The impact of prior occupations and initial teacher education on post-graduate pre-service teachers’ conceptualization and realization of technology integration

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Abstract
Post-graduate teacher recruitment schemes are designed to fulfil ongoing teaching shortages. However, despite the emphasis of technology integration in educational contexts, little research has examined the knowledge, skills and attitudes post-graduate pre-service teachers bring to teaching from a technology perspective. This paper presents findings from the final phase of an explanatory case study exploring the development of post-graduate pre-service teachers’ technology integration beliefs and practice during a teacher education program at an Australian university. Semi-structured interviews were conducted with 17 post-graduate pre-service teachers after two professional (field) experiences. A social cognitive lens was applied to understand how technology integration beliefs and practice developed during this time. Results showed occupation-specific technology experience provided this group with a diversity of technology expertise, confidence using technology, resilience to overcome technical issues, and self-regulatory traits to learn new technology tools. Contributing personal factors influencing beliefs and practice included age, professional background, technology skills and technology self-efficacy beliefs. Initial practice revealed a predilection to integrate technology to supplement teacher-directed pedagogy. The shift towards technology integration to support student-centred pedagogy was dependent upon modelling and mentoring provisions offered by both teacher-educators and teacher-mentors during professional (field) experience placements. Other extrinsic factors, such as hardware provisions, Information Technology infrastructure, and school culture, were also instrumental in the conceptualization and realization of technology pedagogy. Recommendations include the necessity for post-graduate teacher education programs to recognise the untapped technology expertise this group may bring to teaching, and practical suggestions to support the development of meaningful technology integration epistemologies.

Keywords Technology pedagogy · Social cognitive theory · Self-efficacy · Career-change teachers · Teacher education
Introduction

The exponential growth and potential of digital technologies has fundamentally changed the way we work, communicate and live. Whilst such technological advancements were initially seen as an extension of the Digital Revolution, the increase scope and capabilities of emerging digital technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), 3D printing, robotics and other smart technologies depict the arrival of new era: the Fourth Industrial Revolution (Schwab, 2015). The benefits of such technological advancements in educational settings have served to sustain worldwide digital technologies educational policy agendas (US Department of Education, 2017; Council of Australian Governments Education Council, 2019; UK Department for Education, 2019; European Union, 2020). At the core of these directives is the implementation of technologies (electronic devices, tools, applications and resources) to provide students with digital literacies and twenty-first century learning competencies: critical thinking, creativity, collaboration and communication (Australian Trade and Investment Commission, 2017; OECD, 2019; UK Department for Education, 2019; European Union, 2020). However, there are concerns surrounding the capabilities of the current teaching workforce to meet the demands of this new digital era (UNESCO, 2015). Moreover, whilst educators acknowledge the importance of technology as a tool to support learning, literature shows many struggle to demonstrate practice that reflects their espoused beliefs (Ertmer et al., 2012; Prestridge, 2017; Tondeur et al., 2017).

The inhibitors of technology integration fall into two categories: external barriers, which include accessibility to technology hardware, software, resources and training; and internal barriers: Confidence, beliefs and attitudes towards technology integration in educational contexts (Ertmer, 1999; Tondeur et al., 2017; Makki et al., 2018). Intrinsic factors, such as beliefs, confidence and attitude, have been singled out as crucial determinants that impact how teachers choose to use technology in their practice (Tondeur et al., 2017a, 2017b; Vongkulluksn et al., 2018; Farjon et al., 2019). Current evidence indicates pre-service teachers, also commonly referred to as trainee-teachers or student-teachers, despite growing up in a digital age, experienced similar difficulties integrating technology as their experienced teacher counterparts; with confidence and skill limitations cited as the most common inhibitors of technology practice (Ottenbreit-Leftwich et al., 2018; Sadaf et al., 2016). Findings from Tondeur et al., (2020) research showed pre-service teachers acquisition of digital competencies to be influenced by a multitude of factors including knowledge, confidence, and attitudes towards technology. However, limited research has investigated this phenomenon from the perspective of those pre-service teachers entering teaching via post-graduate pathways, referred to in this study as career-changers.

The traditional pathway into the teaching profession typically occurs directly after secondary/senior education, and involves the completion of a three or four-year undergraduate teacher preparation program, referred to in this paper as Initial Teacher Education (Clinton et al., 2016). However, global teacher shortages (UNESCO, 2015), especially in Mathematics, Science and Technology fields, have necessitated the implementation of post-graduate teacher recruitment schemes. Research has shown those entering teaching via post-graduate routes bring knowledge, skills and beliefs from undergraduate degrees, prior occupations and lived experiences (altruism, resilience and metacognition) that facilitate critical thinking and problem solving (Crow et al., 1990; Mayotte, 2003; Rowston et al., 2021). However, it is unclear whether occupation-specific technology experiences enable career-changers to integrate technology in the classroom better, and if so, under what conditions.
Therefore, this study applied a social cognitive lens to investigate how the technology integration beliefs and practices of post-graduate pre-service teachers evolve during teacher education, and how prior occupation-specific technology experiences and initial teacher education (ITE) influence their development.

**Literature review**

**The why, what and how of technology integration**

Technology’s potential to assist students with the acquisition of the skills necessary to function in a changing world continues to push international technology integration campaigns (OECD, 2016). The OECD Future of Education and Skills 2030 Project is an example of a globally adopted framework designed to eradicate outdated standardised nineteenth century pedagogies, and facilitate the incorporation 21st Century technological innovations such as: cyber physical technology, social media, Artificial Intelligence, robotics, the Internet of Things and 3-D printing (OECD, 2019). The genesis behind OECD’s 2030 project is to identify the proficiencies students need to thrive in the future, and the teaching and learning environments that can nurture such competencies: with the effective integration of technology crucial to achieving the goals of this initiative.

Effective technology integration is, in its essence, the application of suitable pedagogical practice and appropriate technology tool selection to support the realisation of student learning outcome expectations (Jonassen et al., 2003; Mishra & Koehler, 2006; Tondeur et al., 2017a, 2017b). Those countries with developed economies are typically better equipped financially to develop and implement programs designed to fulfil digital technology agendas (World Bank, 2021). Such programs can incorporate policies designed to facilitate the acquisition of hardware, software and training accessible at school levels. Further support mechanisms exist in the form of frameworks, scaffolds and matrices developed to assist teachers with the achievement of effective technology integration. The most referenced and adopted technology integration framework is Mishra and Koehler’s (2006) technology pedagogical and content knowledge (TPACK) model (Voogt et al., 2013), followed by another commonly referred tool: Puente’s (2010) substitute, augmentation, modification and redefinition (SAMR) hierarchical model. The Technology Integration Matrix (TIMs) (Allsopp et al., 2007) is another example, designed as a scaffold to support the alignment of technology integration with meaningful pedagogy practice.

Developed as an extension of Shulman’s (1986) pedagogy content knowledge framework, TPACK is a globally adopted model depicting the critical intersection between content, pedagogy and technology to support effective teaching and learning practice (Mishra & Koehler, 2006). Puente’s (2010) SAMR model uses a hierarchical approach to measure technology integration, with the specific type of technology and method of integration determining where this practice sits within the model. However, Hamilton and colleague’s (2016) research findings highlight potential issues surrounding the hierarchical nature of SAMR and the emphasis on the technology tool and its application, rather than actual pedagogical approaches to enhance learning; recommendations included the need for this framework to be context sensitive when categorizing technology integration practice. Unlike SAMR, the essence of TIMs is to guide the integration of technology to facilitate the creation of goal-directed, active, collaborative, constructive, and authentic, meaningful learning environments. TIMs is grounded in Jonassen et al’s (2003) meaningful
learning with technology framework; an extension of Jonassen’s (1996) seminal research identifying technology as a cognitive tool to support the development of students’ problem solving and critical thinking skills; facilitating meaningful learning with technology, not from technology. While two decades old, Jonassen’s (1996) vision still reflects many educational technology integration objectives of today (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2016; UK Department for Education, 2019; US Department of Education, 2017). Nevertheless, despite the availability of technology integration frameworks, teachers continue to struggle to authentically embed technology to realise meaningful pedagogy goals (Ertmer & Ottenbreit-Leftwich, 2013; Tondeur et al., 2017; Ottenbreit-Leftwich et al., 2018). There is still a predilection for integrating technology to support administrative tasks such as word processing, rather than a cognitive tool to facilitate meaningful learning (Ertmer & Ottenbreit-Leftwich, 2013; Hsu, 2016; Prestridge, 2017).

**Barriers to technology pedagogy integration**

Ertmer’s (1999) seminal research categorised the barriers impeding the realisation of technology integration goals as first-order and second-order. First-order barriers included external factors such as access to resources, support and training; and second-order barriers incorporated internal factors such as beliefs, attitudes and skills. Despite preliminary efforts by key stakeholders to address external barriers, internal barriers prove to be more of an immovable obstacle (Tondeur et al., 2017; Ottenbreit-Leftwich et al., 2018; Vongkuluksn et al., 2018). While in-service and pre-service teachers recognised the critical role of technology in educational contexts, low levels of beliefs and confidence using technology compromise the realisation of technology integration goals. Furthermore, research shows the technology pedagogy beliefs and subsequent practice of in-service and pre-service teachers also depends upon the implementation and maintenance of government and school-driven technology integration initiatives (Sadaf et al., 2016; Maré & Mihai, 2018; Roblin et al., 2018). These factors include school integration policies, whole-school culture, mastery of technology tools, modelling of effective technology practice, and mentoring to support technology implementation in the classroom (Maré & Mihai, 2018; Roblin et al., 2018). To facilitate a contextualized investigation of how these factors influence teachers’ technology pedagogy, Porras-Hernández and Salinas-Amescua (2013) advanced the TPACK model incorporated three levels to reflect macro contexts (political, technological, economic and social global and nationally), meso contexts (principals, schools, support) and micro contexts (classroom and learning environments). Rosenberg and Koehler’s (2015) systematic review of TPACK studies found a greater understanding of the factors that promoted or prevented technology integration when context was addressed in TPACK research.

Initial hopes for millennials entering ITE directly from school to demonstrate effective technology pedagogy practice have been, unfortunately, unrealised (Bennett & Maton, 2010; Dinçer, 2018). Despite growing up in a digital era, this cohort’s technology pedagogy beliefs and practice are shaped by a causal relationship between external and internal factors (Sang et al., 2010; Tondeur et al., 2012). Studies have shown teacher-educators and professional (field) experiences as vital components in determining pre-service teachers’ technology pedagogical competencies (Tondeur et al., 2016; Uerz et al., 2018). Questions have been raised concerning the effectiveness of educational technology subjects embedded within teacher education programs (Batane & Ngwako, 2017; Mouza et al., 2017).
Literature has highlighted pre-service teachers cite limited expertise using technology in educational contexts as an influential factor compromising their capacity to integrate technology into their practice (Tondeur et al., 2017a, 2017b, 2018). However, for career-changers, little is known about this group’s response to achieving edicts surrounding technology integration, especially given the constant, unpredictable, and evolutionary nature of technology.

**Career-changers: skills and pedagogical beliefs**

Arthur and colleagues (1989) define the term career as ‘the evolving sequence of a person’s work experiences over time’ (p8). Typically, career stages were seen to reflect an individual’s age, family responsibilities and duration of employment at a specific organisation (Demerouti et al., 2012; Kohlberg, 1969). However, literature has shown the workplace has changed, with generational differences and preference for a sustainable work-life balance responsible for an increasing number of career-switching (Twenge, 2010). Referred to as the job-hopping generation, Millennials (those born between 1982 and 1999), still seek job security; however, are more likely to switch careers in favour of seeking a better work-life balance or to pursue other meaningful career opportunities no matter what stage in their career, and (Gallup, 2016; Twenge, 2010). Psychological based theories such as Super’s (1953, 1957, 1990) theory of vocational development, and Lent et al. (1994) social cognitive career theory seek to explain the phenomenon of career choice and goals. (Super, 1953; Brown, 2002) identified five stages of career development: Growth (Birth -14 Years), Exploration (15–24 years), Establishment (25–44 years), Maintenance (45–64 years) and Decline (65 years and older). A key tenet within (Super’s 1953; Brown, 2002) model of career development is the influence of self-concept; occupational preferences are influenced by lived experiences, competencies, environment, interests and life situations. Similarly, social cognitive career theory identifies the role of environmental, behavioural and personal factors as core determinants of career interests, goals, choice and performance (Lent et al., 1994).

From a teaching perspective, altruistic motivations appear to be the commonly shared principle inspiring career-changers to make the switch to teaching (Wilkins & Comber, 2015; Varadharajan et al., 2016), followed closely by the potential to achieve a greater work-life balance (Richardson & Watt, 2005). Furthermore, over the past decade, teacher-shortages have increased enrolment into teacher education programs through alternative pathways, particularly those entering teaching from prior professions (Tigchelaar et al., 2012; Wilkins & Comber, 2015; Crosswell & Beutel, 2017). The monikers used in literature to define this teaching cohort includes: ‘second-career teachers’ (Powell, 1994; Tigchelaar et al., 2008; Varadharajan, 2014), ‘mature-age teachers’ (Etherington, 2011; Green, 2015), and ‘career-change teachers’ (Crow et al., 1990; Priyadharshini & Robinson-Pant, 2003; Watters & Diezmann, 2015). In this study, the term ‘career-changers’ was chosen to align with Eifler and Potthoff’s (1998) review findings and Tigchelaar and colleagues’ (2008) research, depicting an individual aged 25 years or older who possesses considerable industry experience.

Motivations behind current recruitment initiatives targeting career-changers are not solely focused on enlisting this group as a stopgap to fill teacher shortages. Empirical studies have recognised the valuable traits career-changers bring to teaching afforded from prior occupational experiences (Tigchelaar et al., 2008; Varadharajan, 2014; Crosswell & Beutel, 2017). These include occupation-specific expertise (Richardson & Watt, 2005;
Tigchelaar et al., 2008), maturity, problem-solving, organisational and managerial skills (Crow et al., 1990; Mayotte, 2003; Watters & Diezmann, 2015). With an increased emphasis on providing students with 21st Century skills to function in the ‘real-world’, the ability for career-changers to apply their extensive skill set to provide context-based learning experiences is now a viable alternative (Anthony & Ord, 2008; Roggeman, 2017). The UK government, for example, has recently invested £10 million to attract 600 highly skilled professionals and PhD graduates to retrain as teachers (UK Department for Education, 2018). In Australia, over 30% of the teaching workforce comprises career-changers (McKenzie et al., 2014). Ingersoll and colleagues’ (2018) report exploring the trends within the United States teaching force recorded over 42% of new teacher recruits in public schools to be aged 29 or over, and 19% over the age of 40.

Conversely, a recurring theme in the literature highlights the difficulties career-changers experience transitioning from prior professions into teaching. Epistemological perspectives from previous experiences influence a reluctance to depart from outdated pedagogical beliefs (Grossman, 1991; Powell, 1992; Tigchelaar et al., 2012). Career-changers cite frustration from teacher-educators inability to recognise prior industry skills (Crow et al., 1990; Mayotte, 2003; Priyadharshini & Robinson-Pant, 2003). Many career-changers experience difficulties transferring incumbent skills to teaching (Etherington, 2011; Green, 2015; Grier & Johnston, 2012); and literature shows teacher education programs are not designed to meet the specific needs of career-changers (Varadharajan, 2014; Watters & Diezmann, 2015; Wilkins & Comber, 2015).

From a technological standpoint, little research has specifically investigated the technological skills career-changers bring from industry, and more importantly, how they influence practice. While many studies have referenced the possibility of career-changers fulfilling teacher shortages in STEM fields (Snyder et al., 2013; Varadharajan et al., 2018), a paucity of studies has investigated the specific technological expertise they bring from industry. Moreover, little empirical research has explored the relationship between incumbent technology expertise and career-changers conceptualisation of technology pedagogy. When examining the links between career-changers’ industry skills and teaching practice, Mayotte’s (2003) study referenced one participant’s willingness to integrate technology into teaching had been strengthened from her prior career. When examining the transition process of career-change beginning STEM teachers from science backgrounds, Watters and Diezmann’s (2015) referred to one participant’s previous role in a technology environment; however, the specific technological expertise was not identified. Findings from Teo and Noyes (2014) research showed older pre-service teachers understood the importance of including technology in their teaching, regardless of the difficulty in learning and integrating these tools. However, their study examined intentions to use technology, not actual technology integration practice.

This study was designed to conduct a contextualised investigation to understand the effect of occupation-specific technology experience, combined with ITE, on career-changers’ conceptualization of effective technology pedagogy.

**Conceptual framework**

Findings from empirical research continue to highlight the causal relationship between technology integration beliefs and practice. Therefore, the principles of reciprocal determinism were applied to explore the relationship dynamics between technology beliefs,
technology integration practice and technology environments, and how they impact career-changers’ conceptualisation of technology pedagogy during ITE (Bandura, 1978, 1986, 1997) (see Fig. 1).

Shaping an individual’s thoughts and behaviour choices is the reciprocal relationship between personal, environmental and behavioural determinants, referred to by Bandura (1986) as reciprocal determinism. Personal determinants incorporate an individual’s beliefs and cognitive capabilities. Behavioural determinants include choices of physical action and verbal opinions, and environmental determinants encompass extrinsic elements such as resources, culture influence and physical settings. Each determinant’s weight within this model fluctuates, dependent upon which causal factors have the greatest impact at a given stage.

A pivotal influence in determining beliefs, goals and choices of action is self-efficacy, the foundation of human agency and social cognitive theory (Bandura, 1997). Social cognitive theory postulates an agentic perspective, whereby an individual’s beliefs and future courses of action are cultivated by inherent “self-organizing, proactive, self-regulating, and self-reflecting” characteristic traits (Bandura, 2006, p. 167). Self-efficacy beliefs are a personal determinant that influences an individual’s judgement of their self-knowledge and skills to perform a particular task in a specific domain (Bandura, 1994, 1997). These beliefs are generated from four primary sources: mastery experiences, vicarious observations, social persuasion and physiological reactions. Successful task mastery in a domain-specific field increases self-efficacy, while failure often diminishes it. Vicarious observations of successful modelling by experts or peers within a specific domain can increase self-efficacy beliefs, while witnessing failures can decrease them. Social persuasion incorporates feedback received from peers/superiors. Positive reinforcement can bolster self-efficacy beliefs to complete activities/tasks/goals successfully, whereas negative commentary can compromise confidence and future goals. Interpretations of physiological and affective states that arise from challenging situations such as breathlessness, elevated heart rate and adrenalin rushes can also affect self-efficacy beliefs to perform a task/activity/goal. The most significant influence upon the generation of self-efficacy beliefs is domain-specific mastery experiences, followed by vicarious observations.

In this study, the triadic reciprocal determinants represented within the conceptual framework were defined as follows:

![Conceptual framework of study grounded in Bandura’s (1986) triadic reciprocal causation model](image)
Technology beliefs (personal determinants) included career changers’ background knowledge, physical characteristics, self-efficacy beliefs, attitudes and personal disposition using technology during previous workplaces, knowledge from ITE subjects and professional experience.

Technology practice (behavioural determinants) incorporated verbal commentary, physical actions and social relations of career-changers when integrating technology during previous workplaces, ITE and professional experience placements.

Technology environment (environmental determinants) referred to the surroundings in which career-changers used technology during previous workplaces, ITE subjects and professional experience. These environments included: imposed, selected and constructed structures, the availability of technology tools, applications, training and support.

The research question directing this phase of the study was considered to support explanatory research design (Yin, 2013): How do career-change pre-service teachers’ technology pedagogy beliefs and practice develop during a post-graduate teacher education course; and what are the factors that support or constrain this process?

Method

Background of study

The overarching aim of this case study was to apply a social cognitive lens to investigate how prior technology expertise and experiences, coupled with ITE, influence post-graduate pre-service teacher’s technology integration beliefs and practice. For the purposes of this study, categories of technology integration could include:

1. Hardware: interactive whiteboards for example, SMARTboards®, laptops, smart devices such as Apple iPads®, 3-D printers, drones, codable robots such as LEGO, Sphero, and microprocessors such as Micro:bit®;
2. Software applications: for example, generic administrative software applications within the Microsoft Office® suite, specialized software such as graphic design (PhotoShop®), CAD programs (AutoCAD®) or programming applications (Scratch®);
3. Web 2.0 tools: for example, search engines such as Google®, Google® applications: Google Docs, Google Slides, Google Sketch-Up, Google Earth, collaborative tools such as Padlet®, online video sharing such as YouTube®, online quiz tools such as Kahoot Quiz®, website builders for example Weebly®

This paper presents the findings from the third and final phase of an explanatory case study. The adoption of explanatory case study methodology facilitates the investigation of causal relationships through semi-structured interviews focused on extrapolating the ‘how’ and ‘why’ of participants’ beliefs and behaviour (Yin, 2013; Baškarada, 2014).

Certification to teach in Australian schools requires the completion of an accredited teacher-education undergraduate program, or for those entering via alternative postgraduate pathways, a Graduate Diploma of Teaching or Master of Teaching program (Clinton et al., 2016; The Australian Professional Standards for Teachers [AITSL], 2017). Professional (field) experience placements are embedded within teacher educations programs to
facilitate the development of pedagogical knowledge and practice in a classroom environment (AITSL, 2015). To graduate from teacher education programs, students must satisfactorily demonstrate achievement at a graduate level of three domains within the Australian Professional Standards for Teachers: Professional Knowledge, Professional Practice and Professional Engagement (AITSL, 2017).

All participants in this study were commencing either a one-year Graduate Diploma (GradDipT) (Teaching—Secondary), or a two-year Master of Teaching (MTeach) (Primary or Secondary) course at one Australian university (N = 220). Recruitment occurred pre-Covid 19 pandemic in March 2015. Both primary and secondary pre-service teachers were challenged with how to integrate technology into their teaching, in consideration of their past occupational experience. Invitations were distributed to all 220 post-graduate pre-service teachers completing a common core Educational Studies subject at the commencement of their teacher education program. Both teacher education programs incorporated coursework, and two professional (field) experience placements that were three weeks in duration. The first placement occurred after completing curriculum and educational studies coursework subjects at the end of a 12-week semester. The last placement occurred in the final semester, after completing further curriculum and educational studies coursework subjects: November 2015 for the participants enrolled in the Grad Dip Teaching program, and November 2016 for those participants enrolled in the MTeach program. Including the primary teachers increased the sample size, and also the findings demonstrated that the two primary teachers experienced similar issues as the secondary teachers. For these reasons they have been kept in the study.

Phase One of this project was quantitative in design, conducted at the commencement of ITE to explore the relationship between prior technology expertise (generic and occupation-specific) and the initial technology self-efficacy beliefs of post-graduate pre-service teachers. Of the 220 post-graduate pre-service teachers invited to partake in Phase One, 146 volunteered to complete a survey containing questions to collect demographic data (age, prior occupations, qualifications and technology experience) and self-efficacy scales to measure general technology (Teo & Koh, 2010), and technology integration (pedagogy) beliefs (Wang et al., 2004), (see Rowston et al., 2016).

Phase Two’s focus was to identify how environmental determinants, including occupation-specific technology experiences, influenced the initial technology pedagogy beliefs and career-changers practice (Rowston et al., 2020, 2021). After completing the first-semester professional experience (PE1) placement, semi-structured interviews were conducted with a purposeful selection of participants (n = 19) from Phase One. As opposed to the generalizations derived from probability sampling, Patton (2002) defines purposeful sampling as the selection of ‘information-rich cases’ that enable the researcher to acquire greater understandings of the phenomenon under investigation. Therefore, those participants selected reflected a broad representation from the initial group using a selection matrix that focused on the following attributes: demographics (gender), career stage: establishment and beyond (25 years and older), previous occupations incorporating a combination of early-career (25 years and over) and mid-career changers), and prior technology expertise, and technology self-efficacy beliefs.

This study (Phase Three), occurred at the end of ITE and the second (and final) professional experience (PE2) placement. Phase Three focused on investigating how career-changers’ technology pedagogy conceptualization had evolved since the commencement of ITE, and the impact of technology environments, beliefs and actual practice on this process. Of the original nineteen participants in this study, two had withdrawn from the course. Phase Three was primarily qualitative by nature. Another series of semi-structured
interviews (n = 17) was used to monitor changes in technology beliefs and practice. Wang and colleague’s (2004) technology integration self-efficacy scale was re-administered, and descriptive statistical analysis was conducted to measure changes between pre and post technology integration self-efficacy scores.

**Participants and data collection**

Of the seventeen participants, 35% (n=6) were males and 65% (n=11) were females. These percentages reflect a similar representation of male to female teacher ratios in Australian schools (Australian Bureau of Statistics, 2017). Participant ages at the commencement of Phase One ranged from 25 to 48 years: the majority were aged between 25 and 39 years (82%, n=14), and 18% (n=3) were aged between 40 and 48 years. The professional background representations included: Design = 6 (35%), Business/Finance = 4 (24%), Law = 2 (12%), IT = 1 (0.06%), Arts = 4 (24%) (See Table 1).

**Instruments**

**Self-efficacy scale**

Wang and colleagues (2004) 16-item, single-factor measure was re-administered after PE2 to monitor changes in technology pedagogy self-efficacy beliefs. This survey’s questions were rated using a 5-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). Examples included: “I feel confident I can successfully teach relevant subject content with appropriate use of technology” and “I feel confident I can regularly incorporate technology into my lessons, when appropriate to student learning.” The scale achieved a similarly high level of internal consistency (α = 0.95), compared to Phase One (α = 0.94) (Rowston et al., 2016).

**Interview protocol**

Face-to-face interviews were conducted with participants (n = 17) after PE2. Each interview averaged 45–60 min in duration. The interviewer used open-ended questions to guide the semi-structured interview protocol but allowed the interviewee to set the pace. Interview questions were modelled on Zeldin and colleague’s (2008) protocol from their study exploring the self-efficacy beliefs of men and women working in STEM-related fields. Question design reflected the critical tenets of social cognitive theory (Bandura, 1986), enabling the exploration of self-efficacy via the four key sources: mastery, vicarious observations, social persuasion, and physiological indicators (Bandura, 1997). All general statements made by each respondent were followed by a probe focused on the research’s purpose. To ensure reliability, data collection procedures for this phase mirrored those adopted for Phase Two of the study (Yin, 2009). For example, Question 1 focused on the self-reported use of technology during PE2. Probes embedded within Question 1 were designed to identify the resultant pedagogy promoted through described technology integration methods. Question 2 focused on comparing technology integration practices during PE1 to PE2, asking participants to express their attitudes and beliefs using technology throughout PE2 compared to PE1 and evaluating their impact on their practice. The effect of environmental (vicarious) influences was measured by asking: How did others influence your use of technology during PE2; how did these observations of teachers’ technology integration
| Name  | Prior occupation          | Age | Qualifications           | Teacher education program                                      |
|-------|---------------------------|-----|--------------------------|----------------------------------------------------------------|
| Georgie | Artist & Vocational Educator | 48  | BDes                    | MTeach (Secondary—Visual Arts)                                |
| Liana  | Human Resource Lawyer     | 46  | BLaw                    | GradDipT (Secondary—Humanities and Religious Studies)          |
| Louise | Senior Product Designer   | 40  | BArch                   | GradDipT (Secondary—Technologies)                             |
| Phillip | Marketing                 | 38  | BBus                    | GradDipT (Secondary—Humanities and Business Studies)           |
| Rick   | Finance Manager           | 37  | BArts                   | GradDipT (Secondary—Humanities and Business Studies)           |
| Maree  | Industrial Designer       | 34  | BIndDes                 | GradDipT (Secondary—Technologies)                             |
| Nicole | Standards Engineer        | 34  | BArch                   | MTeach (Primary)                                               |
| Miles  | Systems analysis, Lecturer| 33  | BCompSc                 | GradDipT (Secondary—Technologies)                             |
| Owen   | Bank Manager / Bus Driver | 33  | BArts                   | GradDipT (Secondary—Humanities and Religious Studies)          |
| Sally  | Junior Partner            | 33  | BLaw                    | GradDipT (Secondary—Legal Studies and English)                 |
| David  | Accountant                | 32  | BArts, MArtHis          | GradDipT (Secondary – Humanities and Business Studies)         |
| Erin   | Art Collections Manager   | 29  | BVArts                  | GradDipT (Secondary—Visual Arts)                               |
| Tilly  | Language Arts Teacher     | 27  | BArts                   | GradDipT (Secondary—Technologies)                             |
| Greg   | Account Manager           | 26  | BBus                    | GradDipT (Secondary—Humanities and Business Studies)           |
| Katrina| Preschool Teacher         | 25  | BEd (EChil)             | MTeach (Primary)                                               |
| Michelle | Marketing Junior        | 25  | BBus                    | GradDipT (Secondary – Business Studies and Chinese)            |
| Penny  | Graphic Artist            | 25  | BVArts                  | GradDipT (Secondary—Visual Arts)                               |

Key: (a) Pseudonyms have been assigned to all participants in this study
(b) Table is ordered by the age of participants
methods differ from PE1; and what was the effect of feedback on your use of technology during your final placement? Question 4 was designed to re-examine the impact of technology use in prior occupations upon beliefs and practice during PE2 and future technology integration goals. The interviews were digitally recorded for transcription and analysis. This process enhanced the accuracy of capturing the participants’ responses. Each participant received a copy of the transcript from their interview to validate the accuracy of their record. See “Appendix” for copy of interview protocol.

Data analysis

Anney’s (2014) trustworthiness criteria were applied using identical pre-and post-survey measures (quantitative) and repeated investigations using coherent and consistent interview protocols (qualitative). The data collected from quantitative and qualitative measures during Phases One to Three created a case study database (Yin, 2009). Triangulation of the quantitative and qualitative data from the case study database facilitated a comprehensive understanding of how career-changers’ technology integration beliefs and practice had developed since commencing ITE, and the causal determinants responsible for these changes. The triangulation of quantitative (descriptive statistics) and qualitative data enhances this research’s credibility and trustworthiness (Santiago-Delefosse et al., 2016).

A nonparametric test was conducted to understand the mean score differences of participants technology integration self-efficacy beliefs since the commencement of the program. Due to the changes in the sample size from Phase One (N = 147) to Phase Three (N = 17), a nonparametric Wilcoxon signed-rank test was chosen to facilitate the comparison of the mean between two matched samples from this study. Prior to conducting a Wilcoxon signed-rank test, it was important to ensure the data from this study met two assumptions: the independent variable was categorical between the two related sample groups, and there was symmetry in the distribution of differences for the two related sample groups (Field, 2009; Laerd Statistics, 2015).

Standardization of interview protocols and comparability of interview settings adopted for Phase’s Two and Three increased reliability and consistency of code development (Boyatzis, 1998). All coding of transcripts from Phase’s Two and Three of this study were undertaken by the principal researcher and lead author of this paper. In cases of uncertainty, the other members of the research team were consulted until consistent coding approaches were realised. All thematic coding of transcripts from Phase’s Two and Three of this study were undertaken by the principal researcher and lead author of this paper. The study was heavily qualitative, with coding used to identify and organise data according to interpretivist themes, moving beyond more stochastic discourse analysis where all sentences were categorised according to exactly one theme and frequencies reported. For that reason, interrater reliability measures were not applied, and we acknowledge in the limitations section of the paper that the qualitative nature of this paper means that different researchers may have made different interpretations of the data. However, and at the same time, we contend that this interpretivist aspect of the study is part of its richness, enabling nuances beyond mere categorisation to be illuminated. Heavy use of primary data (quotes) during reporting of results also enables the reader to establish objectivity of coding.

Explanatory analysis provided rich reporting using the participants voice to mitigate risk of reporting bias. A codebook was created to locate reoccurring themes within transcripts using a combination of inductive and deductive methodological approaches (Crabtree & Miller, 1992; Fereday & Muir-Cochrane, 2006; Miles et al., 2014). The adoption of
a codebook during thematic analysis increases reliability and dependability of data interpretation regardless of the epistemological perspective of the researcher (Boyatzis, 1998). There was consistency between the codes produced for analysing Phase Two transcripts and this research phase to support a reliable comparison of technology practice and beliefs between PE1 and PE2 (see Table 2). Three broad code categories were created a priori to align with this study’s conceptual and theoretical framework: technology integration beliefs, technology integration practice, and technology integration environment (Boyatzis, 1998). This process helped to connect additional sub-categories identified from interview narratives (Boyatzis, 1998; Fereday & Muir-Cochrane, 2006). These categories were guided by research questions, theory, and causal factors affecting technology pedagogy as identified in the literature (Tondeur et al., 2012; Li et al., 2016; Ottenbreit-Leftwich et al., 2018).

A more nuanced understanding of the ‘how and why’ of career-changers’ technology integration beliefs and practice during ITE was achieved through adopting a data-driven inductive approach. Recognition of patterns emerging from data facilitated exploring the relationship between technology self-efficacy beliefs, technology integration practice, and technology environments (see Table 3). For example, completing PE in schools with unreliable IT infrastructure often thwarted technology practice regardless of technology integration self-efficacy beliefs. These patterns highlighted the determinants affecting the dynamics between technology integration goals, practice and evolution of practice. As recommended by Saldaña (2009), memos were made on each participant’s transcript to ensure consistency and connection to the data during the initial coding process. Supplementary codes were included to identify changes to technology practice since PE1.

Ethical considerations

Ethics approval to conduct this study was received by the participating university’s Human Research Ethics Committee. An explanation of the study was provided to all participants prior to receiving written informed consent. The interviewer was the lead author of this paper, principal researcher, and did not hold a position of power over the participants. To prevent implications of coercion and conflict of interest during the recruitment drive, the questionnaire for Phase One was administered by an academic employed at the university but not involved in this research project. To mitigate risks relating to positions of power, the selection of participants and conducting of interviews for Phase’s Two and Three did not take place until the conclusion of each semester, after grades have been released. An introductory script within the interview protocol detailed the purpose of the study, interview process and sort verbal consent from each participant prior to the commencement of each interview. In line with ethical research conventions, pseudonyms were adopted for all participants involved in this study to preserve confidentiality and anonymity (Crow & Wiles, 2008). All participants received a copy of the transcript from both Phase’s Two and Three to validate as true and accurate depictions of responses provided during the interviews.

Findings

Examination of personal, behavioural and environmental determinants showed career-changers’ technology integration beliefs and practice were shaped by a combination of lived experiences (personal and prior occupations), the design and delivery of
| Broad category codes | Sub-categories codes | Sample data from narratives |
|----------------------|----------------------|-----------------------------|
| Technology beliefs   | i. Beliefs (confidence) about technology | “I felt more confidence than my first one[placement]. IT’s [technology] still not my greatest strength but I feel like I’ve improved a bit” |
|                      | ii. Expectations (goals) using technology | ‘You have got to be flexible, keep your mind open to new things [technology]. Listen to what the students are interested in, what they know, what they’ve found. Trying to get them to collaborate more and share ideas and teach each other things’ |
|                      | iii. Attitude (emotion) using technology | ‘Technology gives us a lot more freedom to experiment and try different things’ |
| Technology Practice  | i. Choices made regarding technology | ‘I know Photoshop® and they are doing their posters in Photoshop®. The thing is the capabilities in Word® now. Taking backdrops off, making transparent. You can get a pretty good result’ |
|                      | ii. Evidence of actual technology actions | ‘I got them to build quadcopters in Google SketchUp®’ |
|                      | iii. Verbal statements regarding use of technology | ‘Maybe I’m changing my approach a little bit towards it [technology] but I think once I start to learn more and more, like I know that I have to, maybe you start to accelerate when you’re learning’ |
|                      | iv. Meaningful links between technology integration and curricula | ‘I’m like well, if you wanted to create the same person over and over that would be a lot better to be done on a graphic program and I can show you Illustrator’ |
| Technology environment | i. Physical setting using technology | ‘They built this whole new flexible learning precinct, which is all glass and fancy and all glass doors, and they had big fancy-pants screens, but the glass wall didn’t go all the way up and sound [was] coming in everywhere’ |
|                      | ii. Consequences of technology use | ‘Using the technology, trying to show them how the logical flow works. This was really simplistic, but it kind of helped them to think in a way that they weren’t used to’ |
|                      | iii. Technology resources (hardware, software, training & support) | ‘The second last day the IT guy, who I was phoning and texting, finally gave me a cord to connect my laptop to the laptop in the big flexible learning spaces’ |
Table 2  (continued)

| Broad category codes | Sub-categories codes                  | Sample data from narratives                                                                                                                                 |
|----------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Self-efficacy beliefs| i. Mastery                            | ‘I’m definitely very confident using technology’                                                                                                                 |
|                      | ii. Vicarious observations             | ‘It was virtually the same use of technology. Open it up and type your notes in. Maybe go to Google® and do some research’                                        |
|                      | iii. Verbal persuasion                 | ‘I came back and said to my supervisor this is my plan and he said yep, that sounds brilliant, let’s do it’                                                      |
|                      | iv. Physiological reactions            | ‘Either give us a laptop, ensure our supervising teacher gives us their laptop for the lesson; we weren’t supported. It’s frustrating. You’ve got to work twice as hard’ |
### Table 3 Examples of inductive, data-driven codes

| Broad category codes                                      | Sample data from narratives                                                                 |
|-----------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1. Personal backgrounds                                   | ‘My brother has probably been an influence my entire life. He is eight years older than me, and he’s always done IT [technology] stuff’ |
| 2. Educational backgrounds                                | ‘I graduated in 2008, those graphic technology skills are redundant. I’ve had to keep, through my job, retraining myself’ |
| 3. Prior occupation-technology skills                     | ‘I have more technical skills, I’ve got more general knowledge of technology that will help, and also the experience of keeping up with technology and just kind of going a little bit with the flow’ |
| 4. Prior occupation influence on technology use            | ‘I think my industry background in IT [technology] meant that I had access to a lot of really interesting bigger problems that I can bring down’ |
| 5. Prior occupation influence on beliefs                   | ‘You have got so many options and so many features in any technology. You don’t have to know everything.’ |
| 6. Teacher training program                               | ‘I think also with the way that the course was structured, like they had a fair bit of stuff in there that helped out, like learning Web 2.0 stuff, like Voki®’ |
| 7. Teacher-educators                                      | ‘Her classes were really good, every lesson we had a new collaborative learning strategy, but it was all just paper-based. I took out the core elements and used technology to apply it in my class’ |
| 8. Professional experience (PE) placement                 | ‘There was nothing at all in terms of technology and I wonder if that’s part of the culture of the school or the culture of that faculty’ |
| 9. PE Mentor technology integration                        | ‘I wanted the kids to see something that was fresh, that was funny because my prac [mentor] teacher’s a bit of an old man. He’s not 40 yet but he’s, I think Generation X.’ |
|                                                           | ‘My teacher—she told me she’s steered clear of any type of technology’                      |
| 10. Technology integration mentorship                     | ‘For Year 12, he [mentor teacher] was like, just stick to the textbook. he really wasn’t terribly encouraging’ |
| 11. PE technology infrastructure                           | ‘…kids couldn’t log off. Computers were failing, links were not loading’                    |
| 12. Content knowledge                                      | ‘I put a lot more content in the presentations in the first prac [placement], because I think I was worried about missing information or something’ |
| 13. Comparing use of technology during PE placements       | ‘I wanted to use the technology in the first prac [placement] but just didn’t have access to it or the, I guess, encouragement to use it’ |
| 14. Self-Regulation/self-reliance                          | ‘So instead of maybe getting really frustrated with it [technology], then I would Google® how to find how to use this, and if you go to YouTube® it will give you the instructions’ |
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teacher-education subjects, and PE placements. The most noticeable change to self-reported pedagogy between PE1 and PE2 was the adoption of technology to support student-centred learning. Interestingly, despite the different individual contexts such as teaching programs (Primary or Secondary), subject disciplines, age, school placement and technology expertise, there was a commonality in the themes that emerged from the data. Table 4 reflects the nature of changes to self-reported technology integration and pedagogy practice.

**The development of technology integration self-efficacy beliefs during ITE**

Initial technology integration self-efficacy scores indicated 59% of participants (n = 10, N = 19) rated their capacity to integrate technology into their practice as neutral (M = 3.90). Upon completion of ITE and final PE placement, post-test results revealed technology integration self-efficacy beliefs had increased, with 76% of participants (n = 13, N = 17) confident to incorporate technology into their practice (M = 4.17). There appeared to be no unique relationship between age, gender and these results. A histogram assessed the score differences and showed an approximate symmetrical distribution using a superimposed normal curve. Unless otherwise stated, data are medians. The mean difference between the two tests indicated the technology integration self-efficacy for 15 of the 17 participants in Phase Three of this study had increased, whilst for the remaining two participants, self-efficacy to integrate technology into practice had decreased. Results from the Wilcoxon signed-rank test determined there was a statistically significant increase in the median technology integration self-efficacy scores from the commencement (3.88) to the conclusion (4.19) of ITE, $z = 2.25, p < 0.024$.

Sustained higher self-efficacy scores typically aligned with an increased interest in using technology on a personal level. Growing up in a family of technology enthusiasts had cultivated Michelle’s love of coding and curiosity using technology tools: “I just always had access to them, and grown up with people interested in IT. I’ve been using it, been pushing boundaries.” Michelle’s above-average technology self-efficacy score in Semester One reflected this confidence (m = 4.38, M = 3.90). Interestingly, despite the difficulties realising technology integration goals during PE2, an increase in self-efficacy measured after ITE reinforced the strength of Michelle’s beliefs (m = 4.56, M = 4.17).

Likewise, Miles’ pre-and post-test self-efficacy scores were well above the mean (Semester One: m = 4.88, M = 3.0; Semester Two: m = 5.00, M = 4.17). These scores reflected his confidence and described his innate ability and interest in using technology: “it came quite naturally, and I actually quite enjoy working with a lot of this stuff [technology].”

Overall mean comparison of pre-and post-test self-efficacy scores was encouraging, showing 88% of this group (N = 19, n = 15) felt more confident to integrate technology into their practice since commencing ITE. However, for two participants, post-test scores indicated a decrease in technology integration confidence. Like Michelle, Katrina entered ITE with a strong personal interest in using technology. Her self-efficacy pre-test score was above the group mean (m = 4.18, M = 3.90), and she was enthusiastic about using technology in her future practice: “technology is a huge part of my life. I can’t separate myself from technology; it’s just so ingrained.” Nonetheless, after a problematic final PE, Katrina’s technology self-efficacy post-test score had fallen below the group mean (m = 3.50, M = 4.17), mirroring the described difficulties she experienced using technology during this placement: “Computers were failing, links were not loading. I was feeling completely lost using this new SMART [IWB] board.”
| Name   | Technology Self-Efficacy 1 (a) | Technology Self-Efficacy 2 (b)(c) | Self-reported PE1 Pedagogy | PE1 technology tools | Self-reported PE2 Pedagogy | PE2 technology tools |
|--------|--------------------------------|---------------------------------|-----------------------------|---------------------|-----------------------------|---------------------|
| Miles  | 4.88                          | 5.00                            | Teacher-directed            | PowerPoint®         | Student-centred             | Google® Applications (Apps): Sheets and Slides, Coding (Scratch®) |
| Sally  | 4.44                          | 5.00                            | Teacher-directed /Student-centred | PowerPoint®, WebQuest | Student-centred: PBL (d) | Movie making (iMovie®, Animation app (GoAnimate®), Twitter®) |
| Georgie| 4.31                          | 4.81                            | Teacher-directed            | Prezi®, YouTube®   | Teacher-directed            | PowerPoint®, YouTube® |
| Erin   | 3.69                          | 4.69                            | Teacher-directed /Student-centred | PowerPoint®, Digital Media Adobe InDesign® | Student-centred: PBL | Digital Media (Adobe Illustrator® & Photoshop®) |
| Michelle | 4.38                         | 4.56                            | Teacher-directed            | PowerPoint®, Kahoot® | Teacher-directed            | PowerPoint® |
| Greg   | 4.19                          | 4.50                            | Teacher-directed            | Google Earth®, Excel®, Mind Mapping (Popplet®) | Student-centred: PBL | Google Classroom®, Google® Apps |
| Phillip| 4.00                          | 4.31                            | Teacher-directed            | YouTube®, PowerPoint® | Teacher-directed            | PowerPoint® |
| Tilly  | 3.13                          | 4.31                            | Teacher-directed            | PowerPoint®         | Student-centred: PBL         | Google® Apps & YouTube® |
| Rick   | 3.88                          | 4.19                            | Teacher-directed            | Google Earth®, Excel® | Student-centred: PBL         | Animation app (GoAnimate®), Google® Apps |
| Liana  | 3.84                          | 4.06                            | Teacher-directed            | PowerPoint®, YouTube®, Google Classroom®, Edmodo® | Teacher-directed | Powerpoint® |
| Penny  | 3.81                          | 4.06                            | Teacher-directed            | SmartBoard®, Prezi® | Student-centred              | SmartBoard® collaborative tools, Padlet®, Adobe Illustrator® & Photoshop® |
| David  | 3.56                          | 4.06                            | Teacher-directed            | PowerPoint®, YouTube® | Student-centred:             | WebQuest, Google® Apps |
| Louise | 3.69                          | 4.00                            | Student-centred             | Website design (Weebly®, Wix®) | Student-centred: PBL        | iMovie®, Website Design (Weebly®), Adobe Illustrator® & Photoshop® |
| Name  | Technology Self-Efficacy 1 | PE1 Pedagogy | PE1 technology tools | Self-reported PE1 Pedagogy | PE2 Pedagogy | PE2 technology tools |
|-------|---------------------------|--------------|----------------------|----------------------------|--------------|----------------------|
| Maree | 3.13                      | 3.56         | Teacher-directed/Student-centred | PowerPoint®, YouTube®, WebQuest | Student-centred: PBL | Illustrator® & Photoshop®, Auto-CAD®, laser cutter |
| Katrina | 4.18                     | 3.50         | Student-centred      | SmartBoard® Apps, iPad® | Teacher-directed | PowerPoint® |
| Nicole | 3.19                      | 3.25         | Teacher-directed     | SmartBoard® games | Student-centred | Lego Mindstorms® (block coding) |
| Owen  | 3.95                      | 3.06         | Teacher-directed     | PowerPoint®, YouTube® | Teacher-directed | PowerPoint®, YouTube® |

Key: 
(a) Mean result from technology self-efficacy scales administered at the commencement of ITE
(b) Mean result from technology self-efficacy scales administered at the conclusion of ITE
(c) The participants are ranked in order of Semester 2 technology self-efficacy mean scores
(d) Project-Based Learning
Conversely, Owen professed little personal interest in using technology, yet his technology self-efficacy score at the commencement of ITE was higher than the group’s average (m = 3.95, M = 3.90). In Owen’s initial interview, his lack of confidence in both technical knowledge and technological skills was apparent: “It’s [technology] never been my strong point. I just didn’t have a great interest in it, and I feel sort of a bit behind.” These beliefs seemed rooted in the perception of possessing an almost genetic learning style, inhibiting his ability to effectively use technology: “I learn like my grandfather and dad… I don’t cope well to changes to routine. So, with technology constantly changing, I know I’ll struggle to keep up.” With Owen’s post-test self-efficacy scores decreasing below the mean, these inherent beliefs, coupled with IT infrastructure issues during PE1, and increased emphasis on delivering content in PE2, appeared to compromise any further growth of technology integration confidence, with Owen’s post-test self-efficacy scores decreasing below the mean (m = 3.06, M = 4.17).

The influence of previous occupations on technology integration beliefs and practice.

An omnipresence of technology in prior occupations was credited for participants’ value of technology in education, and future technology integration goals, Greg: “in the business economics world, technology is very important to communicate. Like ABS data. Economic data, business data, technology’s important to those type of subjects.” For Georgie, these experiences also emphasised the need to keep abreast of technological changes: “my graphics background has definitely been really helpful, but you’ve just got to keep expanding on them [skills] though.”

All participants previously held professionally ranked positions (ANZSCO, 2016) from various industries (see Table 1) and reported constant workplace changes during these roles. Accommodations of revised job descriptions due to technological advancements and economic downturns were commonplace; Liana: “I remember there was one secretary to the team of us and then as it progressed there was no secretary, and then we were expected to do our own typing.”

All participants spoken of resilience garnered from prior workplace experiences that supported technology integration during ITE and both PE placements. Louise credited her confidence in integrating unfamiliar technologies during ITE to her experiences using technology as a product designer: “You just have to be practical and pragmatic about it [technology] and not be daunted by trying something else. You might use that once and never use it again” Similarly, David drew upon his industry experience to resolve technical issues encountered during PE placements: “Working with computers, it’s given me a level of comfort and confidence using them in the classroom, they will break, but I will still use technology.”

Technology integration practices during PE placements were influenced by skills using specific applications in prior roles, with usefulness to teaching dependent upon the currency and type of technical skills. During PE1, a predominantly teacher-directed technology pedagogy was supported through the integration of administrative applications extensively used in industry such as word processing, spreadsheets and slideshow presentations: “I would end up doing a PowerPoint®, which was very content intense” (Liana); “PowerPoint® on the board, that was it, and I tried to bring a lot of paper so I could make them write” (Phillip); and Rick: “In my previous career, I learned how to use applications like PowerPoint® and Excel®, and I have used them throughout this prac. I love Excel®, so I will always try and use it as much as I possibly can when teaching.”

Over 35% of participants (n = 6) during both PE placements demonstrated a reluctance to depart from using generic technology applications from previous roles, such as slideshows (see Table 2). Michelle’s confidence and familiarity using slideshows as a marketing
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executive intensified the valued of this application as a teaching tool: “I got used to a certain way of designing PowerPoint® and presenting it to people to get across messages, I feel that basis will continue in my teaching.” The regular integration of slideshow presentations reflected these beliefs during PE1 and PE2. Likewise, Georgie regarded skills creating aesthetically pleasing presentations as more valuable to teaching Visual Arts than her extensive skills using graphics software such as Photoshop®, Illustrator® and InDesign®: “It’s kind of natural for me, I prefer to have a Prezi going. I like to have a framework for me to work with.” It was apparent those participants who demonstrated a retention for integrating traditional technology tools like PowerPoint during PE2 sustained adoption of teacher-directed pedagogical practice.

The shift to integrate specialised, occupation-specific technology during PE2 was clear for those participants teaching in subject areas where links between industry and curricula were obvious. For example, Erin’s technology pedagogy beliefs and practice shifted during PE2 to include meaningful connections between skills using occupation-specific graphic tools, and the Visual Arts curriculum: “I try and tell them … why am I using Photoshop®, why am I using InDesign®, why am I using—even digital cameras. I tried to get them to use every lesson for their portraits.” From the commencement of ITE, Miles was enthusiastic about integrating his computer programming knowledge and skills to provide real-world learning experiences for his future Digital Technologies students. “My industry background meant I had access to really interesting bigger problems. I was able to say this is how it’s done in industry, and sometimes bring up a website and say here’s an example.” These goals were constrained during PE1; however, mentor support during PE2 supported the realisation of these goals, and the student responses confirmed the value of this pedagogical approach: “They could see why they were learning the theory when they could put it straight into practice.”

The influence of ITE on technology integration beliefs and practice

During Semester One, technology integration frameworks such as TPACK and SAMR were discussed briefly in a generic educational studies subject, as Georgie indicated: “you’re familiar with the TPACK? I think it’s that kind of idea that we are integrating ICT platforms and formats into what we’re doing.” However, Georgie’s propensity to incorporate slideshows to support self-reported teacher-directed pedagogy during both PE placements reflects an apparent disconnect with theoretical understandings and practice.

Five participants credited the completion of curriculum subjects delivered by teacher educators identifying technology tools relevant to curricula throughout ITE for their greater confidence to integrate technology during PE2. Phillip attributed his increased awareness of curriculum-specific technology tools to demonstrations by his curriculum lecturer using Web 2.0 applications. For Erin, the conceptualisation of technology integration approaches was generated from: “exposure and understanding the purpose of technology in teaching shown by lecturers during education training.” Likewise, Tilly’s increased confidence and future technology integration goals as a Design and Technology teacher were fostered through the introduction to technology tools during curriculum subjects: “I have a Makey-Makey®. I’m going to work on coding. This Christmas holidays, I’m working on upskilling and doing things I’m not comfortable with 100 per cent. I’m hungry, I want to learn”.

During PE2, content knowledge difficulties sustained technology adoption to support traditional, teacher-directed pedagogy (n = 6). A heavy dependency on slideshow tools buoyed this approach. For Liana, curricula content apprehensions, student engagement
concerns, and familiarity using slideshows justified the adoption of transmissive pedagogy during PE2: “Well, literally every lesson I ensured I always had a great PowerPoint® presentation.” Working in commercial sectors provided Phillip with confidence in teaching Business Studies content during PE1. Familiarity and capabilities using PowerPoint® presentations in previous marketing roles fostered Phillip’s dependency on this tool to scaffold content delivery and support classroom management weaknesses. During PE2, Phillip was teaching outside of his primary discipline area, and content knowledge deficiencies sustained the inclusion of information-dense slideshows: “because I’m learning the content, I was building the PowerPoint® first then writing the lesson plan”.

Conversely, increased content and pedagogical knowledge confidence in PE2 saw 40% of participants (n = 7) depart from slideshow presentations and reported the adoption of more student-centred approaches. Group activities were scaffolded using collaborative software such as Google Docs® and learning management systems (LMS) such as Google Classroom® and Edmodo®. Louise shifted towards adopting problem-based technology pedagogy to align with the fundamental tenants of Design and Technology: “I put a lot more content into PowerPoints® during the first prac [PE1]. This time [PE2] I was more confident, and it [presentations] served as a discussion prompt rather than giving students information.” For three participants, technology was used during PE2 to support student-centred approaches such as inquiry-based learning (PBL), Rick: I got the students to create a Padlet® on travel as a means of sharing their findings from explorations using Google Maps®…just like a little quest.” Rick credited the development in his pedagogical practice to his supervising teacher’s modelling of technology integration during PE2 and completing additional educational studies subjects after PE1. The combination of experiences from PE1, and completion of teacher education subjects, saw Greg transition in beliefs from traditional teacher-directed pedagogy (PE1) to integrating more learner-centred technology pedagogy strategies during PE2:

I’m more confident because I know what I’m dealing regarding student learning. With the help of the uni courses, understanding those different multiple intelligences and different types of learning, I’m trying to hit as many of those buckets as I can with the technology I use.

Professional (field) Experience: influence on technology integration beliefs and practice

The completion of PE placements was a considerable influence on the reported current and future technology integration beliefs and practice for all participants in this study. The school ethos, availability of resources, IT infrastructure, type of technology pedagogy observed, quality of feedback provisions, and mastery opportunities integrating technology during PE1 and PE2 served to guide technology pedagogy beliefs, practice, and future teaching goals.

School culture, ethos and IT Integration policies

The ethos and collective school focus on technology was reported to affect whole-school technology integration practices. Staff in schools with well-designed technology integration policies and IT infrastructure typically embodied a positive and progressive attitude towards technology integration. Participants completing PE in schools with a collective
optimism towards technology reported a sustained technology pedagogy focus from a whole school perspective. Such schools supported participants’ realisation of planned technology integration during PE placements and even extended technology goals for others. During PE2, David observed a progressive, informed and supportive attitude collectively demonstrated by the school towards technology: “they’ve been using technology for quite a few years. The staff are supported in terms of if they want to learn things, they get a lot of support. That helped me too”. His self-reported practice during this placement shifted from transmissive, teacher-directed pedagogy described in PE1 to technology integration that encouraged collaborative and constructivist learning design, e.g., WebQuests and Google shared docs®. Likewise, Miles attributed the positive changes to his technology pedagogy during PE2 to the attitude and technology pedagogy of teaching staff, coupled with the accessibility of technology resources and technical support provisions:

The culture in the school, and also in your faculty. It will affect the attitude students have towards the use of technology. I’m [at] a school which is quite positive in this regard and, as such, I’m much more inclined to experiment and be creative.

Well-considered Bring Your Own Device (BYOD) programs or whole-school laptop provision initiatives increased confidence and the integration of technology pedagogy tools in teaching practice. Rick attributed the ready access of reliable technology during PE2 to his increased confidence to incorporate more technology than PE1:

I did use technology a lot in this one [PE2] compared to first one [PE1]. The school was really well geared up for it. The first school had very unreliable technology all the time. This school’s much better. Really good. No problems at all. I can’t think of a single lesson where I just used the board.

Likewise, the availability of technology tools at Miles’ PE2 placement enabled the realisation of pedagogical goals that reflected constructivist, hands-on student-centred learning:

In some of the classes, they had Lego Mindstorms, and the students were actually playing with quadcopters. I had those little Sphero® balls for teaching programming and all manner of other little things, actual physical things they can play with.

For Katrina, confidence and skills using technology as a pre-school teacher facilitated the adoption of self-exploratory approaches to learning unfamiliar technology tools during PE1. Newly acquired skills included mastering the Interactive White Board (IWB), Web 2.0 applications such as Edmodo®, and online educational games such as Kahoot®. However, completing PE2 at an academically selective primary school challenged Katrina’s content knowledge. The whole-school focus on performance in national standardized assessments rather than technology cultivated a dependence on reliable and traditional forms of technology to support transmissive, teacher-direct practice.

**IT resources and infrastructure**

Unreliable networks, limited IT support, internet limitations and hardware constraints during PE2 were the most common determinants compromising the extension of technology integration beliefs and practice since PE1. Resource limitations compromised Michelle’s technology integration practice and the realisation of technology integration goals generated from PE1:
I would’ve loved to do more, but the school I was at the kids don’t have laptops. Stuff like that was holding back my creativity. Out of charge, they don’t bring their chargers. I had to become less dependent on technology. I made PowerPoints to minimise any internet connectivity issues.

Unreliable technology from poorly implemented BYOD programs during PE2 was a constant source of disruption for Phillip. These limitations impacted confidence to integrate technology tools introduced during ITE, and justified the replacement of more dependable, traditional methods of delivering content:

I don't have any problems with it [technology], but there were days where I planned lessons using technology that just crashed, so I’d shoot from the hip anyway. I just write on the board, so I got back to teaching and chalk and talk.

Similarly, ongoing network connectivity issues during attempts to integrate technology in PE2 further impacted Katrina’s technology pedagogy confidence and practice: “Technology failed; kids couldn’t log on…kids couldn’t log off. Computers were failing; links were not loading.” Owen’s use of technology during PE2 was restricted due to similar network connectivity and hardware problems experienced during PE1: “When students were using the laptops, the network was fairly unreliable. It slowed down the lesson, and the kids got frustrated. So, after using it once or twice, I pretty much canned it.” Despite identifying technology tools to enhance student content understanding for Year 9 Commerce, little IT support to overcome network connectivity issues further compromised Owen’s confidence and subsequent technology integration goals: “They really have to make an effort to help prac teachers with technology. Otherwise, it means you’ve got to fall back on boring stuff.”

Supervising teachers’ use of technology during professional experience placements

Technologically proficient supervising teachers with a vested interested in effective technology integration boosted participants’ confidence levels and tendencies to integrate technology during PE placements. For David, the technology pedagogy practice modelled by his supervising teacher during PE2 highlighted the value of student-centred learning, together with the application of complementary technology tools: “Definitely her use of technology, like Edmodo. She’d teach for a bit, and then she’d get them to do some research, and that helped me to think I don’t have to be teaching them the whole time.”

Compared to PE1, Miles believed the greater latitude and support from his supervising teacher during PE2 provided increased opportunities to learn and integrate new technology tools:

Second prac [PE2] in terms of feelings, I’d say it was quite exciting as there was more potential. They said you could use whatever you want. If there’s programs you know they don’t have; they’re happy for them to be downloaded.

Similarly, his supervising teachers’ optimism and technology competence during PE2 positively influenced Rick’s technology pedagogy beliefs. Moreover, it buoyed his confidence to expand the integration of technology tools in his practice: “The teachers’ [were saying] we’ve got these tools so let’s see how we can make them work in the classroom. How we can improve learning through them? I think that just filtered down to the students and me.”

Conversely, Katrina attributed the limited technological capabilities of her supervising teacher during PE2 to his older age. She believed this factor restricted the growth of her
technology integration practice throughout this placement: “I wanted the kids to see something that was fresh, but my prac teacher’s a bit of an old man.” Positive appraisals during PE2 from Georgie’s supervising teachers on her adoption of similar technology integration strategies to PE1 validated retention of transmissive, teacher-directed pedagogy practice: “They said oh, we love the PowerPoints. They wanted to keep all of them [slideshows].” Exposure to similar environments during PE2 also impacted Liana’s technology pedagogy growth: “So I didn’t see a lot of technology being used, I wasn’t overwhelmed by the level of creativity. But he [supervising teacher] loved all of my PowerPoints [presentations]. He thought it was great I could do all that.” Phillip’s supervising teacher also validated the suitability and retention of this practice: “She said my PowerPoints were a good use of technology. But her own lessons were just YouTube; there wasn’t much IT.”

Discussion

The overarching aim of this study was to understand how career-changers technology pedagogy cognisance developed throughout a post-graduate teacher education program and the determinants that supported or constrained their level of progression. Findings reflected the key tenants of this study’s conceptual framework, with interactions between personal, behavioural and environmental determinants critical in shaping career-changers technology integration beliefs and subsequent practice throughout ITE. Palpable, bi-directional reciprocity between beliefs and practice was evident, with increased beliefs and confidence to integrate technology apparent for over 80% of participants (n = 15). However, technology integration practice largely depended upon the individual school contexts during PE placements, reinforcing the importance of contextual barriers to technology practice (Ottenbreit-Leftwich et al., 2018). The influence of the environment on shaping beliefs about technology pedagogy and subsequent technology integration practice was strongly apparent for all participants in this study. Nonetheless, given the knowledge and experience level of career-changers as pre-service teachers, the impact of their technology integration practice and beliefs on their environment was unremarkable. Table 5 provides an overview of the emerging themes from the findings in this study.

Personal and occupational experiences on career-changers’ technology beliefs and practice

Life experiences and prior industry expectations shaped career-changers’ preliminary technology beliefs and reinforced technology’s importance in their future teaching practice. Earlier research highlighted the effect of background technological experiences on pre-service teachers’ initial beliefs to use technology in their practice (Teo, 2009). For career-changers in this study, technology confidence at the commencement of ITE depended upon the exposure and use of technology personally and professionally. These results reinforce Teo and Noyes’ (2014) findings emphasising the value of lived experiences and exposure to technology in fostering older pre-service teachers’ awareness of current technology mandates.

Literature has previously advocated the positive influence of lived experiences on career-changers teaching beliefs and practice (Powell, 1992; Tigchelaar et al., 2012). Watters and Diezmann’s (2015) findings highlighted the importance of confidence and autonomy as support mechanisms for career-change beginning science teachers.
Table 5  The relationship between determinants influencing the development of career-changers’ technology integration beliefs and practice from a triadic causation perspective

| Environment                | Conceptualisation (technology integration beliefs)                                                                                           | Realisation (technology integration practice)                                                                                     |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| **Personal**               |                                                                                                                                               |                                                                                                                                 |
| Family                     | Increased exposure to technology fostered personal interest and greater confidence to integrate technology throughout teacher education and future teaching goals | High confidence levels sustained motivation during teacher education to learning technology and develop teaching resources using extended features of technology applications |
|                            | Family backgrounds where contact to technology was limited decreased interest and confidence to use technology both personally and in educational contexts | Low technology integration confidence levels stymied realisation of technology integration goals when technical difficulties were encountered during both PE placements |
| **Prior workplaces**       |                                                                                                                                               |                                                                                                                                 |
| Professional background    | Dictated use, exposure, and value of technology skills from prior occupations to teaching                                                                 | The use of occupation-specific technology tools fostered meaningful integration of these applications during both PE placements, e.g. Computer programming, Excel® and Photoshop® |
|                            | Metacognitive skills garnered from using technology in industry facilitated confidence to overcome technical issues encountered during teacher education and PE placements | Dependence and reliability of administrative technology applications amplified and sustained inclusion of these applications during both PE placements, e.g. PowerPoint© slideshows |
|                            | Self-assessments determined the relevance of occupation-specific technology skills to teaching if curriculum links were obvious                     | Transference of occupation-specific technology skills during PE placements was dependent upon self-estimates of apparent curricula links |
| Employer expectations      | Financial constraints and role responsibilities validated the importance of technology and cultivated self-regulatory (metacognitive) approaches towards learning technology tools | Self-regulation promoted investigatory approaches towards acquisition and maintenance of technology skills during teacher education, PE placements, and future technology integration goals |
| **Teacher education**      | Modelling, mentoring, and mastery opportunities using educational technology resources within curriculum subjects increased awareness and confidence to integrate these tools during PE placements | Successful mentoring and mastery encounters using specific technology during teacher education, such as Web 2.0 tools, facilitated the integration of these tools during PE placements, e.g. Online quizzes (Kahoot®) |
| Teacher-educators          | Regular observations of teacher-educators using transmissive technology pedagogy (e.g. slideshow presentations) validated the use of these tools in educational contexts | Vicarious observations of teacher-educators using technology to support teacher-directed pedagogy supported regular use of slideshows presentation tools during PEi placements |
| Environment                      | Conceptualisation (technology integration beliefs)                                                                 | Realisation (technology integration practice)                                                                 |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Content knowledge               | Content knowledge limitations validated slideshow presentations as an effective tool to scaffold and support teaching during PE | Curricula content weaknesses sustained the integration of transmissive technology tools (e.g. slideshow presentations) to support teacher-directed pedagogy during both PE placements |
| Pedagogical knowledge           | Pedagogical knowledge limitations fuelled preferences for teacher-centred learning approaches during PE1                  | Broader understanding of pedagogy strategies from education subjects during teacher education promoted technology integration to support student-centred, constructivist pedagogy during PE2 placements |
| **Professional experience**     |                                                                                                                       |                                                                                                                                                                        |
| School Culture and Ethos        | Effective IT policies that collectively cultivated whole-school technology integration attitudes fostered confidence using technology during PE placements | Incorporation of technology during PE was dependent upon operative IT integration policies and support systems that buoyed whole-school technology integration practice |
| IT resources and infrastructure  | Reliability of network and technology resources influenced confidence to integrate technology and subsequent technology integration goals during PE1 and PE2 | Limited access to technology tools and unreliable IT infrastructure promoted the adoption of more reliable, teacher-directed technology pedagogy during both PE placements |
| Supervising Teacher             | The technological competence, mentoring and modelling by supervising teacher’s predisposed confidence to integrate technology and technology pedagogy goals | Modelling and mentoring of student-directed pedagogy promoted the adoption of similar teaching approaches |
|                                | Positive appraisal of transmissive technology integration by supervising teachers during PE1 and PE2 validated appropriateness of teacher-directed technology pedagogy | Technology practice was compromised by supervising teachers with limited technological capabilities, modelling minimal integration of technology or negative attitudes towards technology in educational contexts |
For the career-changers in this study, acquired confidence from adapting to previous workplaces’ technological changes had instilled metacognitive traits such as resilience, critical thinking, self-reflection, and self-regulation. These skills encouraged agentic approaches when integrating technology during ITE and PE placements. These results reflected the interplay between personal, behavioural and environmental determinants (Bandura, 2008) and influenced the career-changers choice of technology and their subsequent integration of that tool. Tondeur and colleagues’ (2018) multilevel analysis showed the importance of self-regulation and problem-solving capabilities as determinants of technology pedagogy beliefs, attitudes and practice of experienced and pre-service teachers. We believe this study’s results reinforce recommendations to design post-graduate ITE programs that recognise the value of incumbent skillsets, such as metacognition, as mechanisms to support pre-service career-changers in their future teaching practice (Grier & Johnston, 2012; Varadharajan & Schuck, 2017). Moreover, harnessing these traits could help sustain career-changers realisation of authentic technology integration to enable meaningful pedagogical practice (Jonassen et al., 2003; Ertmer & Ottenbreit-Leftwich, 2013).

**Influence of ITE coursework subjects upon career-changers’ technology beliefs and practice**

At the commencement of ITE, the career-changers’ in this study shared similar intentions to use technology in their practice. The design and delivery of coursework subjects embedded within their ITE program were pivotal in affecting technology integration conceptualisations and subsequent practice. Only 30% of career-changers credited the completion of curriculum subjects and use of technology by teacher-educators for enhancing their technology practices during PE placements. This group reported the formation of links between curricula and occupation-specific technology skills during the final PE placement. Facilitating these connections was the inclusion of technology integration frameworks within curriculum subjects, supplemented by modelling and mentoring of effective technology integration practices. Limited exposure to multimodal technology integration methods by teacher educators could explain why one-third of the career-changers were hesitant to depart from integrating traditional technology tools such as slides shows to support teacher-directed learning. Post-graduate teacher education programs need to embed mentoring and modelling provisions to challenge outdated pedagogical conceptualisations (Grossman, 1991) and cultivate meaningful, student-centred pedagogical practice (Tondeur et al., 2017).

When examining pre-service teachers’ understanding of TPACK, Mouza and colleagues’ (2017) identified the importance of including intentional education technology subjects to develop TPACK conceptualisations. Tondeur et al. (2018) found similar positive results when pre-service teachers were exposed to increased observations of strategies to facilitate ICT competencies development. Findings from this study reinforce the influence of contexts upon the development of TPACK, with equitable opportunities of explicit modelling, mentoring and mastery opportunities necessary to foster authentic learning experiences (Rosenberg & Koehler, 2015; Mouza et al., 2017). Practical strategies to develop technology pedagogy understandings include demonstrations to situate technology in educational contexts successfully and guidance to support mastery of authentic technology integration experiences (Tondeur et al., 2012, 2018; Ertmer & Ottenbreit-Leftwich, 2013).
The impact of prior occupations and initial teacher education…

2013). For example, Uerz and colleagues’ (2018) literature review highlighted the need for teacher-educators to be technologically proficient, together with technology, pedagogy, and content knowledge competencies. However, their literature analysis showed limited evidence of teacher educators successfully meeting this benchmark (Uerz et al., 2018). These findings also reflect career-changers experiences in this study.

Influence of professional (field) experiences on career-changers’ technology beliefs and practice

The initial self-reported preference for career-changers to adopt transmissive, teacher-directed pedagogy during PE1 mirrored findings from Tigchelaar and colleagues’ (2012) investigation of second-career teachers’ conceptions of teaching and learning. With recommendations to provide explicit preparatory training that targets conceptualisation of effective, student-centred pedagogy before professional experience placements (Tigchelaar et al., 2012). For 65% of the career-changers in this study, a shift in pedagogical practice was apparent during PE2, with the adoption of technology integration to support more student-centred approaches. A greater understanding of curricula content and pedagogy facilitated opportunities to incorporate occupation-specific technology to support real-world activities. Findings from Green’s (2015) study highlighted career-changers’ use of vignettes in their practice to enhance meaning and context. Supporting earlier research, opportunities for career-changers in this study to realise these associations depended upon the technology pedagogy skills, attitudes and beliefs of both teacher-educators and supervising teachers during PE placements (Sadaf et al., 2016; Tondeur et al., 2018). Results in this study expanded upon Tigchelaar and colleagues’ (2012) investigation, with efficacious mentoring and modelling of technology pedagogy during professional experience placements proving to be an influential factor in the evolution of career-changers technology integration beliefs and practice.

School environments with a united focus on technology bolstered in-service teacher attitudes towards technology integration. These surroundings saw whole-school subscriptions to professional development programs, fostering collective future technology teaching and learning goals (Tondeur et al., 2017a, 2017b). Career-changers completing PE in schools with operative IT integration goals and infrastructure, mentored by supervising teachers demonstrating effectual technology pedagogy, finished ITE more confidently and were more likely to use technology in their future practices. Nelson and Hawk’s (2020) research findings reinforced the positive impact of completing professional (field) experiences when mentored by technologically proficient supervising teachers.

The increase in post-test self-efficacy scores for over three-quarters of career-changers was buoyed from positive mastery experiences, reliable IT infrastructures and the modelling of effective technology integration by supervising teachers during PE placements. Interestingly, only two from this cohort measured lower levels of self-efficacy since the commencement of the course. These results were attributed to irreconcilable external barriers, including disenfranchised school environments during PE2 placements that compromised pedagogical conceptions. This finding reinforces the crucial role school culture, ethos, and IT policies play in fostering environments that shape the technology beliefs and subsequent pedagogy practice of collective staff members (Maré & Mihai, 2018; Tondeur et al., 2018). Moreover, consideration needs to be
given regarding these disenfranchised environments capacity to effectively fulfil their role as teacher-trainers and the ramifications on pre-service teachers’ conceptualisation of meaningful technology pedagogy. This consideration is critical, given self-efficacy beliefs, once established, are often difficult to shift (Bandura, 1997).

Limitations of study and future research recommendations

The inference of the results from this research provides a greater understanding of the relationship between the determinants that shape career-changers’ technology pedagogy conceptualisation. However, consideration needs to be given to the limitations of this study. The constraints of convenience sampling from one cohort from one university could compromise the generalisability of this study’s findings. Furthermore, self-reported data may introduce possible subjectivity and biased perspectives from the participants in this study. Nevertheless, these personal interpretations of experiences during PE placements are essential as they help identify the nuances and commonalities that determine career-changers’ technology pedagogy beliefs and practice (Garcia & Gustavson, 1997). Moreover, these retrospective self-reports also helped examine relationships between beliefs and practice (Montgomery & Duck, 1993). Future research should focus on a more nuanced exploration of context areas to explicitly understand what prohibits and promotes the technology pedagogy conceptualisation of career-changers.

Conclusion and recommendations

Global mandates focus on the integration of technology into teaching practice to cultivate critical, creative and problem-solving thinking skills (Australian Trade and Investment Commission, 2017; OECD, 2019; UK Department for Education, 2019; European Union, 2020). The career-changers in this study entered ITE with a range of technological capabilities and characteristic traits fostered from lived experiences and prior occupations. The regular use of technology to fulfil previous role responsibilities had fostered resilience and cultivated positive prevailing attitudes and beliefs towards the inclusion of technology in education. These incumbent skillsets and beliefs are positive indicators of career-changers’ potential to infuse their teaching practice with technology expertise from industry to provide authentic and meaningful learning environments. However, little recognition of prior occupation-specific technological skills occurred at an institutional level. Provisions to support the transference of specialised skills pertinent to teaching were inconsistent, and challenges to possibly redundant pedagogical beliefs to support effective technology practice was also lacking. If supported, career-changers have the potential to realise technology integration agenda’s through the incorporation of technology skills and experiences from prior occupations to create real-world learning environments.

Research continues to highlight intentions to integrate technology in future teaching are not enough (Ottenbreit-Leftwich et al., 2018). In this study, efficacious mastery, mentoring and modelling of technology integration during both teacher education and professional experience increased self-knowledge, beliefs and confidence to adopt more constructivist technology pedagogy. Therefore, to cultivate meaningful technology integration pedagogy, we recommend ITE programs support career-changers with the appraisal of incumbent
skills to curricula and provide learning environments that foster pedagogical knowledge and confidence to transfer these connections into practice. For example, imagine the possibility for rich and authentic learning opportunities in Design and Technology classrooms if career-changers, such as Louise and Maree from this study, were provided with mentoring that enabled transference of their skills and experiences using graphic design applications in real-world contexts into their pedagogical practice.

Technology remains an omnipresent force within education; however, the realisation of meaningful technology pedagogy is dependent upon a positive interplay between environmental, personal and behavioural determinants. Professional experience environments were shown to exert a considerable influence on the relationship between espoused and enacted technology integration beliefs. Consequently, we also recommend key stakeholders implement strategies to support schools to cultivate a collective positive technology integration culture. Such environments are crucial to nurturing and sustaining technology integration self-efficacy beliefs robust enough to adapt to change and resilient enough to turn technology integration goals into practice.

Appendix

Title of Protocol | Career-Change Pre-service Teachers and Technology Integration Practice.
Principle Investigator | xxxx Phase 3 | Qualitative Component.
Interview Protocol | Introductory Script.

Welcome and thank you for your participation today. My name is xxxx. Thank you for completing the survey handed out in xxxx. This follow-up interview will take approximately 30 min and will include questions regarding your previous occupational experiences, and what might affect how you integrate technology into your teaching.

At this time, I would like to remind you of your written consent to participate in this study. I am the responsible principle investigator, specifying your participation in this research project. You and I have both signed and dated each copy, certifying that we agree to continue this interview. You received one copy when you completed the initial survey and I have the other under lock and key, separate from your reported responses.

I would like your permission to digitally record this interview on my iPhone using an application called Smart Recorder, so I may accurately document the information you convey. If at any time during the interview you wish to discontinue the use of the recorder or the interview itself, please feel free to let me know. All your responses are confidential.

Your responses will be used to develop a better understanding of the previous occupational experiences of you and your career-change pre-service peers, together with understanding your view on technology in education and what might influence these views. The purpose of this study is to increase our understanding of how career-change pre-service integrate technology into their teaching and what influences their technology integration practice.

Your participation in this interview is completely voluntary. If at any time you need to stop and take a break, please let me know. You may also withdraw your participation at any time without consequence.

Do you have any questions or concerns before we begin?
Then with your permission we will begin the interview.
Interview Protocol Phase THREE | Questions

1. The following questions are specifically related to your second and final professional experience:

   i. Did you use technology during your second (and final) professional experience?
      
      *Probe:* What did you use?
      *Probe:* How did you use it?
      *Probe:* Why was this the case?

   ii. How would you describe your attitudes and beliefs about technology as you were using it during your second professional experience? (Zeldin, et al., 2008, p. 1056)
      
      *Probe:* Why was this the case?
      *Probe:* Did this affect your use of technology during your second professional experience?

   iii. How did others influence you in your use of technology during your second professional experience? (Zeldin et al., 2008, p. 1056)
      
      *Probe:* For example - Supervising teacher/Peers/Lecturers/Tutors/Other

   iv. What feedback did you receive regarding your use of technology during your second professional experience? (Zeldin et al., 2008, p. 1056)
      
      *Probe:* How did this affect your use of Technology during your second professional experience?

   v. From your observations during your second professional experience, how are teachers currently using technology in their teaching?
      
      *Probe:* Why do you feel this is the case?
      *Probe:* How did this affect your use of Technology during your second professional experience?

   i. Did your use of technology in your previous career technology influence how you used technology during your second professional experience?
      
      *Probe:* Why was this the case?

2. The following questions are related to comparing your Practicum experiences:

   ii. How did your use of technology during your first professional experience influence how you used technology during your second (and final) professional experience?
      
      *Probe:* Why was this the case?

   iii. How would you describe your attitudes and beliefs about technology during your second professional experience compared to your first professional experience? (Zeldin, et al., 2008, p. 1056)
      
      *Probe:* Why was this the case?
      *Probe:* How did this affect your use of technology in your teaching?

   iv. How did the feedback you received on your use of technology during your second professional experience differ from your first professional experience?
      
      *Probe:* Why was this the case?
      *Probe:* How did this affect your use of technology in your teaching?
v. How would you compare teachers use of technology during your second professional experience to those teachers you observed during your first professional experience?
   *Probe:* Why do you feel this is the case?
   *Probe:* How would these observations influence your use of technology in your teaching?

3. The last remaining questions are concerning your future career as a beginning teacher:
   i. After completing two professional experience placements during your course, how do you feel this experience may influence your use of technology in your future teaching career?
      *Probe:* Why do you think this to be the case?
   ii. Do you feel how you used technology in your previous career will influence the way you will use technology in your future teaching career?
      *Probe:* Why do you think this to be the case?
      *Probe:* How do you think it will influence your teaching practice?
      *Probe:* How has your attitude changed since completing your first professional experience?

4. Is there anything else you would like to add about your previous occupational experiences using technology and how it may affect your teaching practice in the future?

**Concluding Script:**

*That is all the questions I have for you. Thank you for your patience and co-operation; I truly appreciate this.* All the information given to me today will be kept confidential. You will receive a copy of the transcript from this interview and be asked to validate that it is a true and accurate record of their responses given within the interview. *I will be in touch should anything come up for which I might need your expert views on, and I will be available should you need to contact me for any reason related to this interview. Thanks again for your participation in this research project.*

**Notes (adapted from Chandler & Reynolds, (2013)):**

1. The Interviewer/Principle investigator (xxxx) will follow the topic guide but allow the pace to be set by the interviewee. They will follow-up all general statements made by the respondent with a probe, particularly bearing in mind the purpose of the research.
2. The Interviewer/Principle investigator (xxxx) will follow the recommendations for seating position, asking good questions and demonstrate active listening.
3. The Interviewer/Principle investigator (xxxx) will make brief notes on their topic guide that notes down the main items discussed during the interview (this is useful if topics are covered in advance by the respondent and for the contact summary).
4. The Interviewer/Principle investigator (xxxx) will also write a summary of the context of the interview—the first page of the notes will be dedicated to this, with details of the immediate setting and atmosphere of the interview and of the surrounding people, activities and infrastructure.

5. When the topic guide questions are finished, the Interviewer/Interviewer/Principle investigator (xxxx) will ask for any additional comments the participant would like to give and remind them that all the information given will be kept confidential. These will be transcribed at the conclusion of the notes in quote for “Unsolicited reactions”.

6. The Interviewer/Principle investigator (xxxx) will advise the participant that they will receive a copy of the transcript from this interview and be asked to validate that it is a true and accurate record of their responses given within the interview.

7. The Interviewer/Principle investigator (xxxx) will assure them again of their promised confidentiality and give them any additional information necessary, then invite them to leave.

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