content knowledge.** Content knowledge is integral to teachers’ subject expertise and their trade knowledge. It is also a minimum requirement for teaching in the VET sector. As such, it is intricately connected to a teacher’s identity. It is therefore, not surprising that teachers rated their content knowledge highly in the TPACK survey.

The survey items relating to content knowledge did not measure teachers’ content knowledge as defined by the framework. Instead, they measured the knowledge relating to the way content was recontextualised to teach. Therefore, determining teachers’ actual content knowledge was difficult because neither the survey nor the interview was able to assess teachers’ content knowledge in any depth.

In this study and within the VET context, content knowledge was predetermined. Teachers relied on competency standards from the industry training package contained. Teachers were not able to own the knowledge they taught. It was external to them. Their involvement with content knowledge was confined to directing students where to access it. Content was on the internet: ‘The content of our course is on the state website so we send them
to their website to see their policies’ (003). Content was in the LMS: ‘In Blackboard…we have all the information the students need’ (004). It was in a learning guide: ‘Some only need the learning guides and materials and off they go’ (010). It was also in a text book: ‘Access to course content is…still all in their textbooks’ (017).

It is not surprising that teachers did not describe the importance of technology in facilitating the development of higher-order conceptual knowledge. This was not expected of students either. In most cases, teachers described their practices as requiring students to reproduce low-level tasks. This could have been a reflection of teachers’ pedagogical knowledge more so than a reflection of their actual content knowledge. Put simply, students: ‘…find the online content, a picture…a procedure sheet and then they demonstrate a basic weld…I demonstrate how it will be done. I underlie that with follow up material and practical exercises’ (012).

There was minimal evidence of teachers creating resources to teach their content. Even when a resource was inappropriate and the students did not enjoy it, if nothing else was available, it would have to do. One teacher explained it this way: ‘it is not ours, we pay for it and you do assignments online…They don’t like it. It steps you though like a Learning Guide and then there is a quiz at the end to see if they understood what they have read’ (020). Systemic reliance on external resources for content knowledge suppressed teachers’ identities as experts as well as their creative and innovative tendencies. This may, in part, be due to the prescriptive nature of units of competency from training packages that make up the qualifications in the VET sector, constraining teachers’ creativity and innovation as well the dilution of their professionalism. It might also be related to vocational teachers’ understanding of the different ways in which content is organised, adapted and represented.

To account for the inconsistency between the survey and interview findings, it was possible that the TPACK items related more to teachers’ perceptions of how to meet compliance with the Australian Quality Training Framework standards. Items such as ‘mapping’, ‘scope’ and ‘concepts’ for these teachers would pertain more to adhering to the standards than any connection to the content knowledge they hold.
Content knowledge changes in the vocational sector more so than in the primary, secondary and university sectors. It is possible that teachers have lost confidence in the content knowledge and skills they had as workers, having been removed from their industry for a period of time. Measuring technological knowledge and pedagogical knowledge seemed to be clearer than measuring content knowledge. Several other studies have noted the difficulty in measuring content knowledge (Anderson et al., 2013; Archambault & Barnett, 2010; Voogt et al, 2013). The definition seemed too broad for the way in which it was practically applied in measuring and developing teachers’ TPACK.

**Pedagogical content knowledge.** Teachers reported having high level pedagogical content knowledge. In light of the previous discussion these results were surprising. It was not always possible to identify teachers’ awareness of conceptual issues relating to pedagogy and epistemology. Interview transcripts revealed limited evidence of descriptions or demonstrations of a range of teaching strategies which could confirm teachers’ self-reports. The following strategy was not atypical of many teachers’ approaches: ‘In the emails I send…they will receive exactly what they are doing, what is required…there are also the learning guides. If they come to me and say I want to do it externally but have no idea how to use a computer, this will tell them’ (022).

The survey items for the TPACK domain, pedagogical content knowledge related to: anticipating students’ misconceptions within a particular topic, comfortably producing delivery plans with an appreciation for the topic, assisting students to notice and make connections between concepts. Although teachers rated themselves very highly, they were not reflective of the type of linear teaching and learning presented in externally sourced content, hard copy or electronic. Teachers provided direct instructions, illustrated by one teacher’s comment: ‘We give advice as to where to go and what to do…work them though their assignments and what to access’ (003).

It was not evident from the interviews that teachers were distinguishing between correct and incorrect problem solving attempts by students, as problem solving did not feature readily in either teaching strategies or assessment design. As discussed previously (Chapter Four and
Assertion Five), perceptions of students emerged as a central theme in most teachers’ interviews. Care and support for students was evident throughout. This could possibly denote teachers’ intuitive or ‘craft’ (Voogt et al., 2013) knowledge, that which has accumulated over time as well as a desire to pass on their knowledge. Alternatively, this nurturing perspective would explain why teachers continued to adopt an inherently traditional, teacher-centred practice. It is possible that teachers interpreted pedagogical content knowledge survey items as relating to their ability to assess students. This perspective would also reflect concerns teachers had in adhering to the AQTF standards.

As Robertson (2009) noted, pedagogical content knowledge develops on-the-job and over a period of time. With appropriate support in developing pedagogical and content knowledge as foundational teaching knowledge for VET, teachers’ pedagogical content knowledge has the potential to develop more deeply.

**Technological pedagogical knowledge.** Teachers in this study, reported technological pedagogical knowledge lower than their TPACK, which is not uncommon (Archambault & Crippen, 2009; Messina & Tabone, 2012). Yet, the results were confirmed by the interview findings. Their technological pedagogical knowledge was limited to an understanding that technology was a useful resource for administrative and teaching purposes. Teachers who were not using a range of technology used hard copy, older forms of technology for the same purposes. One teacher described a traditional method he used: ‘You were sent a CD and a book … you study it and then come, in ten days and we give you a day of practical work … face to face (016).

Teachers in this study had neither experienced teaching nor learning with technology and therefore did not have exposure to models with which to emulate. According to Bos (2011), teachers’ knowledge to teach with technology requires a deliberate, conscious and analytical effort on the teacher’s part. Further, they were unclear about effective ways to integrate technology into their teaching (Hechter & Vermette, 2013; Levin & Wadmany, 2008). Teachers reported the will and the enthusiasm to do more with technology suggesting that technological pedagogical knowledge was the greatest barrier to teaching with technology.
The most compelling evidence to support these finding is that teachers did not recognise the need to adapt their pedagogical practices to accommodate the changes technology allowed. It is possible that teachers did not see technological knowledge as important teacher knowledge; rather, that it was perceived as a teaching resource. Although teachers agreed that technology had transformative potential, they believed that it was only something to be achieved in the future. That there was little pressure to integrate technology meant that teachers had a choice. The choice typically resulted in teachers using technology as an adjunct to traditional teaching practices.

**Technological content knowledge.** In this study, teachers rated their technological content knowledge higher than their technological knowledge. Interview findings did not support teachers’ self-reports. The survey items for this domain referred to the ability to use multimedia to visually represent concepts (e.g. PowerPoint), to teach units of competency using technology and to use a LMS (e.g. Blackboard). Teachers’ technology use reflected these applications. There was no evidence of teachers using technology to transform content.

It is also possible that the survey items relating to technology and content questions were problematic. Technical knowledge referred to the technical aspects of the technology, rather than knowledge of industry-specific technology and software applications with which teachers were familiar. Technological content knowledge domain items referred to the use of ‘technological representations to demonstrate concepts in content area rather than knowledge of industry-specific technology. Alternatively, teachers may have rated their technological content knowledge high because they perceived they were using technology to teach their content without the understanding that it could transform content. Adding technology to their content knowledge, therefore, was not straightforward.

Teachers did not believe that technology could be used to teach aspects of their course, especially if the units were practical and skill-based. Based on the interviews, there was very little evidence of industry-specific technology used to teach the content. One teacher noted: ‘to gain knowledge about a leaf, we can read about it and see it using technology but this is not as effective as actually touching, smelling and looking at real leaves’ (004). Farming was one
instance where technology was perceived to be of value: ‘You can’t just run a farm chasing sheep, driving tractors and shearing because at the end of the day, there is always paperwork to be done whether you do it online or manually’ (024).

Technological content knowledge was not apparent nor was it perceived as necessary when applied to practical tasks such as working with animals or machinery, despite the availability of industry-specific technologies that could have been used. There was no evidence or explanation that agricultural students were learning with Gravitational Positioning System (GPS) or mobile phone apps, despite their ubiquity within the industry. Rather technology was conceived as related to the internet and to software applications. The lack of content-specific or industry-specific technology used to transform content, as indicated by the data in Chapter Four, might be related to teachers’ unfamiliarity with the latest technology of that industry. Teachers leave the industry when they become teachers; therefore, they may lose currency of content knowledge.

There were occasions where technology such as the mobile phone was used. As a diagnostic tool in an automotive workshop, apprentices took ‘before’ and ‘after’ photos of the engines they were learning how to dismantle: ‘Anything they pull apart, they can just take a picture of it ... so they can see how it goes back together’ (020). Within the same automotive context, the internet was used to access manufacturer specifications. YouTube was used as a teaching and learning resource. In each of these instances, technology was used as a resource rather than a means of transforming the content. It is possible that content is not perceived to be transformable as it exists in training packages. Teaching other than what training packages stipulate may constitute non-compliance under the AQTF. From this perspective, teachers’ limited technological, pedagogical and content knowledge perpetuated the belief that technology was an alternative conduit for the transmission of knowledge. This use of technology is in direct contrast to the notion that technology has the potential to transform, challenge and contest knowledge that is held by those in authority.

Teachers’ did not show awareness of the multiple ways in which technology could enhance teaching and learning. As a rich source of information, the internet could provide
exposure to other experts in different contexts thus providing access to multiple learning opportunities. Teachers, generally, were not using technology to provide students with alternative ways of knowing, seeing and doing. Multiple representations of that content did not appear to be a priority suggesting that teachers’ pedagogical content knowledge was steeped in traditional understandings of knowledge. It may also have meant that teachers felt constrained by the lack of access to industry-specific technology in the organisation, or that workplaces were not investing money on resources and technologies to enable workplace training to take place.

Alternatively, and according to Koh, Chai, & Tsai (2014), technological content knowledge may not always be related to pedagogical knowledge. This might explain why teachers scored higher on technological content knowledge than technological knowledge or technological pedagogical knowledge. Teachers’ technology knowledge, having come from an industry, may be directly related to their content knowledge but not necessarily related to pedagogical knowledge.

The precision with which this study was able to discern differences between technological content knowledge and technological pedagogical knowledge raises questions as to how clear the boundaries really are (Graham, 2011). In the VET sector, particularly, it is possible to have technological content knowledge without involving pedagogical knowledge. For example, plumbing (content knowledge) uses live-feed video camera (technological knowledge) without any reference to teaching it (pedagogical knowledge). The appeal of the TPACK framework, therefore, in the VET sector is that having strong technological content knowledge might mean that teachers develop strong relationships with industry. These relationships would ensure that vocational teachers remained current in their industry, cognisant of changes in both the technology and the content as it changes rapidly.

The real value of the TPACK framework for understanding VET teachers’ technology integration practices lies in the way that technology can transform content matter in ways which better complement the skills and knowledge required in the 21st century. As important, is an
understanding of how teachers believed they were using technology to transform content and how this use was expressed within the teachers’ belief system.

**Technological pedagogical and content knowledge.** In light of the previous domains’ analyses, it was of little surprise that teachers self-reported low TPACK. They reported seeing very few examples of best practice among their peers. Without it, it was unlikely that teachers would have been able to recognise examples of teaching with technology as effective practice. The way teachers generally described best practice was based more on their peers’ software proficiency or their administrative proficiency rather than examples of changed teaching and learning practices. One teacher described his colleague’s best practice:

- It’s a tracking document with an Excel spreadsheet…it’s got all his apprentices on it.
- We are paper based whereas he is electronic. He has links to where his files are stored…That’s impressive. It’s a tracking tool, assessment plan, delivery tool. (020)

The TPACK framework provided a visually, simple means for measuring teacher knowledge. It also provided a means for a better understanding of the complexity of VET teacher knowledge. Teacher preparation programs are often held accountable for failing to adequately prepare teachers to establish pedagogical connections between the pedagogy and the technology. The TPACK framework connected various knowledge blends vital to the VET sector. Although contradictory to TPACK as a single body of knowledge, once deconstructed, these knowledge bases exposed the relationships between the blends. It also highlighted the importance of teachers’ belief systems behind their knowledge. In doing so, it has highlighted gaps in VET teacher knowledge and not necessarily gaps related to technology.

Teachers’ knowledge and beliefs about TPACK included the importance of teaching skills as teaching knowledge. Although the TPACK refers to ‘knowledge’ teachers need, its application in the VET sector has exposed the importance of ‘skill’ as well as ‘knowledge’, better reflecting the practical nature of vocational programmes.

Many VET courses require a skilled performance. Tasks such as operating machinery, shearing sheep and cutting hair require skilled operators. Behind these skills is the knowledge required to execute the skill. Teaching and assessing these skills requires an expert performance
which is somewhat different to teaching the knowledge component of a practical skill. One teacher illustrated why skills are so important: ‘My skills need to be kept up to date… I need to demonstrate how my skills work (012). Pedagogical skill as well as knowledge was clearly identified as basic teacher knowledge.

The addition of ‘skill’ to the TPACK framework would render a more contextualised and nuanced understanding of what teachers need for teaching with technology in the VET sector. The next chapter proposes a VETPACK model as a potentially more rigorous and reflective framework for supporting professional development and teacher education programs in the VET sector.

**Chapter Summary**

This chapter discussed the three assertions, Assertions Four, Five and Six, in turn. These assertions related to teachers’ attitudes and perceptions regarding technology in teaching. Assertion Four was based on evidence that VET teachers expressed positive attitudes towards technology. Teachers’ intentions to develop technology knowledge for personal and professional purposes appear to be of greater importance than their intentions to develop and transform pedagogical knowledge.

Firstly, teachers were confident about using technology and were enthusiastic about what it could do. They were not confident about their technology knowledge. Teachers realised its potential to change learning so that they could participate in a digital society and had positive intentions to integrate more technology in the future.

Secondly, evidence of teachers’ TPACK awareness, how TPACK is conceptualised and examples of best practice as it is perceived within the organisation were presented. Teachers perceived that quality teaching with technology was about providing a positive learning experience for students. Teachers’ perceptions of best practice were constrained by the minimal exposure they had to effective examples of teaching with technology. Moreover, best practice was what they had seen their peers do. Teachers felt supported by the organisation. They received adequate access to professional development, although much of teachers’ teaching with
technology knowledge was self-taught, many had to pursue their own professional development. Teachers felt pressure to participate in order to remain current as teachers in the 21st century.

Assertion Five was based on evidence that VET teachers’ technology use was largely shaped by their perceptions of students. Teachers provided a range of reasons as to why it was difficult to involve students in teaching and learning with technology. Teachers’ language was couched in a deficit model. These student-related issues referred to: technology knowledge, need for support, self-regulation, goals and motivation, behaviour, language, literacy and numeracy skills as well their access to technology.

Assertion Six presented evidence to support the assertion that TPACK is a useful framework for understanding how teachers teach with technology. It provided an analytical structure for researching what teachers should know and be able to do, highlighting the importance of pedagogical and content knowledge when incorporating technology. The TPACK framework provided a visually, simple means of measuring teacher knowledge so that teachers can be supported to develop knowledge across the domains as they correlate in real teaching contexts (Doering, Veletsianos, Scharber, & Miller, 2009; Jimoyiannis, 2010; Koehler & Mishra, 2009; Lee & Tsai, 2009; So & Kim, 2009). However, applying the framework to VET teachers’ practice requires some modification to reflect a more decidedly vocational context. These changes are proposed in the next chapter.
Chapter Seven: Summary of Findings, Implications and Recommendations

Chapter Overview

This final chapter summarises the key findings arising from the five research questions. It then presents the implications for vocational teachers and teacher educators. Limitations of the study are presented. The chapter concludes with recommendations for further research to develop a proposed VETPACK model to support teachers’ integration of technology into their teaching practices.

Teachers’ Perceptions of Their Technological, Pedagogical and Content Knowledge

R1 How do VET teachers perceive their knowledge in relation to technology, pedagogy and content?

Deconstructing each TPACK domain provided a clearer understanding of how VET teachers in this study perceived their knowledge in relation to technology, pedagogy and content. Teachers knew what they had to teach based on their knowledge of training package curriculum. The content was prescribed. They knew how to teach based on their years of experience in the profession. Teachers reported being most comfortable and confident with aspects and perspectives of traditional teaching environments, using their experiences and skills associated with face to face environments. The TPACK survey clearly indicated the teachers with high TPACK scores and teachers with low TPACK scores. Each teacher was de-identified and therefore it was not possible to match survey results with teacher interviews. It is probable that teachers who self-reported low TPACK, also used less technology in their teaching for a range of reasons. Conversely, teachers who reported high TPACK scores would have been more likely to report experimenting and trialling new technologies and feeling optimistic about teaching with new technologies in the future.
Consequently, they rated their pedagogical and content knowledge highly. Based on the survey and interviews, teachers generally did not have sufficient knowledge to teach effectively with technology. They did not have the knowledge of a range of various technologies or the knowledge to operate them, troubleshoot or learn new ones. Teachers did not provide evidence that content could be transformed through technology or that it could change the way they taught and consequently, how students learn. As teachers did not have previous experience of teaching in technology-rich environments, they had neither developed the knowledge nor the skills to encourage and promote teaching in these environments. Overall, teachers were not confident about meeting the overall demands of teaching with technology. As a result, teachers perceived their TPACK as well below what they felt they required.

The Influence of Beliefs about Teaching, Learning and Knowledge on Teachers’ Practices

R2 How do VET teachers’ epistemological and pedagogical beliefs relate to their beliefs about teaching with technology?

Teachers’ epistemological and pedagogical beliefs were not consistent with their beliefs about teaching with technology. Teachers’ beliefs about teaching and knowing were based on a traditional educational paradigm. That is, teachers commonly understood teaching as the transmission of knowledge from the teacher to the student. Their practices for the most part, were inherently teacher-centred and teacher-controlled. The teacher’s identity was an important concept to preserve.

Learning was expressed as active, observable, demonstrable, involving practice, engagement and interaction. Teachers had an awareness of constructivist pedagogies; yet they perceived learning as a replication and reproduction of the teacher’s knowledge and skill. As a result, their pedagogy was inherently transmissive. Evidence of constructivist practice was gradually emerging. Whether or not this continues as a trend remains to be seen.

Teachers’ epistemological beliefs, that is, their beliefs about knowing and knowledge for the most part also reflected a traditional transmissive paradigm. Teachers accepted the
knowledge provided to them. They did not have the confidence to question or challenge the content provided in training packages. Findings from this study showed marked consistency between teachers’ epistemological and pedagogical beliefs, thus confirming findings from previous research (Anderson et al., 2013; Calderhead, 1996; Chan & Elliott, 2004; Feucht & Bendixen, 2010; Kagan, 1992; Kim et al., 2013; Levin & Wadmany, 2006; Pajares, 1992; Sosu & Gray, 2012; Tanase & Wang, 2010).

Teachers generally extolled the virtues of technology and through these expressions, celebrated the opportunity for paradigmatic change. Technology, they believed, enhanced students’ learning. Consistent with a student-centred learning, they saw the potential for technology to support engagement, connectivity, communication, collaboration, flexibility and independence.

Believing in constructivist pedagogy is not sufficient to advance VET teachers’ practices. Teachers recognised the alignment between the technology and pedagogy but they lacked the savoir-faire to be able to harness this potential and manage the transition. They did not have the tools to describe the meaning they tried to make from adding technology to their teaching practice. These core beliefs rendered it almost impossible to conceive of a new pedagogy, let alone implement one (Archambault, Wetzel & Fulger, 2010).

The Characteristics of VET Teachers’ Technology Use

R3 What are the characteristics of VET teachers’ technology use?

Findings from the interviews suggested that teachers used technology to support and enhance their teaching practices rather than their students’ learning. Teachers were familiar with ubiquitous technologies although there was some experimentation with technologies less common. Teachers’ understanding was constrained by inadequate exposure to models of teaching with technology.

Lack of exposure to alternative pedagogical theories and practices exacerbated this misunderstanding, as did inconsistent use of terminology relating to teaching with technology. These finding are similar to other contexts whereby teachers’ pedagogical beliefs did not change.
in technology-rich environments (Anderson et al., 2013; Angeli & Valanides, 2009; Hechter & Vermette, 2013; Levin & Wadmany, 2006; Liu, 2013; Palak & Walls 2009). In this study of VET teachers, technology was rarely used to support student-centred pedagogy (Cuban, 2001; Palak & Walls, 2009). Although the internet was used as a significant source of information, the use of Web 2.0 tools was not evident despite the regional and rural context in which this study took place. Teachers’ TPACK reflected their transmissive epistemologies and pedagogies.

In summary, VET teachers’ beliefs about knowledge, teaching and learning were consistent with their practice. These beliefs may be critical for understanding why technology is not integrated as frequently and effectively as it could be. For as long as teachers adhere to the belief that knowledge is transmitted from an authority to a learner, their use of technology will reflect that practice (Buehl & Fives, 2009).

The Influence of Teachers’ Attitudes on Their Technology Practice

R4 How do VET teachers’ attitudes towards technology shape their teaching practice?

VET teachers’ attitudes towards technology shaped their teaching practices in several ways. Attitudinally, teachers were confident and enthusiastic about technology and the ways it impacted upon their personal and professional lives more so than it did their students’ lives. It was considered important to keep up with the digital world and it was valued as essential teacher knowledge.

Teachers undertook professional development of their own volition, despite some teachers indicating that it was readily available within the institute. They intended to use more technology in the future because they valued the promises it held for learning. Despite their positive attitudes, teachers used a limited range of technological resources to support their traditional, teaching practices. Without ongoing professional development to challenge teachers’ practices, they will not be able to transfer their confidence in using technology to their teaching practices as long as their beliefs are steeped in traditional ways of knowing and doing.
The Value of the TPACK Framework for the VET Sector

R5 How useful is the TPACK framework for understanding VET teachers’ technology integration practice?

The TPACK framework provided a means to measure and explore teachers’ knowledge, beliefs and practice. However, applying it to VET teachers’ practices requires significant change. Examining the domains separately highlighted specific gaps in teacher knowledge. Pedagogical knowledge, rather than technological knowledge, tended to have had the highest impact on TPACK. This limited the ways technology was integrated meaningfully. Moreover, teachers’ content knowledge was measured in relation to its pedagogical connection and therefore did not represent teachers’ actual content knowledge.

The complexity of the knowledge required by VET teachers existed within the blends. Vocational education’s close connection with workplace and industry underscored the need for teachers to develop and maintain current technological pedagogical content knowledge. To teach workplace knowledge, teachers require pedagogical content knowledge. To teach technological content knowledge, teachers require technological pedagogical knowledge. While the TPACK framework was of value in understanding where the gaps were in VET teachers’ technology integration practices, developing it in the vocational sector seems more compelling than in any other educational context.

These findings provided the catalyst for modifying the existing TPACK framework to reflect the significance of the workplace in informing and transforming teachers’ knowledge and practice. TPACK was a sufficiently robust model upon which to consider an adaptation that would guide VET teacher professional development and teacher education programs. The revised model should provide greater synergy between the TPACK domains by ensuring the knowledge bases were reflected upon, vocational currency maintained and industry-relevant to prepare students for the workplace. The next section describes this revised model.
Implications

Several implications are drawn for VET teachers’ practices, teacher education and professional development programs. Three interrelated factors are posited to explain the limited use of technology by teachers in this study:

- widespread acceptance of a teaching practice steeped in a traditional, transmissionist paradigm
- inconsistency between teachers’ beliefs and practice, and
- deficiency in technological, pedagogical and content knowledge

The greatest impact of traditional epistemological and pedagogical beliefs manifested itself in how VET teachers undertook their own practice, transmitting knowledge without questioning it and using a linear development of learning outcomes through explanation, demonstration and practice (Orlando, 2013). Despite these traditional teaching methods, many of the teachers had begun to view technology as a valuable resource and source of information. It was possible that teachers had begun making the necessary paradigm shift. Rather than relying on external sources of information, teachers acknowledged that the Internet, in particular, opened their students’ world. Implicit in these views is that teachers had started to question their own practice. Thus there exists an opportunity for many of these teachers to move beyond the transmission model of teaching.

Vocational Education Technological Pedagogical and Content Knowledge (VETPACK)

To address these findings, VETPACK is proposed as a modification of the TPACK model for vocational teacher education. Based on the research findings, it has the potential to ‘restructure knowledge blocks that risk being fossilised through teaching routines’ (Messina & Tabone, 2012, p. 1026). As Mishra and Koehler (2006) argued, the emergence of, ‘newer technologies often disrupts the status quo, requiring teachers to reconfigure not just their understanding of technology but of all three components’ (p. 1031).
The proposed VETPACK could potentially allow vocational teachers to re-evaluate old assumptions and open doors for new ways of thinking (Tee & Lee, 2011). Developing it would enable teachers to realise new pedagogical forms (An & Reigeluth, 2011; Holmes, 2009).

VETPACK represents a total package of knowledge teachers need for teaching in the vocational education and training sector. See Figure 7.1. It adds the concept of vocational education to the original TPACK model (Mishra & Koehler, 2006) and offers the research community a contextualised form of TPACK (Finger, Jamieson-Proctor & Albion, 2010).

![Figure 7.1](image-url)

**VETPACK**

VETPACK is similar to the earlier framework in that it recognises the dynamic relationship between technology, pedagogy and content. As a body of knowledge, it would represent a class of knowledge that is central to teachers’ work with technology (Mishra & Koehler, 2006; Voogt et al., 2013).
Importantly, VETPACK differs from the TPACK framework in several ways. It highlights the importance of developing knowledge in each of the domains and at the points of their intersection. One of the most notable changes is the addition of ‘skill’ to acknowledge the physical and practical component of many courses in the vocational education sector. Skill, in this sense, is the application of knowledge. Unlike knowledge, skills are visible. As teachers’ beliefs about teaching ‘skills’ reflected their traditional epistemologies, adding technology to their practices could mean that teachers might no longer see themselves as the sole authority from which students learn. Exposure to a range of skilled performances from different contexts and cultures through a range of media could challenge the foundations of traditional vocational practice. Technology empowers students by giving them choice and the freedom to construct their own physical performance. Through digital recording, students’ skills could be practiced, reflected upon and thus improved. Technology, therefore, potentially changes how skills are taught as much as how knowledge is acquired.

Next, VETPACK acknowledges the social nature of vocational practice. It is a shared practice involving a complex network of people and technologies. The vocational teacher is only one of many involved in preparing students for the workplace. In particular, industries, and the workplaces they represent, exert considerable influence over VET practice. They determine what counts as knowledge, how students are trained and consequently what students learn. They provide the evidence for making judgments about students’ competence and their ability to perform a set of predetermined standards. The importance for VET teachers to work collaboratively is mandated by industry. VETPACK also recognises teachers’ dual identities: their teacher expertise and industry expertise. To maintain VETPACK currency, they need to develop relationships with others: industry, workplaces, government and funding agencies (Clayton, 2013). They have access to multiple sources of vocational knowledge and skill, all of which can be potentially shared, rather than owned, in practice.

Finally, and cognisant of the previous consideration, VETPACK proposes to explore aspects of teachers’ practices beyond their knowledge and skill bases. Mishra and Koehler’s (2006) original framework emphasised the elements and relationships characteristic of each
domain. Based on the findings from this study, VETPACK acknowledges and retains these descriptors. In addition to these, VETPACK would incorporate an affective dimension to the TPACK’s predominantly cognitive dimension.

The affective dimensions of teachers’ practice are often held unconsciously. Personal attributes such as core, fundamental beliefs about teaching and learning, confidence, or self-efficacy and their motivation for action (or inaction) are intricately woven into their practice. Greater emphasis on this dimension of teachers’ lives is needed if teachers are to prepare students for workplaces of the future. These will be explicited in the next section.

**VET pedagogical knowledge and skill.** Pedagogical knowledge and skill alone would be inadequate to develop and implement VETPACK. Beliefs about teaching, learning and knowing have been included to specifically address gaps in the recent TPACK research (Voogt et al., 2013). VETPACK registers the importance of examining teachers’ beliefs. It also acknowledges the importance of students in VET teachers’ practice.

In this study, teachers did not see the need to change their practice. As teachers were also found to have had limited awareness of constructivist principles and practices, they had fewer resources to draw upon to challenge their traditional ways of knowing and teaching.

From the VETPACK perspective, pedagogical development is not the responsibility of the teacher alone (Kemmis, Sutcliffe & Ahern, 2009). Therefore, it is imperative that professional development programs and teacher education programs are aligned with the pedagogical reasoning and complexity demanded of the workplace and industry.

**Examine beliefs.** From the findings, it is important for teacher educators and professional development organisers to understand how beliefs about TPACK can influence technology use and integration. Allowing teachers to articulate these beliefs means making their beliefs explicit and challenging the adequacy of them (Kagan, 1992). With support, these beliefs can change (Kim et al, 2013; Levin & Wadmany, 2006).
VETPACK would support and guide teachers to mirror the epistemological positions of workers in the workplace and the demands of technologically-rich workplaces by adopting new pedagogies to reflect these complexities.

Another important implication relates to the finding that teachers’ pedagogical knowledge comes from their experiences as learners. Teachers tend to teach as they were taught. The role of teacher education is to replace old beliefs with new ones. This is critically important in changing practice (Sandholtz, 1997). Entering the teaching profession from the workplace, rather than from university, limited their understanding of educational theory and knowledge, which might have challenged their practices.

VETPACK recognises that beliefs about all three knowledge and skills bases should be developed concurrently. Part of this process involves reflection on their deeply entrenched beliefs. In professional education or teacher education programs, to enable reflection, questions could be asked such as:

- Are your beliefs about knowledge consistent with the way you teach?
- Are your beliefs about teaching consistent with your beliefs about learning?
- Are your beliefs about technology consistent with your beliefs about teaching and learning?

**Promote constructivist practice.** The implications of teachers having not been exposed to models of constructivist practice are far reaching. Without sufficient exposure to constructivist, student-centred models of teaching, teachers may have heard of these concepts but would not be able to realise them. According to Windschitl, (2002), one of the most powerful indicators of the adoption of constructivist practice is the degree to which teachers understand the concept. These findings are consistent with other research that shows constructivism is often espoused, but not often realised (Bound & Salter, 2007; Brennan et al., 2003; Kilpatrick & Bound, 2003; Messina & Tabone, 2012). Moreover, constructivist principles may have been misaligned with teachers’ traditional epistemologies and pedagogies (Maor & Taylor, 1995). The inconsistency in teachers’ belief systems adds weight to the evidence that technology was used to support teaching rather than to support learning. These findings are
consistent with studies in other educational contexts (Chen, 2008; Cuban, Kirkpatrick, & Peck; 2001; Hermans, 2008; Lim & Chai, 2008; Webb & Cox, 2004). Exposing teachers to constructivist practices might enable better alignment of their belief systems.

Constructivism posits that knowledge is created through shared communication and interaction with others. Teachers in this study believed that the source of knowledge existed in external authority and agency. Believing that knowledge was fixed also meant that it should not be contested or challenged. Teachers may not have felt sufficiently confident or empowered to subvert the dominant educational paradigms. Their working lives were most likely managed by other people. To challenge authority in such contexts would have posed the risk of being dismissed.

Group work, solving problems and critical thought did not feature in teachers’ practices. Encouraging a constructivist learning environment would enable VET students to develop the necessary skills for work in the 21st century. Unless teachers are supported to develop their VETPACK, they will continue to use technology to support traditional teaching practices by updating familiar teaching methods and just adding new technologies.

It might be useful to model constructivism rather than be too concerned about the development of technological knowledge to begin with (Koh, Chai & Tsai, 2014). Inculcating constructivist learning attitudes and beliefs within the students that teachers teach may promote critical thought among their students (Orlando, 2013). Teachers could also be immersed in social, authentic and ongoing learning experiences with opportunities for reflection and feedback.

Changing teachers’ core beliefs is a slow process and might be met with some resistance (Hager, 2004): however, teachers should be encouraged to examine and reflect on their beliefs in a supportive environment. Through incremental change, teachers need to be given time to practice new pedagogical approaches (Somekh, 2008) beginning with small successful experiences (Ottenbreit-Leftwich, 2007) that build on teachers’ immediate needs (Zhao & Cziko, 2001).

**Validate students’ background knowledge, skills and experiences.** VETPACK acknowledges that students’ knowledge and skills are of no greater or lesser value than teachers’
own. Empowering students was not part of these VET teachers’ traditional belief system. Relinquishing power to students would be antithetical to their teacher-centred practice. Changing teachers’ beliefs about students as sources of their own knowledge, would challenge teachers to consider alternative pedagogies.

Teachers’ perceptions of their students presented a significant barrier to achieving their aspirations of teaching with technology. They often characterised their students as having limited ability in formal learning contexts, framing them within a deficit model which justified teachers’ transmissive teacher-centred practice. These findings are similar to previous research that showed teachers’ greatest concerns were about students not being able to learn independently despite seeing this as an educational goal (Bound & Salter, 2009). With such perceived deficiencies, it would be difficult to conceive of students as being able to participate in student-centred constructivist practice.

While teachers cared for and valued their students, they saw them as wholly dependent on the teacher. Dirkx et al. (2004) found that teachers’ beliefs about students shaped their technology use. The similarity between these findings decades apart, yet consistent, suggests that teacher epistemologies may exert a more powerful influence about what teachers believe about themselves and their students.

Several ways in which teacher education and professional development programs might address these perceptions of students would be to plan the programs around students’ experience of success and students’ need. In showcasing and modelling VETPACK, professional development presenters could point out the value of technology for students, illustrating the impact it has on student learning. Showcasing the ways students might experience success is another strategy. Gradually introducing and scaffolding new teaching and learning approaches with technology might increase teachers’ confidence to develop appropriate and targeted learning to accommodate students’ diverse needs. Bonk & Koo (2014) recently developed a TEC-VARIETY model to support teachers to provide motivating and engaging learning experiences.
**VET content knowledge and skill.** Neither the original, nor the proposed framework could possibly measure the breadth of teachers’ content knowledge and skills. Instead, the VETPACK model proposes to develop teachers’ confidence to assert their ‘expert’ content knowledge. This means teachers will create contextualised resources for their learners as well as evaluate resources from other sources. In this study, teachers, while feeling confident about their content knowledge, did not seem to possess the confidence to be innovative and create resources to teach their content. This might support teachers to develop awareness that they are producers of knowledge.

The VETPACK model recognises that teachers can capitalise on their content knowledge and industry experience to help build their technological and pedagogical knowledge. As workplace practices and technology change, workers and teachers will always be novices because the knowledge and skills of that discipline are constantly growing (Orlando, 2013). This presents real challenges for vocational teachers. VETPACK harnesses the potential of the workplace to provide opportunities for teachers and students to develop new content skills and knowledge.

Content knowledge in the VET sector develops independently of pedagogical knowledge and might be held in a form not easily shared with others. To teach it requires pedagogical knowledge. Complex pedagogical knowledge is required to convert content knowledge into a knowable and learnable form. The strength of the TPACK framework for the sector lies in an understanding of the TPACK blends.

**VET technological knowledge.** This domain has caused considerable theoretical debate in applying the TPACK framework. In VETPACK, it is proposed as a means to motivate teachers to update their personal and professional work skills. Teachers’ confidence in using common, ubiquitous technologies could be capitalised upon, helping them to transfer it into their teaching practice in concurrence with other knowledge bases. Through critical reflection on this process and the powerfully transformative nature of technology, the development of VETPACK would offer a formidable means to challenge teachers’ traditional epistemologies and pedagogies.
Contextualised to the workplace, technological knowledge becomes a potentially valuable learning resource—one that would lead to collaborative networks for students and teachers as they prepare for technology-rich workplaces. Awareness of workplace technologies suggests that teachers’ technology knowledge might be intricately connected to their content knowledge. VETPACK would recognise that developing knowledge and skills in the blends between the domains offers much greater potential to develop VET teacher knowledge.

**VET technological content knowledge.** The VETPACK model added an industry and a workplace component to ensure that teachers consider workplace-specific technologies to support students’ learning and their preparation for the workplace. This model recognises that teachers need to know how content changes when technology is applied. It supports the development of technology skills in the context of designing student-centered learning activities in content areas (Brush & Saye, 2009; Ertmer, 2003; Hew & Brush, 2007; Mishra & Koehler, 2006; Koehler, Mishra & Yahya, 2007; Polly & Hannafin, 2010).

**VET technological pedagogical knowledge.** The VETPACK model also recognises that vocational education is based on partnerships with a range of other agencies, many of which are responsible for collecting evidence to determine assessment decisions. Workplace supervisors, industry trainers and others external to an organisation provide learning support for trainees, apprentices or students on paid or unpaid workplacements.

The transition from teaching without technology to teaching with technology requires new pedagogical understanding. Teachers spoke of how they will use different pedagogical practices and technological affordances in the future. Although the technology to support these aspirations is available, technological and pedagogical knowledge to make the change is necessary. VETPACK provides the means through which teachers are supported to acknowledge the ways in which teaching and learning changes.

**VET pedagogical content knowledge.** Teachers had good knowledge of a range of teaching approaches that were appropriate to the content. They knew the concepts and structure of that content and how these could be rearranged to improve teaching practice. In the VET sector, the relationship between educational organisations and workplaces means that teachers
require collaborative forms of pedagogical and content knowledge. Teachers need to ensure students gain the skills and knowledge to engage in constructivist practice with other workers especially where workplaces are not always able to provide pedagogical models.

**Implementing the VETPACK Model**

For VETPACK to be successful, teacher educators and professional development designers must explicate this model. It should not be assumed that teachers already have this knowledge. Although visually simple, the knowledge and skill bases of the model are self-explanatory. Providing an orientation to the concept and its purpose would be valuable. Although teachers themselves would not have to articulate VETPACK, it would be expected that professional development programs would be teaching it in the integrated ways in which the model was conceived. It would mean making explicit the links between technology, pedagogy and content knowledge so that future teachers learn to represent their content using a range of technologies and pedagogical techniques.

To implement VETPACK, there are several conditions which need to be met. Firstly, a culture for sharing knowledge and expertise has to be established. Secondly, teachers need to be exposed to models of best practice. Lastly, developing VETPACK requires a whole of organisation approach.

**A culture for sharing knowledge and expertise.** As a framework for developing teacher knowledge, VETPACK is predicated on validating teachers’ background experiences as learners and as workers. Whether or not it is being developed in teacher education programs or professional development forums, developing a culture of shared knowledge and skills as opposed to transmitting individual knowledge would seem to be of greater value. Promoting such a culture requires teams to come together with different levels of expertise (Kilpatrick & Bound, 2003) in professional learning communities (Putnam & Borko, 2000) and to work with knowledgeable peers (Ertmer, Ottenbreit-Leftwich, & York, 2006).

Situating the learning within the authentic context of teachers’ ongoing work would address findings that showed that teachers’ experiences of best practice were what they had seen
from their peers. Although teachers’ confidence in using technology did not necessarily mean they knew how to teach with it (So & Kim, 2009), it meant they were more likely to increase the success of integrating technology (Abbitt, 2011) effectively. Therefore in a shared culture of learning with and from their peers, teachers could plan and prepare for more pedagogically sound uses of technology.

**A model of best practice.** Teachers’ TPACK reflected gaps in their experiences of using technology for teaching. Technology was rarely used to support student-centred pedagogy (Cuban, 2001; Palak & Walls, 2009). Instead it was used to transmit content (An & Reigeluth, 2011; Bound & Salter 2007; Chen, 2008; Dirkx et al., 2004) and to control the overall delivery and pace of that transmission process. Teachers, therefore, lacked access to suitable models of teaching with technology (Albion, 1997; Ertmer, 2005). This is not uncommon as there are few benchmarks with which to compare their performance (Bonk & Khoo, 2014). Without VETPACK, teaching practice will not change as long as the emphasis remains on teaching than on learning (Lawrence & Lentle-Keenan, 2013).

Exposing teachers to best practice models of VETPACK would ensure that students were engaged in higher order thinking and meaningful learning. As part of teacher education programs, opportunities for teachers to practice integrating technology could be offered in various ways. Through assessment design, there could be a requirement that teachers plan and implement a group presentation using a range of online software tools. As teachers become more experienced in learning with technology, integration will move from teacher-directed to learner-centred (Angeli & Valanides, 2009).

As suggested by Zhao and Cziko (2001), observing successful others might increase teachers’ perceived need for change as well as assure them that the required changes are not impossible. In addition, if teachers are going to actually alter their practices, they will need access to others who can challenge and support them as they implement these new ideas in their classrooms. Providing teachers with more examples of successful integration would ensure that instances of best practice instances could evolve.
In the delivery of the course, teachers could purposefully demonstrate best practice, by using exemplary resources as a means for inspiring teachers to understand an innovation. As Archambault (2013) suggests, technology could be integrated into the coursework and work experience requirements of practicum students. VETPACK offers an approach that exposes teachers to alternative visions of teaching and offers them the opportunity to test their ideas without risk to the progress of their students in supportive contexts.

**A whole of organisation approach.** Strong leadership should be embedded into the culture of an organisation to support the development of VETPACK. Management could set expectations for teachers who previously used technology minimally and were not inclined to experiment with new technology. In this study, teachers felt some pressure to integrate technology. However, the pressure was not enough to make the change towards more constructivist or pedagogically effective uses of technology.

Where there is an e-learning strategy in place, as in this instance, it might be worth promoting VETPACK as an inherent component of teachers’ professional development requirements. Performance Management Reviews allow the opportunity for teachers to self-identify such needs. As teachers, for the most part, felt supported by the organisation, it would be sensible to work from this base to align the development of VETPACK as an essential component of their ongoing professional development.

If VETPACK is promoted as a model for teachers to think about combining pedagogy, content and technology knowledge, it would be prudent to acknowledge their efforts to develop constructivist, student-centred practice. Most importantly, it could be valuable as a means for identifying training needs. Teachers could use the model to identify and reflect on their beliefs and their teaching knowledge as well as their professional development needs (Anderson et al., 2013).

The development of VETPACK could also be aligned with other frameworks such as the recently released VET Capability Framework (IBSA, 2013), which provides a common language for the knowledge, skills, behaviours and attitudes that practitioners are supposed to display when they are performing well in their roles. VETPACK focuses on the knowledge and
the skills teachers need to get to the point where they are perceived, or perceive themselves as performing well in their roles. Judging by the broad and universal appeal of its motherboard, VETPACK highlights the potential to redesign professional development programs, inform teacher education programs and enrich teachers and students’ lives.

This study illuminated the need for VET teacher education programs to broaden the educational paradigm upon which the Certificate IV in Training and Assessment is based in order to prepare students for learning in the 21st century. VETPACK provides a framework for not only developing teachers’ knowledge in the VET sector. It also provides a scaffold upon which technology can dismantle the traditional, behaviourist assumptions underpinning VET practice in Australia.

**Limitations of the Research**

There are several limitations to this research. This relatively small scale study within a regional context and in relation to the total vocational teacher population in Western Australia, while potentially limiting, may threaten its potential transferability to other contexts.

The decision to use a universally administered survey may enhance the replication and the credibility of findings. However, it should be noted that the reporting of results from the current study reflected a sample of vocational teachers from one organisation and does not necessarily reflect the population as a whole.

Another limitation of this research is that technologies change over time. The research has attempted to keep up-to-date with these changes; however, the rate at which existing technologies are improved and new ones become available may limit the usefulness of some of the findings particularly in relation to teachers’ actual technology use.

The selection of the highest, medium and lowest scores from the TPACK survey may not have accurately captured high technology use teachers, as the selection of teachers for the interviews were based on teachers’ self-reported TPACK. This selection may not have represented higher level uses of technology by other teachers within the institute.
One possible limitation might be that the concept of TPACK was ‘decomposed’ (Voogt et al., 2013) for the purpose of measuring individual domains in light of Mishra and Koehler’s (2006) notion that it was a separate body of knowledge. However, and in response to concerns about the need to enhance vocational teachers’ knowledge discussed in previous chapters, its deconstruction into separate domains provided additional data enabling the researcher to examine the items which constituted that knowledge base.

Additionally, it was noted that items contained within the TPACK survey might benefit from further refinement in the future. This would include consideration of adding content specific questions and an update of technology-related questions to include functional uses of technology, especially in the affordances of read/write Web and Web 2.0 tools.

**Recommendations for Future Research**

It is recommended that further research be undertaken to develop a VETPACK survey based on the model proposed in this chapter. As part of this research it would be important to establish adequate reliability and validity so that it can be used in the VET sector. It would be equally important for this new survey to incorporate teachers’ beliefs as well as knowledge about the TPACK domains. The model could then be assessed to determine how well the VETPACK framework captures the complexities of teaching within the VET sector. These recommendations provide an opportunity to enhance teaching practices in the VET sector.

The aims of this research were to examine the impact of knowledge and beliefs on VET teachers’ practices in relation to teaching and learning with technology in a unique regional context. In relation to these aims, the major findings showed discrepancy between teachers’ beliefs and their practices. The proposed VETPACK model would create awareness of the gaps between teachers’ beliefs and their practices. It would also enable teachers to reflect on, and modify their pedagogical approaches when considering ways to integrate technology into their practices.

The VETPACK model contains a visual framework in which teachers can recognise the intricate connection between technology, pedagogy and content. Vocational teachers in regional
areas of Australia would then be preparing their students for an increasingly technologically-based world of work.
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TPACK Image (rights free). http://tpack.org/as the source.


## Appendix A: TPACK Survey

Please rate your ability to undertake the following tasks associated with teaching in a VET context by placing a tick in the relevant column.

<table>
<thead>
<tr>
<th>1- Poor</th>
<th>2- Fair</th>
<th>3- Good</th>
<th>4- Very Good</th>
<th>5- Excellent</th>
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</thead>
<tbody>
<tr>
<td>(a) My ability to troubleshoot technical problems associated with hardware (e.g., network connections)</td>
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<tr>
<td>(b) My ability to create resources that map to specific units of competency.</td>
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<tr>
<td>(c) My ability to use a variety of teaching strategies to relate various concepts to students.</td>
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<td>(d) My ability to decide on the scope of concepts taught within my delivery.</td>
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<td>(e) My ability to modify instruction based on student assessment using technology</td>
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<td>(f) My ability to distinguish between correct and incorrect problem solving attempts by students.</td>
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<td>(g) My ability to address various computer issues related to software (e.g., downloading appropriate plug-ins, installing programs)</td>
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<td>(h) My ability to create a technology enriched environment which allows students to build new</td>
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<tr>
<td>(i) My ability to anticipate likely student misconceptions within a particular topic.</td>
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<td>(j) My ability to determine a particular learning strategy best suited to teach a specific concept.</td>
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<td>(k) My ability to use technology to predict students’ skill/understanding of a particular topic</td>
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<td>(l) My ability to implement different methods of teaching using technology.</td>
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<td>(m) My ability to plan the sequence of concepts taught within my delivery area.</td>
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<td>(n) My ability to moderate interactivity among students using technology.</td>
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<td>(o) My ability to use technological representations (i.e. multimedia, visual demonstrations, etc.) to demonstrate specific concepts in my content area)</td>
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<tr>
<td>(p) My ability to encourage interactivity among students using technology</td>
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</table>
(q) My ability to assist students with troubleshooting technical problems with their personal computers

(r) My ability to adjust teaching methodology based on student performance/feedback.

(s) My ability to comfortably produce delivery sessions with an appreciation for the topic.

(t) My ability to implement units of competency in a technology rich environment

(u) My ability to assist students in noticing connections between various concepts in training packages

(v) My ability to use various courseware programs to deliver instruction (e.g., Blackboard, CE8).

(w) My ability to use technology to create effective representations of content that depart from textbook knowledge

(x) My ability to meet the overall demands of teaching with technology