Career-changers' technology integration beliefs and practice in initial teacher education: A summative cross-case analysis.

Abstract

Fundamental to career-changers' successful transition into teaching is the design and delivery of post-graduate initial teacher education (ITE) programs. Career-changers enter teaching eager to share applied knowledge from prior occupations; however, support during ITE to facilitate the inclusion of these skills into teaching is often lacking. This study explored this phenomenon from a technology perspective and presents the outcomes of a cross-case analysis of four pre-service career-changers from an Australian university during ITE. Results indicated career-changers perceived their capacity to link existing technology skills to curricula depended on modelling and mentoring of technology integration during ITE subjects and school placements. School cultures combined with IT infrastructures also reportedly impacted technology practice. Recommendations to better support career-changers during ITE are discussed.

1. Introduction

For over half a century, extensive research has explored the phenomenon of career-change teachers to understand why they enter teaching, the qualities they bring to teaching, and how well they transition into the teaching profession (Clopton, 1967; Crow et al., 1990; Richardson & Watt, 2005; Varadharajan et al., 2021). Yet, we know little about the nature of the relationship between technology experience during prior occupations and career-changers' intentions to use technology in their future practice.

Literature has shown pre-service teachers entering ITE directly from secondary schooling (referred to in this study as traditional pre-service teachers), recognise the value of technology as a tool to engage and support students in their learning (Tondeur et al., 2017). However, despite growing up in an era where technology is omnipresent, empirical studies have shown technology is often under-utilised by pre-service teachers in their teaching practice (Batane & Ngwako, 2017). Current research continues to reinforce findings from earlier studies regarding the impact of external influences, such as access to resources, support, and training, and internal influences, including beliefs, confidence, and skills, on pre-service teachers' technology integration intentions (Anderson & Maninger, 2007; Fu, 2013; Ottenbreit-Leftwich et al., 2018). Justifications for limited incorporation of technology

often given by pre-service teachers include low levels of confidence due to minimal mentoring of technology use in classroom settings, together with little opportunities to master meaningful technology integration during professional (field) experience placements (Batane & Ngwako, 2017; Ottenbreit-Leftwich et al., 2018; Tondeur et al., 2017).

This study sought to understand whether experience using technology in previous occupations positively supported career-change teachers' confidence and ability to conceptualise and realise effective technology integration practice during ITE. For example, how do the internal and external influences that reportedly impact the technology integration of traditional pre-service teachers affect career-change pre-service teachers' beliefs and practice? In line with the criterion used by other researchers in this field, a career-change teacher is defined in this study as an individual aged 25 years or older who have chosen to switch professions after 2-5 years' experience within at least one other vocation. (Eifler & Potthoff, 1998; Tigchelaar et al., 2008; Varadharajan & Schuck, 2017). This paper reports on findings from a cross-case analysis that examined the technology integration practice and beliefs of four career-changer pre-service teachers from the commencement to the conclusion of ITE. The researchers aimed to present a contextualised understanding of the perceived influences that shape the technology integration practice from a career-change pre-service teacher perspective. We asked each of the four career-changers in our study to describe their technology experiences in prior occupations, lived experiences (at home), and experiences using technology during ITE (including professional (field) placements). Quantitative measures were used to support predominantly qualitative methodology to examine the perceived influences of each case's technology integration beliefs and practice during this time.

2. Background

2.1. What we know about career-changers

Recruitment initiatives and the fulfilment of deferred vocations has contributed to a steady increase in the number of individuals entering teaching through alternative pathways (Laming & Horne, 2013; Wilkins, 2017). Schemes such as Teach for Australia, Teach for America, and Teach First (UK) are examples of recruitment programs specifically targeting experienced professionals designed to fulfil teacher shortages (Ingersoll, Merrill, Stuckey, & Collins, 2018; UK Department for Education, 2018; Weldon, McMillan, Rowley, & McKenzie, 2013). Additional nuanced programs have emerged focused on enlisting experts

from science, technology, engineering, and mathematics (STEM) fields to mitigate critical shortages of educators in these subject areas (Baker, 2020; Foster, 2019; Marder et al., 2017).

The monikers often used to classify career-change teachers includes mature-age teachers (Etherington, 2011; Green, 2015), career switchers (Mayotte, 2003), non-traditional teachers (Crosswell & Beutel, 2017a; Eifler & Potthoff, 1998; Powell, 1992), second-career teachers (Chambers, 2002; Novak & Knowles, 1992; Tigchelaar et al., 2014), and career-change teachers (Beutel et al., 2019; Varadharajan & Schuck, 2017; Watters & Diezmann, 2015). This study chose to adopt the term career-changers to reflect the distinctive change of professions of the participants whose voices are represented in this paper.

Existing literature profiling career-changers highlight the skills and expertise garnered from both industry and personal experiences, and the value of these previous experiences as support mechanisms during their teaching. Lived experiences such as child-rearing and other general life experiences enable career-changers to bring valuable character traits to teaching, such as maturity and perspective (Rowston et al., 2021a; Eifler & Potthoff, 1998; Powers, 2002). Navigating the landscape of an ever-changing workplace equip career-changers with resilience (Crosswell & Beutel, 2017; Wilkins & Comber, 2015), coupled with autonomy and metacognitive traits such as self-regulation (Rowston et al., 2021b; Tigchelaar et al., 2008; Varadharajan & Schuck, 2017). Richardson and Watt (2005) believe career-changers "have the potential to enrich and diversify the profession by bringing their wealth of experience from other occupations into schools and classrooms" (p. 488). Likewise, Green's (2015) investigation posited the benefits those career-changers with trade/vocational experience offer to teaching.

Career-changers typically enter teaching proud of their achievements in previous roles and hence, enthusiastic about sharing their professional proficiencies (Rowston et al., 2021a, 2021b; Tigchelaar et al., 2008; Varadharajan & Schuck, 2017). Collectively, career-changers believe incorporating their experiences from prior professions will further enrich their teaching practice "as this adds meaning and context to classwork" (Green, 2015, p. 58). Career-changers deem the integration of such vignettes provide more prosperous and meaningful learning experiences and are "keen to share the 'outside world' or 'real-world' perspective with their students" (Varadharajan & Schuck, 2017, p. 90). However, limited recognition of their incumbent knowledge base, real-world experiences, and managerial skills during both ITE, and professional experience placements, can hamper career-changers capacity to successfully transition into teaching (Hamilton & O'Dwyer, 2018; Wilkins &

Comber, 2015). Findings from Varadharajan et al.'s (2020) study revealed that failure to acknowledge the knowledge and lived experiences of career-changers "can contribute to their disillusionment and consequent decision to leave the profession" (p.486).

Career-changers' initial pedagogical conceptions are influenced by child-rearing, prior occupations, initial schooling, and other environmental influences (Novak & Knowles, 1992; Powell, 1992; Tigchelaar et al., 2008). Studies have shown career-changers have a predilection to retain outdated pedagogical concepts that can hinder their ability adopt student-centred teaching practice (Tigchelaar et al., 2014; Watters & Diezmann, 2015). The term 'experienced novices' has been applied to recognise the wealth of professional experience career-changers bring to teaching, plus the limited pedagogical and behaviour management cognisance and beliefs they demonstrate (Beutel et al., 2019; Varadharajan et al., 2018; Watters & Diezmann, 2015a).

When examining the construct of teacher beliefs, Pajares' (1992) seminal research suggested pre-service teachers enter teaching with unrealistic confidence based on beliefs cultivated from self-serving bias surrounding their pedagogical perceptions. From a social cognitive perspective, Bandura (1996) attributes psychosocial factors (family and socio-economic status), academic efficacy, and goal aspirations to account for variances in academic beliefs and performance. From a teacher education perspective, investigations into this phenomenological relationship continue to report a compelling connection between beliefs and subsequent pedagogical practice of experienced and pre-service teachers alike (Lortie, 1975; Pajares, 1992; Tschannen-Moran & Hoy, 2007). The durability of pedagogical preconceptions appears to be considerable, given pre-service teachers often cite their own schooling experiences as influential on their initial pedagogical constructs (Fajet et al., 2005; Sheridan, 2016). For example, Koeppen & Griffith (2003) found many pre-service career-changers in their study defaulted to traditional teacher-directed practice as modelled during their schooling. Conversely, Tigchelaar and colleagues' (2008) applied Korthagen's (2004) 'onion model' to understand the influences on career-changers learning during the transition process into teaching. Their results showed the longer the time that had elapsed since career-changers own schooling experiences, the more "open to instructional innovation" they became (Tigchelaar et al., 2008 p. 1537).

The topic of career-changers has continued to pique researchers' interest due to the growing number of alternative teacher recruitment programs implemented to mitigate increasing teacher shortages. Over the past five years (2018-2022), investigations have continued to

examine the circumstances that motivate the decision to change careers (Akar, 2019), how career-changers navigate ITE programs (Varadharajan et al., 2020), what are the resilience and adaptive qualities of career-change teachers (Hamilton & O'Dwyer, (2018), and what are the transition and attrition rates of this cohort (Varadharajan et al., 2017). However, there is limited research investigating the technological skills career-changers bring from prior occupations, and the potential transference of these skills into their classroom practice. Earlier studies, such as Novak & Knowles (1992), explored the influence of life experiences on career-changers' transition into teaching. Their findings showed that using computers in previous roles fostered positive beliefs towards using computers in their future teaching (Novak & Knowles, 1992). Conversely, Mayotte's (2003) research found that second-career teachers could transfer competencies from prior roles to teaching. One participant cited greater confidence in using technology due to her previous career, but technology integration practice was not detailed. Of the 32 studies conducted during 2018-2022 that we reviewed, under 20% (6) examined teacher recruitment initiatives targeting Science, Technology, Engineering and Mathematics (STEM) professionals to fill teacher shortages in STEM disciplines. Of these STEM focused investigations, reference to the technology skills and technology integration practice of career-changers was absent. Therefore, the impetus for exploring this dimension further was driven by the increasing expectation for teachers to possess the skills to effectively embed technology in their teaching practice to future-proof students (OECD, 2020). More specifically, to understand if the technology skills garnered from industry facilitate career-changers with the ability to demonstrate meaningful technology integration practice.

2.2. Technology integration: what we know

The continued focus on technology integration in educational contexts stems from global, national, and local initiatives emphasising the importance of equipping students with collaborative, communication, creativity, and critical thinking competencies to live in the 21st Century (OECD, 2017). However, despite attempts made by key stakeholders, literature continues to show a disparity between technology integration agendas and actual technology integration practice (Makki et al., 2018; Vongkulluksn et al., 2018). Ertmer's (1999) seminal research sort to understand the relationship between the barriers that impede the technology integration practice of pre-service and in-service teachers. A key finding from Ertmer (1999) identified external barriers beyond a teacher's control, such as hardware provisions, training, and support, played a pivotal role in technology integration. However, internal barriers such

as knowledge, beliefs, attitudes, and confidence in using technology could still undermine practice even when external barriers were removed (Ertmer, 1999). Fast forward two decades, and the relationship between internal and external elements are still depicted as determinants of technology integration practice of both pre-service and experienced teachers alike (Backfisch et al., 2021; Howard et al., 2019; Tondeur et al., 2017).

Studies have shown the importance of confidence in using technology in educational contexts as a considerable influence on traditional pre-service teachers' technology integration goals (Tondeur et al., 2018). Likewise, modelling and mastery of technology play a significant role in generating confidence levels and realising said goals (Ottenbreit-Leftwich et al., 2018; Kiili et al., 2016; Tondeur et al., 2017). Thus, teacher-educators play a crucial role in developing pre-service teachers' technology integration cognisance and confidence during ITE (Tondeur et al., 2016, 2019; Uerz et al., 2018). ITE programs need to facilitate opportunities for pre-service teachers to experience exposure to technology-rich classrooms to build strong technology integration knowledge and self-efficacy (Ottenbreit-Leftwich et al., 2018). For example, opportunities to observe modelling of effective technology integration by experienced teachers during professional (field) experience can play a positive role in pre-service teachers' intentions to use technology (Nelson & Hawk, 2020; Ottenbreit-Leftwich et al., 2018; Tondeur et al., 2017). For pre-service teachers to develop meaningful technology integration practice, "they needed to see ML (meaningful learning) approaches used frequently by teachers who were skilled at teaching with technology" (Nelson & Hawk, 2020, p. 10). However, effective and meaningful technology integration intentions can also be impacted by external elements such as the reliability of information technology (IT) infrastructures during field experiences (Pareja Roblin et al., 2018), hardware provisions (Makki et al., 2018), support mechanisms (Ottenbreit-Leftwich et al., 2018), and school cultures (Gürfidan, H., & Koç, M., 2016; Makki et al., 2018). Such findings reinforce the need for ITE institutions to consider the apparent links between self-efficacy beliefs, technology integration competencies, and technology integration practice (Li et al., 2019; Makki et al., 2018; Tondeur et al., 2020).

Given the increased focus, complexity, and capabilities of technology tools and applications, this study builds upon Mayotte (2003) and Novak and Knowles' (1992) research to understand how experience using occupation-specific technology can affect career-changers' technology integration beliefs and practice. We sort to understand if the perceived internal and external influences affecting this group's technology integration beliefs and practice

reflect those impacting the technology integration of pre-service teachers who enter ITE through traditional routes. More specifically, how do environmental influences impact the long-term technology integration beliefs and practice of career-changers, given "ICT does not exist in isolation; it is interwoven with the rest of the environment" (Tondeur et al., 2018, p. 39). Therefore, this study sought to identify and contextualise the influences of technology integration beliefs and practice as perceived by four career-change pre-service teachers' during ITE. The following research question helped to guide the investigation of this phenomenon:

> How do career-change pre-service teachers perceive personal, behavioural, and environmental determinants to influence their technology integration beliefs and practice during ITE?

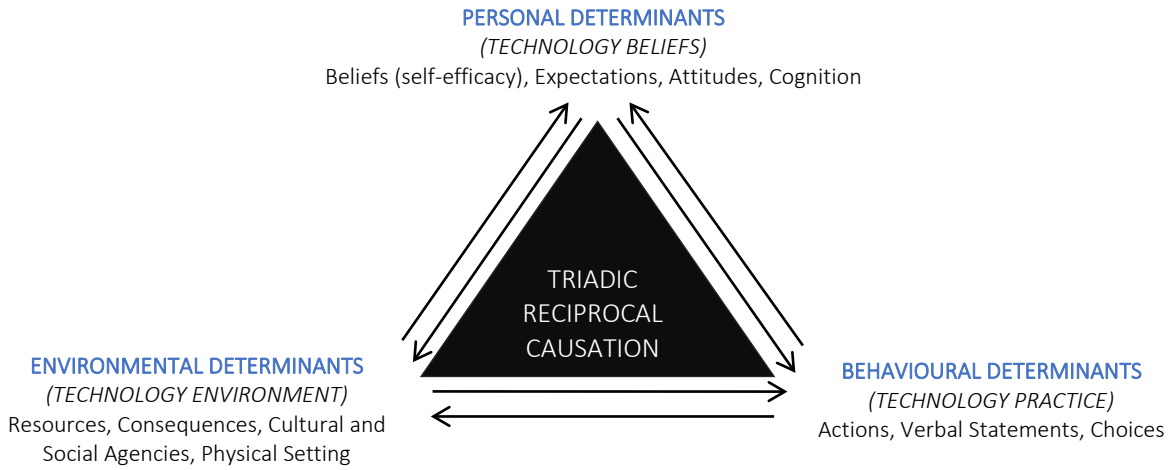
3. Conceptual Framework

The key tenets within Bandura's (1978) theory of reciprocal determinism were applied to the conceptual framework of this study to explore each participant's personal, behavioural, and environmental backgrounds to understand and contextualise the technology integration beliefs and practice of each case. Reciprocal determinism depicts the relationship between personal, behavioural, and environmental influences that accounts for an individual's beliefs and choices of action (Bandura, 1986). Bandura (1978) defines the term determinism to show behaviour is not simply a reaction to external elements, rather the result of a complex interaction between environmental transactions, cognitive perceptions of these external stimulations that in turn shape future goals and behavioural choices. The nature of the reciprocity between these three determinants is not always equal. How each determinant interacts can influence self-efficacy: an individual's assessment of their capacity to successfully perform in a specific domain (Bandura, 1997). Self-efficacy beliefs can shape goals and actions due to their ability to generate outcome expectations: how an individual forecasts the success of future endeavours. High levels of self-efficacy can foster positive outcomes expectations that can sustain choices of action and future goals. Conversely, low levels of self-efficacy can inhibit behaviour and limit future goal setting.

Both self-efficacy and triadic reciprocal determinism are key theoretical tenants within Bandura's social cognitive meta-theory. The core premise of social cognitive theory is the notion of human agency, whereby an individual's beliefs and behaviour are determined by inherent characteristic traits, including the capacity to self-regulate, self-reflect, self-organise and be proactive (Bandura, 2006b). Adoption of reciprocal determinism within the

conceptual framework of this study is better suited to enable a contextualised analysis of intrinsic (personal) and extrinsic (environmental) influences on career-changers' technology integration practice (behaviour) (see Figure 2).

Figure 1. Conceptual Framework grounded in Bandura's (1986) triadic reciprocal causation model.



Teacher beliefs are intrinsic influences on outcome expectations, goal setting, self-initiative, and perseverance that determine technology integration practice (Ottenbreit-Leftwich et al., 2018; Sadaf et al., 2016). Integral to the formation of pre-service teachers' technology integration beliefs are environmental influences such as modelling and mentoring provisions during ITE and professional experience placements, ITE technology integration policies, teacher educators' technology capabilities, and access to IT resources (Tondeur et al., 2020). In addition, behavioural influences, such as mastery experiences using technology in educational contexts, can also influence pre-service teachers' attitudes and beliefs towards integrating technology in their practice (Sang et al., 2010).

The importance of context in achieving effective technology pedagogy cognisance was formally acknowledged by Koehler & Mishra (2008) through the addition of contextual factors within their technology pedagogy content knowledge (TPACK) framework. The concept of multifaceted influences such as systems, theory, and ITE institutions upon pre-service teachers' technology integration is further reflected within Tondeur and colleagues' (2012) Synthesis of Qualitative Data (SQD) model. Moreover, Porras-Hernández & Salinas-Amescua's (2013) modification of Mishra and Koehler's (2006) TPACK model illustrates a differentiated understanding of micro, meso, and macro contextual influences on technology pedagogy practice. Therefore, the principles of reciprocal determinism were applied in this study to contextualise the environmental, personal, and behavioural influences of technology

integration beliefs and practice during ITE as reported by the four career-changers in this study.

4. Methodology

This paper details the findings of a summative cross-case analysis of four career-changers who participated in a larger three-phase case study research project that examined the technology integration beliefs and practice of 146 students enrolled in a 1-year or 2-year post-graduate ITE program at one Australian university (see Table 1) (Rowston et al., 2016). In Australia, those career-changers seeking accreditation to teach through non-traditional routes are required to complete an ITE program via post-graduate pathways (Australian Institute for Teaching and School Leadership (AITSL), 2017). The term post-graduate denotes a student awarded an undergraduate degree who is completing further study within a higher tertiary course. All Australian ITE programs incorporate professional experience placements to foster an authentic praxis between theory and practice (AITSL, 2015). Matriculation is dependent upon demonstrating competency within the following domains of the Australian Professional Standards for Teachers: Professional Knowledge, Professional Practice and Professional Engagement (AITSL, 2017).

The motivations for researchers to conduct cross-case analysis is varied. Cross-case analysis can facilitate the delineation of how factors may combine to affect the outcomes of one case compared to another (Khan & Van Wynsberghe, 2008), deepen understanding and explanation (Miles, et al., 2014), test theoretical frameworks (Eckstein, 2002), highlight relationships between discreet cases, and refine and provide new concepts from the original case (Ragin, 2004). The cross-case analysis reported in this paper combined case-oriented and variable-orientated approaches using the data collected from the larger research project to provide a contextualised examination and comparison of the perceived influences on technology integration beliefs and practice of the four career-changers selected from the broader group.

All four participants were enrolled in an ITE (Secondary) program. Georgie and Erin were chosen as they share the same teaching discipline focus: Visual Arts; likewise, Rick and David were both training to teach within the Humanities and Business Studies subject areas. The similarities between each case provided greater opportunities to compare the technology integration approaches in secondary schools of career-changers teaching within the same subject (discipline) area. The almost 20-year age difference of participants provided the opportunity to compare the perceived influence of lived experiences (personal and

professional) on technology integration beliefs and practice. Cross-case analysis was supported through the application of Bandura's (1978) theory of reciprocal determinism to examine the relationships between each of the perceived influences through a social cognitive lens. To examine 'real-life' behaviour in context, Yin (2014) advocates a replication strategy whereby the use of case-study methodology in data collection and subsequent analysis is guided by a theoretical perspective.

4.1. Instruments and data collection

The findings from the cross-case analysis presented in this paper drew upon data from the larger research case study; therefore, the data collection methodology of the original study will be briefly detailed. The larger study adopted sequential explanatory research methodology to identify and rationalise the elements that influence technology integration beliefs and practice as perceived by the participants (Bass et al., 2018). Three data collection phases employed a combination of quantitative and qualitative measures to examine the evolution of participant's technology integration during ITE. These three phases are briefly detailed below.

Phase 1 of larger study

Data collection for Phase 1 involved a quantitative measurement survey administered at the commencement of the ITE course. This survey was designed to collect demographic data to identify previous occupations and technology experiences. Two scales were included in the survey to capture and investigate general technology self-efficacy beliefs (Teo & Koh, 2010), and technology integration (pedagogy) self-efficacy beliefs (Wang, Ertmer, & Newby, 2004). To support criterion sampling, quantitative data collection preceded qualitative methodology. This process facilitated the development of a participant selection matrix. This matrix was used to identify and invite participants aged 25 years or older, with 2-5 years' experience within another vocation, to participate in the remaining qualitative phases of this study. Of the career-changers identified using this criterion, 19 agreed to participate in the subsequent phases of the larger study. The four cases reported in this paper were select from the 19 participants.

Phase 2 and 3 of larger study

The second and third data-collection methods during Phases 2 & 3 of the larger study were predominantly qualitative in design, and included semi-structured interviews conducted after

the two professional experience placements. Semi-structured interviews were designed to explore the perceived effect of occupation-specific technology experiences and ITE upon technology integration beliefs and practice during professional experience placements. Both series of interview protocols adopted in Phases 2 and 3 incorporated focus questions aligned with the key tenets of reciprocal determinism. Questions were designed to guide the exploration of technology practice, for example: *What were your experiences using technology in your previous occupation/s?* Technology beliefs and attitudes using technology during ITE (including professional experience) were ascertained through questions such as: *How did you feel using technology during PE2?* Together with questions to identify the influence of technology environments, for example: *Did your use of technology in your previous career technology influenced how you used technology during Professional Experience?* Probes were embedded to elicit richer details and responses from participants. The duration of each interview typically ranged between 45-60 minutes. The semi-structured interviews were digitally recorded and stored in an encrypted cloud-based storage facility. Each interview was transcribed verbatim to ensure the participant's response was accurately captured. In addition, the participants received a copy of the transcript from each interview to review and validate the accuracy of their responses. The third and final data collection point (Phase 3) also incorporated quantitative data to measure changes to technology integration self-efficacy beliefs by re-administering Wang and colleagues' (2004) 16-item, single-factor measure after ITE.

Maxwell (2010) endorses the use of quantitative data to complement qualitative information and notes how the inclusion of numbers contributes to internal generalisability of a study. For Maxwell (2010), the term internal generalisability does not imply transferability, rather 'generalisation within the setting or collection of individuals studied' (p.478). In this instance, the inclusion of quantitative data provided an internal generalisation of findings from the 146 participants in the larger study, including the four career-changers involved in this summative research cross-case analysis. The adoption of a predominantly qualitative framework facilitated the examination of the valuable and authentic individual acuities of each case in both the broader and summative cross-case analysis (Miles & Huberman, 1994).

Table 1. Participant Demographics

Name [a]	Age [b]	Gender	Qualifications	Prior Occupation	Technology Experience	Teacher-Training Program	Technology Self-Efficacy 1 [c] M=3.86	Technology Self-Efficacy [d] M=4.43
Georgie	48	Female	BDes; Grad Cert. Adult Ed	Artist & Vocational Educator	MS Word®, MS PowerPoint® Adobe Illustrator®, Adobe Photoshop®	MTeach (Secondary: Visual Arts)	4.31	4.81
Rick	37	Male	BArts	Accountant	MS Excel®, MS PowerPoint® MS Word®, Database software	GradDipEd (Secondary: Humanities and Religious Studies)	3.88	4.19
David	32	Male	BArts, MHis	Accountant	MS Excel®, MS PowerPoint® Database software	GradDipEd (Secondary: Humanities and Business Studies)	3.56	4.06
Erin	29	Female	BVArts	Art Collections Manager	Adobe Illustrator®, Adobe Photoshop®, CAD, MS Office®	GradDipEd (Secondary: Visual Arts)	3.69	4.69

Key: (*a*) Pseudonyms have been assigned to all participants in this study
(*b*) Table is ordered by the age of participants
(*c*) Mean result from technology integration self-efficacy scale (Wang et al., 2004) at the commencement of ITE
(*d*) Mean result from technology integration self-efficacy scale (Wang et al., 2004) after ITE

4.2. Data analysis

The cross-case analysis presented in this paper examined the similarities and differences between the technology integration beliefs and practice as reported by the four cases in this study (Miles et al., 2014). The inclusion of multiple cases facilitates a contextualised understanding and explanation of the phenomenon under investigation (Baxter & Jack, 2008; Miles et al., 2014; Yin, 2014). Bandura's (1978) theory of reciprocal determinism supported the examination the relationships between each of the perceived influences through a social cognitive lens. To examine 'real-life' behaviour in context, Yin (2014) advocates a replication strategy whereby the use of case-study methodology in data collection and subsequent analysis is guided by a theoretical perspective. A combination of case-orientated and variable orientation analysis strategies was adopted. The case-orientated approach allowed for the creation and comparison of biographical profiles (including prior occupational experiences), and variable-orientated methods facilitated identifying themes aligning with the conceptual framework to highlight interrelationships and broader patterns (Miles et al., 2014).

The unit of analysis was semantically homogenous comments from pre-service teachers in this study. A codebook was created to enable consistent thematic analysis of transcripts from the semi-structured interviews conducted at both data collection points (Saldana, 2009). When analysing the transcriptions from Phases 2 and 3, a combination of inductive and deductive methods was adopted to examine the relationship and influence of personal, behavioural, and environmental elements upon technology integration and practice (Miles et al., 2014). A deductive approach supported explanatory case-study methodology (Yin, 2009). Four broad code categories were conceived a priori aligning with the conceptual framework: technology self-efficacy beliefs, technology integration beliefs, technology integration practice and technology integration environments (see Table 2). Inductive methods were also applied to create data-driven coding and thematic analysis of each transcript (see Table 3). These inductive codes emerged from repeated engagement with the transcripts over three iterations to refine and confirm the emergent coding categories. Semantic rather than grammatical boundaries were used to delineate the units of analysis. This method enabled the thematic grouping of contiguous pre-service teacher comments that related to the same theme.

Table 2. Codes conceived a priori aligned to the conceptual framework

Code	Sub Code
Sources of Self-efficacy Examples of sources contributing to the development of participant's technology self-efficacy beliefs during previous occupations, personal use, ITE and/or PE placements.	Mastery *Successful or unsuccessful experiences participants have had using technology* Vicarious Experience *Successful or unsuccessful experiences participants have witnessed others using technology* Verbal Commentary *Positive or negative feedback participants have received from superiors/experts using technology* Physiological Reactions *Types of physical feelings participants have using technology and their responses.*
Technology Beliefs Participant beliefs of their ability to use technology personally, in prior occupations, during ITE and/or completing PE placements. This factor incorporates resources, consequences and physical settings.	Beliefs/Cognition (process of knowing/perception) *What the individual believes they know about technology* Expectations/Goals *Goals or aspirations of the participant regarding technology* Attitude/Affective (Expressing emotion) *How the participants feel emotionally when using technology* Physical: Biological and Physiological *How the participants feel physically when using technology*
Technology Practice The participant's behaviour using technology personally, in prior occupations, during ITE and/or completing PE placements. This factor incorporates Social Interactions, Motor responses and Verbal responses.	Actions *Evidence of how technology was used* Choices *Examples of choices made by participants regarding technology* Verbal Statements *Statements made by participants regarding their behaviour using technology* Self-Regulation *Evidence of the participant's demonstration to apply self-regulation to learn technological skills*
Technology Environments The types of environmental settings where participants' have used technology: personally, in prior occupations, during ITE or completing PE placements. This factor incorporates resources, consequences and physical settings.	Resources *The technological resources available to participants.* Consequences *Consequences experienced by the participants using technology.* Physical Setting *Physical environments using technology.*

Table 3. Emerging themes relating to career-changers' technology integration beliefs and practice

Category	Description
Confidence using technology	Personal interest, mastery, and vicarious observations: family, peers, teacher educators
Value of technology	Personal use, previous occupation, modelling and mentoring during ITE, school cultures
Pedagogy beliefs	Prior education, ITE: educational studies units and modelling, PE placements
Personal antecedents	Lived experiences, family backgrounds, relationships
Workplace environments	Expectations, culture, technology resources, role responsibilities
Metacognitive skills	Self-Regulation, problem-solving, self-reliant, self-assured
Technology use during ITE	Peers, Assessments, Support, mastery opportunities
School cultures during PE	Technology initiatives, whole school attitudes towards technology
IT infrastructures	Reliability, accessibility, support
Impact of mentoring	Attitudes, likelihood of integrating technology, type of technology integrated into PE, goals

Further analysis highlighted the links between themes identified inductively to theoretical concepts present within reciprocal determinism. The pre-and post-technology integration self-efficacy scores were triangulated with findings from the cross-case analysis of narratives using the transcripts from Phases 2 and 3 semi-structured interviews. The triangulation of this data allowed a richer, contextualised understanding of the influences that shaped the technology integration beliefs and practice of the four career-changers' in this study (Yin, 2009). The data analysis software package NVivo 11.4 was used to code and analyse all qualitative data.

Approval to conduct this study was granted by the Human Research Ethics Committee from the participating university. All participants received a written explanation regarding the focus of this study before seeking written informed consent. The survey completed during Phase 1 was distributed by an academic employed at the university but not involved in this study to mitigate any possibility of coercion. Adopting pseudonyms for each participant preserved anonymity and confidentiality of responses as per ethical research conventions (Crow & Wiles, 2008).

5. Results

The narratives from four cases (Georgia, Erin, David, and Rick) are reported to present the key themes from this study. The results of this study are presented in three subsections. Subsection 5.1 includes a concise synopsis introducing each of the four cases. Subsection 5.2 presents a comparison of the reported technology integration beliefs of each case throughout ITE. Finally, Subsection 5.3 examines how each case perceived previous occupations, ITE and professional experience placements to influence their technology integration practice during ITE.

5.1. Case backgrounds

Georgie

Georgie was the oldest participant in the study, with an undergraduate degree in Design (1989) and a post-graduate certificate in Vocational Teacher Education. Georgie had developed extensive skills using sophisticated graphic design applications as a freelance graphic designer. Georgie is a confessed technology enthusiast despite the minimal technology available during her undergraduate Design degree: *"We only had two computers in the whole place. All I had to do was re-train myself to apply what I already knew to a new format using graphic programs."* She lives with her husband and three children who share a

collective interest in technology: *"We have a family room which comes off the kitchen. It kind of looks like NASA mission control with four PCs and three laptops*."

Erin

Erin has worked in the Arts and Design field as an Art Collection Gallery manager for eight years. Erin's background in Design shared similarities to Georgie's, graduating with a Bachelor of Visual Arts (BVA) in 2007. However, given the almost 20-year age gap, what differentiated Erin's undergraduate degree from Georgie's program was the inclusion of digital media tools such as the Adobe Creative Suite® including Adobe Photoshop®, Adobe Illustrator® and Adobe InDesign®. Erin's role as an Art Collection manager involved using administrative software tools to curate exhibitions, manage artwork databases, create presentations, plus using graphic design applications:

> *Working in art galleries, you had to be really versatile in that [technology]. I used all my design skills from my Visual Art Design course to do website updates, taking photographs to go online, and using databases to store all the works.*

Workplace experiences had fostered a self-regulatory attitude towards using technology: *"You couldn't really say I don't know how to use that [technology]. The expectation was to train yourself."*

David

David worked as an accountant in the Insurance industry for seven years. He has an undergraduate degree in Modern History and a post-graduate degree in Ancient History. As an accountant within the insurance sector for six years, David became proficient in using the administrative applications within Microsoft Office® and an industry-specific database management system. As his career progressed, David began using the tools within the Microsoft Office® suite; predominantly Microsoft Excel® for maintaining spreadsheets and Microsoft PowerPoint® for designing and delivering presentations. David's assessment of his skills using those tools was basic, perceiving the expertise of his peers to be much greater than his: *"I'd say I'm a beginner using Excel®, PowerPoint® and also Word®. Some people have an unbelievable skill using technology, but I wouldn't say that was me."* On a personal level, David assessed his technological capabilities as average: *"Overall technology, I would say … like I'm kind of intermediate."*

Rick

Rick entered ITE with a Bachelor of Arts (History), and for the past 12 years, Rick has worked in finance for various companies. Working within the financial sector had given Rick an appreciation for the convenience and value of technology: *"I couldn't have done my other job without technology. I would hate to be an accountant in the old days where they had ledgers."* Fulfilment of workplace expectations, together with financial constraints, motivated mastery of industry-specific technology tools to expedite processes: *"I used to have no time to do things and all these deadlines. I always used to go and play with Excel and stuff and see if there's certain features, I can do something in a quicker way."* Like Erin and Georgie, Rick regularly uses technology personally, including social media, plus online communication applications to chat with family abroad. Rick attributed his future goals to master additional software tools to his interest in technology and desire to embark on a more creative career: *"The accounting job wasn't very creative, whereas you've got more scope for creativity now in teaching."*

5.2. Technology integration self-efficacy beliefs and confidence during ITE

Pre-test technology integration self-efficacy (TISE) scores indicated all four participants felt moderately confident using technology in their teaching practice. At the completion of ITE, a positive increase in technology integration self-efficacy scores for all cases aligned with reported technology integration goals as beginning teachers (see Table 1). Samples of reported influences and changes to participants technology integration beliefs are presented in Table 4.

Table 4: Samples of reported influences and changes to participants technology integration beliefs during PE1 and PE2

	Case	PE1: Technology integration beliefs	PE2: Technology integration beliefs
Attitudes	David	*"You need technology to kind of show the kids that this [content] is useful."*	*"In my first prac [PE1], I thought you had to be teaching every minute. This time I got the students to do the work. That's actually good for them as well."*
	Rick	*"I know PowerPoint's good, but I don't want it to be every lesson; it's just the PowerPoint slides we go through."*	*"In terms of feelings and the second prac [PE2], it was quite exciting in terms of there was more potential for what [technology] they [students] could use."*
Technology confidence:	Georgie	*"I think there's some influence from my previous use of technology 'cause I wasn't particularly afraid of it."*	*"Only thing to hold me back from using technology is if the teachers weren't keen."*
	Erin	*"I do feel a lot more confident as a teacher to use technology because it's just constantly been there in my life."*	*"I felt more confident because I did have at least a little bit of experience, and then I always made sure I'd check devices before then."*
Resilience	Georgie	*"I can do this. I kind of have got that sort of attitude to it."*	*"I guess not going to be scared of it [technology] and be generous with sharing your resources."*
	Rick	*"You can sort of get through, and if something breaks, it's actually not as bad as it seemed."*	*"there were some IT issues. I was able to get on to them. That didn't seem to be a problem at all."*
Prior Occupation	David	*"Just because I would've used technology, it gave me more confidence."*	*"I'm going to use the computer for the problems that we use like Excel for."*
	Erin	*"It was good to have industry skills in programs, and meshing the two just makes everything authentic."*	"*Explaining how Visual Arts isn't what they think it is. You can apply it in any field."*
Teacher-educators	Georgie	*"Both good and bad, it's a bit static and boring."*	*" for one assignment, we had to design an [online] education kit for an art gallery."*
	Erin	*"In University saying technology's a great way to kind of get students motivated and invested in the subject."*	*"it was very strange that huge focus on discipline from the university mentor."*
Supervising teacher	David	*"I suppose him [supervisor] not being good and brilliant at technology meant I wasn't being guided."*	*"The supervising teacher said you haven't done a research lesson; let's do that."*
	Georgie	"*She did the same thing [using technology] as me. She'd get me somewhere and push me to the next thing. It was great."*	*"I was more waiting to see the way the teachers there did it. I didn't want to come in going; this is the way I do it. I think I'm just wary of stepping on toes."*
School Culture	David	*"It looks like they are trying to get that way with technology, but they're not there yet."*	*"knowing that the students all had laptops was a massive thing."*
	Rick	*"I think some of them were a little bit out of their depth with it."*	"*The [school] culture seemed to be a bit more tech orientated."*

Georgie's TISE pre-test score reflected her confidence and commitment to using technology at the commencement of ITE: *"I've become less closed-minded. Like child rearing and many things, I've sort of been able to gather in my life. I feel like that you can teach an old dog new tricks. I'm willing to learn this, and I can."* Her post-test TISE score further reinforced the strength and resilience of Georgie's self-efficacy beliefs during ITE and in her future teaching practice. Likewise, Erin's pre-test TSIE mean score mirrored perceptions of her capacity to integrate technology into the classroom: *"I did have like a design background, and I was like trained in [technology] first. And then that kind of builds your confidence, and then you build your skill level over time."* Erin's post-test TISE score paralleled her increased

confidence to integrate technology into her teaching practice since commencing ITE effectively.

David perceived his technological capabilities as moderate at the commencement of ITE. This self-assessment was reflected in his pre-test TISE mean scores: *"Overall, technology [skills], I would say I'm kind of intermediate. I wouldn't play computer games or anything like that; I'm just like pretty much everyone else."* David's post-test TISE score indicated heightened confidence to integrate technology since commencing ITE and reflected his reported positive experience using technology during PE2. Rick had espoused similar levels of confidence using technology at the commencement of ITE as Georgie. However, like Erin, this initial self-confidence to use technology invariably translate into moderate self-efficacy technology integration levels. Rick's post-test TISE score depicted an increase in self-efficacy and reflected Rick's confidence and future technology integration goals: "*I would be placing a lot of emphasis on technology by the time I was in my second or third year of teaching. I would try and imbed it as much as possible in my lessons because it makes things so interesting."*

5.3. Technology Integration - Environment, Beliefs and Practice during ITE

The technology integration practice of all four cases during their final placement (PE2) was compared to the technology integration adopted during PE1 to identify the perceived influences differentiating the practice of each participant (see Table 5). The inclusion of occupation-specific technology skills was varied and dependent upon each participant's capacity to form tangible links between the application/skill and the subject content. Participants reported the modelling and mentoring provided by supervising teachers during placement played an important role in their technology integration beliefs, pedagogical practice, and their capacity to link prior experiences using technology in industry to curricula. The reliability of IT infrastructures and availability of hardware provisions also influenced confidence and influenced technology selection and pedagogical preferences. The connection between the environment, technology integration beliefs and technology integration practice for each case during ITE reflected a dynamic reciprocal relationship between these three elements. The environmental determinants identified from the data will serve as a framework to scaffold and contextualise the findings of each narrative. This relativist approach supports explanatory research (Yin, 2014) by providing a coherent and meaningful exploration of the relationship between the environment, beliefs, and behaviour of career-changers during ITE

from a technology integration standpoint. Our preference to adopt a predominantly qualitative approach has facilitated a richer, authentic, and meaningful investigation of this phenomenon.

Table 5: Samples of reported influences and changes to participants technology integration practice during PE1 and PE2

	Case	PE1: Technology integration practice	PE2: Technology integration practice
Prior Occupations	Georgie	*"the way I teach art combines the physical and bringing the outside world into art."*	*"my graphic design background slotted very comfortably into this Pop Art unit."*
	Erin	*"It was good being able to tell the kids I had a design background; there's a job related to this [technology]."*	*"I was trying to get them to get into that mindset of you're not just an artist all the time, you can be a designer, an engineer, an animator."*
Teacher educators	David	*"From the lecture, I started using Webspiration. It's a mindmap."*	*"about engaging students, you can engage them in different ways, and technology isn't the be-all."*
	Erin	*"We learnt about creating word clouds, and I used it for a PowerPoint I did on Aboriginal Art education."*	*"I got to practically apply what I'd learnt at Uni [university]. I did a mixture of technology and visual arts."*
Students feedback	Georgie	*"I enjoy it [technology], kids enjoy it [technology], and it's entertaining."*	*"They really liked the worksheets, and they really liked the PowerPoint slides I did."*
	Rick	*"It [Google Map] was a good activity. They [students] were very engaged."*	*"They know how to use iMovie. I explained the task, and they got on with it*
Supervising teacher	Erin	*"My first lesson, the video and PowerPoint failed, and she's [supervising teacher] like do it again. So, she stayed with me, and we went through it to make sure it worked."*	*"PowerPoint use was quite huge. makes me want to get into a classroom do a mixture of electronic art and traditional art."*
	Rick	*"My supervisor's old school, he enjoyed them [students] taking things [writing] off the board. I did a bit to please him."*	*"My supervising teacher was teaching using a website for all the lessons on it, and they [students] go to the website."*
IT infrastructure	David	*"The first class I used Edmodo and the internet wasn't working, so from then on it was mainly PowerPoint."*	*"Do your lesson plan with technology but then have almost 20 minutes, so if it doesn't work, we can substitute it."*
	Rick	*"I couldn't use my own laptop; kids had either iPads or laptops. The ones with iPads couldn't edit the Google Map."*	*"I saw it [technology] was working really well. In planning lessons, I had a more technology than the first prac [PE1]."*
School IT focus	Georgie	*"They were pretty good at it [technology]. It was a school-wide sort of initiative."*	*"The teachers I worked within the second prac [PE2] wrote things on the board. They weren't as specific [using technology]."*
	David	*"A lot of teachers were older. They were using technology but not like we've been told."*	*"Generally, it wasn't about technology; it was more about the teaching [pedagogy]."*

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

All cases entered ITE with some form of technology-based skills garnered from prior occupations. Experiences varied from generic administrative technology applications such as Microsoft Office®, to industry-specific technology tools and applications including graphic tools and databases. The perceived currency and applicability of technology skills from prior occupations to teaching during PE placements were influenced by a combination of feedback and mentoring provided by supervising teachers, and participants own self-assessment. For example, Erin entered ITE believing her skills using graphic design software would be valuable and applicable for integration in her future teaching career. Fortunately, Erin's supervising teacher in PE1 shared a similar industry background and encouraged Erin to

integrate her skills using digital graphic software from previous roles, further reconfirming the viability of these skills. Whereas for Georgie, despite the accessibility and applicability of the same graphical tools during both placements, these applications were not incorporated into her teaching but rather perceived as tools to enhance the creativity of her teaching resources: *"When I did all the worksheets and the PowerPoints, they were very heavily influenced by my graphic design background."* This approach could also be attributed to the perceived limited digital technology skill levels of supervising teachers during both PE placements: "*they weren't even that sure how to connect the laptop up to the projector and stuff."* The other influence preventing Georgie from incorporating these tools in her practice could be her inherent mindfulness of industry protocols from previous roles*: "I think maturity in general, not coming in to try and feel like I know better than they do, or more than they do. I think it's a business skill."*

For Rick, fulfilment of workplace expectations, together with financial constraints, motivated mastery of industry-specific technology tools to expedite processes. This practice was replicated through Rick's attempts to streamline administrative processes during PE placements: *"My other motivation to use tech all the time was to save time".* Unlike Georgie, Rick's experience using presentations in his previous role promoted reticence to depend on MS PowerPoint® in his teaching: *"I was always very cautious in my previous job when I was presenting things, not to have PowerPoints® and you just read them out. I want to be more creative with things."*

Prior workplace expectations had facilitated all participants with self-regulatory approaches towards learning and using technology. David attributed his resilience to deal with technical issues during PE placements to his use of technology as an accountant: *"even like just the pitfalls of it [technology] and you're kind of better able to cope like, just for stupid things like data is going a bit slow."* Enacted mastery of technology in previous roles, and self-regulatory approaches towards learning new technology supported problem-solving capabilities and self-beliefs to overcome technical issues experienced during PE placements: *"I'll always have those past experiences influence me. You do have the confidence and exposure. You rely on that anytime you use technology. (Erin)."* Rick recognised his experiences in industry had provided perspective and flexibility towards learning new technology tools or issues encountered during teaching: *"I wouldn't give up quickly on it [technology] because you kind of get those sort of learning stages in most jobs. And you can sort of get through, and it actually isn't as bad as it seemed at that time."*

5.3.2 The influence of ITE

There were commonalities in participants perceptions of how technology was incorporated during ITE. Using technology in ITE subjects had reported limited influence on planned technology integration during PE placements: "*See, I'm not sure if they influenced me, or I was going to just use it [technology] that way anyway* (David)." The disparity between technology integration expectations and the technology pedagogy modelled in curriculum and educational studies coursework subjects throughout ITE was reported by all participants. Regular observations of teacher-educators demonstrating technology integration to support transmissive, teacher-directed pedagogy were commonplace and perceived as less worthwhile: *"I did see a lot of PowerPoint® and usual things like that but nothing beyond that. Nothing ground-breaking (Rick)."* The regular inclusion of presentation-style assessment tasks within coursework subjects reinforced the value of incorporating applications such as PowerPoint® & Prezi® to support teacher-directed pedagogy: "*I'm much better at presentations since I've been at Uni. I've learnt a lot more about presentation software (Georgie)."* However, when present, the effective modelling and mentoring of technology use by teacher educators were recognised, with attempts to integrate modelled use into practice during placements: *"The [assessment] task using Google Classroom® was the one where I actually got to learn a few new things, that was good. I got to use some of those in prac [PE2] as well (Rick)"; "I'd say learning about Twitter would've helped. I'm getting more stuff from Twitter (David)."*

5.3.3 The influence of professional experience

All four cases cited professional experience placements as having a considerable impact on technology integration attitudes, goals, and practice. In addition, there was a similarity between the influences impacting the realisation of espoused technology integration beliefs during placements. These influences included whole-school cultures, IT infrastructures, the technological expertise of supervising teachers, and mentoring provisions.

Significant environmental influences shaping technology integration practice were IT infrastructure, hardware accessibility, reliability, and technical support. For example, both Erin and David completed PE1 at a school with unreliable networks: *"the video didn't work, the PowerPoint® wouldn't work. I thought this is why so many people just go forget it. I'm going back to like traditional methods (Erin)"; "I wasn't one hundred percent trustful of it [technology]. I was there for twenty-two days, and let's say at least six days there were*

problems (David)." For Rick, hardware accessibility issues during PE1 impacted planned technology integration practice: *"I didn't want to have half the class being able to do it, and the other ones just sitting there (Rick)."* Rick also observed a disenfranchised school culture towards technology during PE1, and reported limited opportunities to master technology, observe modelling, or receive mentoring of effective technology integration practice: "*In my school, the teachers were resentful of it a little bit."* Likewise, David observed the use of technology by teachers during PE1 as a gap filler rather than to enhance learning: *"They paired up students with laptops and so then the class was going through looking up stuff. It was more just a case of let them go, and we'll get to the bell."* However, despite the technical issues Erin encountered during PE1, her supervising teacher's encouragement, combined with shared technology skills and goals, supported Erin's plans to integrate her expertise from industry to foster meaningful, real-world learning experiences: *"I'd tell them I did graphic design, there are other things you can get into other than art - it's more about creative problem solving rather than straight-out visual arts."*

The completion of PE2 in schools with a collective focus on technology integration fostered a shift in pedagogical approaches for both Rick and David. The collective optimism, reliability of technology resources, and successful technology integration demonstrated by staff during PE2 served to extend Rick's use of technology throughout this placement: "*It was obvious that technology had a high priority, so that obviously influenced me. They [teachers] were using it all the time, and it was working, that has given me the motivation to use it."* In addition, Rick's implementation of technology to support project-based learning activities during PE2 was influence by observing constructivist, technology pedagogy practice modelled by his supervising teacher: *"I gave the students a PBL [project-based learning] task creating a movie trailer, and they could come up with whatever they wanted."* Similarly, the school where David completed his second placement had a strong focus on constructivist learning. The modelling of PBL practice by his supervising teacher reinforced the value of this pedagogical approach: *"I was going into her class, and she'd teach for a bit and then she'd get them to do some research and I suppose that kind of helped me thinking, oh I don't have to be teaching the whole time*." Mentoring provisions further shifted David's beliefs towards integrating technology to support student-centred activities: "*My supervising teacher [was] telling me, you know we can use more technology, you can definitely do it. Then looking at her and how she was using it [technology]."*

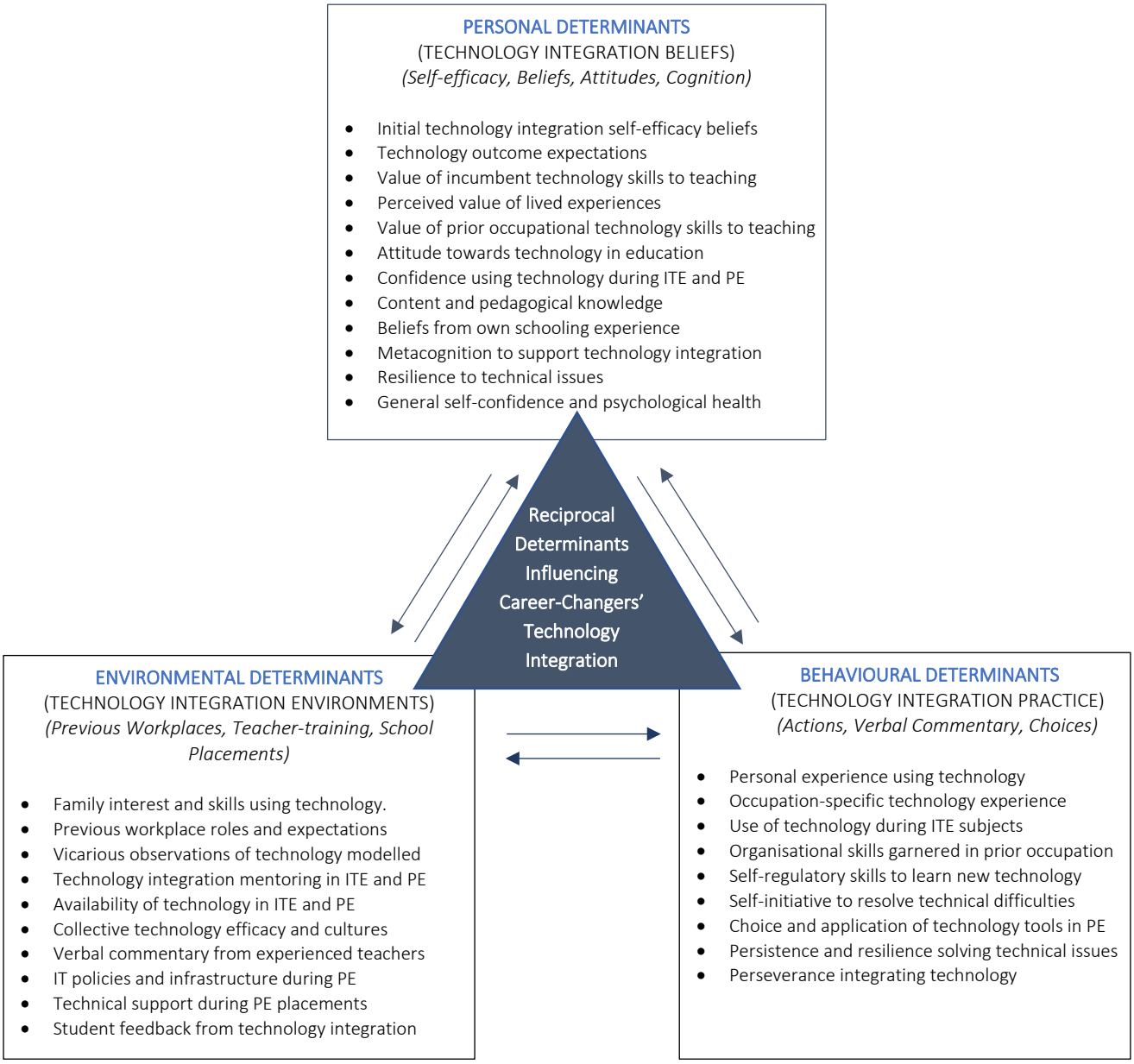
Whereas Georgie justified her preference to incorporate presentations in her practice from her supervising teacher's modelling of presentation applications during PE1: *"so all the presentations I did were very heavily technologically based. I used Prezi® as a platform for every single one of my lessons. The teacher I worked with did the same thing [with technology] as me."* Georgie maintained a similar technology integration approach during PE2, emphasising teacher-directed practice using content-dense presentations and worksheets formatted to reflect the artistic focus of the Visual Arts lesson. The positive feedback from teacher educators' and supervising teachers' appraising her practice during this placement strengthened the value of this pedagogy: *"They really liked the worksheets, and they really liked the PowerPoint slides I did. They wanted to keep all this at the school."* Interestingly, Georgie's choice not to incorporate any design tools from her graphical designer background, despite their availability in PE placements, reinforced the importance of sustaining healthy relationships with her superiors: "*With regards to technology, you've got to be respectful in the way you approach somebody. It's not your class and not your kids."*

6 Discussion

This study aimed to expand upon existing literature concerning career-changers by viewing this phenomenon from a technology perspective. The principles of reciprocal determinism were applied to answer the research question: How do career-change pre-service teachers perceive personal, behavioural, and environmental determinants to influence their technology integration beliefs and practice during ITE?

Findings from the cross-case analysis showed the career-changers in this study perceived their technology integration beliefs and practice to be influenced by a unique interplay between personal, behavioural, and environmental determinants. The themes that emerged from the cross-case analysis were embedded within the conceptual framework of this study (see Figure 2) to align with the scope of the study (Yin, 2014). Whist there were commonalities in the reported influences on technology integration beliefs and practice, the use of self-reported data, and various causal antecedents unique for each case, make it difficult to generalise the specific perceived influences within each determinant (Bandura, 1978).

Figure 2. The final conceptual framework depicting the perceived influence of environmental, personal, and behavioural determinants on technology integration as reported by career-changers in this study



Whilst the career-changers in this study entered ITE with full intentions to use technology in their practice, each brought to teaching a unique set of personal determinants that influenced their initial technology integration goals and beliefs. These personal influences included: incumbent pedagogical perceptions, confidence using technology, and value of technology in previous occupations. Contributing to the formation of these beliefs was a range of environmental influences such as family use of technology, prior workplace expectations, modelling and mentoring of technology integration during ITE and PE (including recognition of technology skills from previous roles), plus school cultures, IT policies, and hardware provisions during PE placements. A combination of environmental and personal influences

then worked together to shape how career-changes' integrated technology throughout ITE. However, this biproduct was not the result of a static, one-way relationship. Instead, the findings showed a bi-directional reciprocal nature between each perceived determinant of beliefs and practice. Consequently, technology integration practice outcomes (experiences using technology during previous occupations, ITE, and PE placements), were perceived to influence personal, or environment determinants, or both, and visa-versa.

All career-changers' entered ITE citing mastery experience using technology to fulfil role responsibilities in previous occupations. As behavioural determinants, these technology experiences could explain why all cases achieved moderate technology integration self-efficacy scores at the commencement of ITE. Whilst self-efficacy beliefs are typically domain-specific, interdomain self-efficacy beliefs can occur if similarities between the skills used within both domains are perceived (Bandura, 2006). Those career-changers' with a greater personal interest in technology, and experience using industry-specific technology tools, espoused greater confidence using technology during PE placements. Furthermore, greater confidence garnered more self-initiative and self-regulatory tendencies to learn new technology during ITE.

The career-changers in this study perceived the positive mastery experiences using technology facilitated their ability to resolve technical issues, fostered greater resilience to extrinsic barriers impacting planned technology integration, which in turn, sustained future technology integration goals. These findings align with previous research identifying the important role beliefs and attitudes play in predicting the technology integration of experienced teachers (Li et al., 2019), and the formation of pre-service teachers' digital competencies (Tondeur et al., 2020). For example, during PE1, both Erin and Rick reported the impact of ineffective school technology integration policies and infrastructure issues on their planned use of technology. However, both perceived the reported issues to have no impact on their subsequent technology integration goals and practice during PE2. This example illustrates how established mastery using technology can support a positive reciprocal relationship between technology integration beliefs and enacted practice. This finding supports those from Sadaf and colleague's (2016) research highlighting the role of experience using technology on confidence levels that affect pre-service teachers' subsequent technology integration goals (beliefs) and practice (behaviour). Moreover, these findings reinforce the influence of competency self-beliefs on choices of action, future goals, self-

regulation to realise said goals, and self-reflection on outcome performance (Pajares & Usher, 2008).

When asked about self-efficacy and self-regulation, Pajares (Bembenutty, 2007) describes the relationship as symbiotic; self-regulation is an essential part of a metacognitive process that involves self-reflection upon past performances that influence motivation and future behaviour choices. For example, Erin and Georgie attributed their confidence to learn new technology on self-regulated approaches adopted to master technology in previous occupations. Likewise, Rick and David cited overcoming technical issues during previous roles for their perspective to cope with IT problems encountered during PE placements. Crosswell & Beutel's (2017) study identified the adoption of agentic "self-activating resilience strategies" (p 426) by career-changer pre-service teachers to cope with difficult circumstances during PE placements. As reported in this study, these traits can act as mechanisms that support career-changers as they transition into teaching (Crosswell & Beutel, 2017; Richardson & Watt, 2005; Varadharajan & Schuck, 2017). Given the link between skills using technology, positive experiences overcoming technology issues, and positive attitudes towards technology integration, these attributes could increase confidence to assist career-changers' in overcoming intrinsic barriers that can stymie technology integration goals (Farjon et al., 2019; Howard, 2013; Hsu, 2016). However, Crosswell and Beutel (2017) found these traits were not as apparent when completing PE in less supportive school environments and could compromise career-changers' motivation and self-belief.

Research continues to identify the crucial role environmental influences play in supporting the realisation of effective technology integration (Makki et al., 2018; Maré & Mihai, 2018; Sadaf et al., 2016). Findings from this study reinforced the important role professional experience environments play in the development of pre-service teacher's technology integration cognisance (Backfisch et al., 2021; Ottenbreit-Leftwich et al., 2018). For example, both Rick and Georgie entered teaching confident to use technology in their future teaching practice due to their extensive experience using technology in their previous occupations. Rick completed PE2 in a school with a collective technology focus (environmental). This experience highlighted how effective IT integration programs and support mechanisms (environmental) can bolster positive, cooperative attitudes towards technology (personal), which encouraged the realisation of espoused technology integration beliefs (behavioural), and fuelled future technology integration goals (personal). Whereas, despite Georgie's extensive skills and confidence using graphic design applications,

combined with the availability of these tools during PE1 and PE2, the value of these incumbent skills was not recognised by teacher-educators or her supervisors during both PE placements. Consequently, positive feedback (environment) on Georgie's preference for integrating digital presentations (behavioural) to supplement teacher-directed pedagogy (personal) during both placements, reinforces the negative impact of ineffectual modelling, mentorship, and supervision by experienced teachers with limited technology expertise (Howard et al., 2019; Ottenbreit-Leftwich et al., 2018; Sadaf et al., 2016).

The necessity of mentoring and modelling to override existing and possibly outdated pedagogical conceptions has been a consistent recommendation in literature investigating the transition of career-changers into teaching (Powell, 1992; Tigchelaar et al., 2010; Watters & Diezmann, 2015). The findings from this study highlighted a possible relationship between the technology integration beliefs and skills of supervising teachers and the subsequent technology integration practice of pre-service teachers. In Georgie's case, the attitude of her supervising teachers during both placements towards technology, coupled with their limited technology skills, appeared to impact her ability to make meaningful links between existing technological skills to curricula. This disconnect meant potential lost opportunities for Georgie to integrate technology in her teaching to facilitate rich, real-world learning environments. Whereas the provision of effective modelling and mentoring offered to both Rick and David during PE2 supported the design of activities to develop meaningful and authentic technology integration practice. This finding strengthens Tigchelaar and colleagues' (2008) research regarding career-changers' capacity to be innovative in their teaching practice. In addition, this finding reiterates the importance of supporting both experienced teachers, and teacher-educators, with the skills and expertise they need to assist traditional and non-traditional pre-service teachers in developing technology pedagogy cognisance to realise effective technology integration (Howard et al., 2019; Tondeur et al., 2017). Finally, these results also support recommendations from earlier studies regarding the importance of recognising that the skills career-changers' bring from previous occupations can enhance their teaching and the transition process itself (Crosswell & Beutel, 2017).

The value of this research is the insight it provides into the unique combination of possible determinants that can impact how career-changers' technology integration cognisance develops during ITE. Moreover, it reinforces that the development of pre-service teachers' digital competencies, regardless of ITE program, requires a personalised approach, including consideration of individual characteristics, particularly their attitudes towards technology

integration (Tondeur et al., 2020). Essentially, understanding the relationship between first order (environmental), second-order (personal), and third-order (behavioural) influences is crucial in determining how pre-service teachers overcome the barriers to technology integration (Makki et al., 2018). In summary, teacher-training institutions need to adopt a more nuanced approach when designing post-graduate teacher-training programs. Most importantly, recognising the valuable skills career-changers' bring from prior occupations that can facilitate richer, authentic learning experiences (Tigchelaar et al., 2010; Varadharajan et al., 2020; Watters & Diezmann, 2015).

7 Limitations and future research

We recognise some limitations that need to be considered when reviewing the results of this qualitative study regarding sampling, generalisations, and the inherent implications on educational practice (Maxwell, 1992). This explanatory case study employed convenience sampling to explore career-changers' experiences from one university and cannot broadly reflect the technology beliefs and integration practice of all career-change pre-service teachers. Moreover, the qualitative nature of this study was dependent upon self-reported data, and the perspectives of the career-changers may introduce subjectivity and possible bias. However, the narratives provided a richer, first-hand account of career-changers' beliefs and practice using technology during ITE (Montgomery & Duck, 1993). Given the influence beliefs have been shown to have on technology practice, this research and methodology were designed to investigate career-changers' technology integration beliefs and practice from a social cognitive perspective. Nuances arising from this study that would align with other theoretical orientations were not contemplated.

8 Conclusion and recommendations

This study presents a portrait of career-change pre-service teachers during ITE from a technology integration landscape. The career-changers in this study reported environmental determinants, as illustrated in Bandura's (1978) triadic reciprocal causation model, as instrumental to the construction of technology integration beliefs and practice during ITE. All career-changers' in this study experienced a PE placement in schools demonstrating disenfranchised cultures, coupled with poorly designed and implemented technology integration policies. Such environments were perceived to fuel negative beliefs, attitudes, and outcome expectations mutually shared by staff. These intrinsic barriers were seen to promote whole-school and classroom level reluctance to integrate technology, and stagnated future technology integration goals. Consequently, there was a reported absence of mentoring and

modelling opportunities in these environments to support career-changers' with the development of technology cognisance; limiting opportunities for this group to override possibly outdated, instructivist pedagogical preconceptions previously identified in literature (Powell, 1992; Tigchelaar et al., 2010). However, schools with a collective focus and proficiency in technology integration were perceived to influence career-changers to integrate technology expertise from industry, or learn new technology to support student-centred and collaborative learning activities. Furthermore, future goals to integrate technology to support constructivist pedagogical practice were reported by the career-changers who completed placements in schools that embraced positive attitudes towards technology integration.

Findings from this study highlight the importance of schools and ITE institutions to obtain, model, and mentor effective technology integration expertise and confidence necessary to buoy ITE cultures that bring about much-needed change. The metacognitive skills and technological expertise career-changers' bring from industry appear under-utilised due to post-graduate teacher education programs not designed to cater to this group's nuanced needs. (Rowston et al., 2021a, 2021b; Mayotte, 2003; Wilkins & Comber, 2015). We argue that support provisions such as mentoring, and modelling are essential for career-changers' to connect incumbent technology skills to curricula and conceptualise effective technology integration beliefs and practice. These contextual elements have also been identified as possible determinants of traditional pre-service teachers' capacity to realise meaningful technology pedagogy (Howard et al., 2019; Ottenbreit-Leftwich et al., 2018). Dewey (1931) identified the importance of context in the generation of beliefs and thought. Therefore, this study reiterates the important relationship between environmental, behavioural, and personal determinants as influences of agency and choices of action. Furthermore, it highlights the importance of considering the path pre-service teachers take to enter teaching, and how this route can influence their technology beliefs, goals, and integration practice.

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