Graduate-entry pre-service teachers: The relationship between their experience using technology in their previous occupations and their technological pedagogical beliefs.

Kim Rowston[*1], **Anne McMaugh**[1], **Lori Lockyer**[2]
Department of Educational, Macquarie University[1]
Faculty of Arts and Social Sciences, University of Technology Sydney & Department of Educational, Macquarie University[2]

Abstract

An important aspect of teachers' work is integrating technology to support student learning. Teachers' beliefs, knowledge, and skills related to technology develop well before their pre-service teacher education begins. For graduate-entry pre-service teachers, prior experiences may play a valuable role in shaping their self-efficacy for, and use of technology in their pedagogical practice. This paper presents findings from the first phase of a mixed method study of students enrolled in a one-year graduate teaching course (N = 146). Graduate-entry pre-service teachers at an Australian university were invited, at the commencement of their course, to complete a survey about their self-efficacy beliefs using technology in their previous occupations and their self-efficacy beliefs for integrating technology into classroom teaching. Analysis revealed a significant relationship between the four variables: frequent use of technology, types of technological tools used, general technology self-efficacy and technology pedagogy self-efficacy. The greater the experience in applying a wide variety of technological tools in their previous workplace, the higher the participant's self-efficacy beliefs for both general technology and technology pedagogy. For participants (n = 58), who used specialised technology applications in their former roles, there was a significant and positive relationship between the types of tools used and their self-efficacy beliefs. This study provides a greater understanding of the technological skills, expertise and beliefs graduate-entry teachers bring with them from previous roles. These findings suggest that graduate-entry teachers' experience of using specialised technology could facilitate the achievement of mandated technology pedagogy reforms and support advanced pedagogical skill development.
Keywords: Technology; Graduate-entry pre-service teachers; technology use; technology beliefs; self-efficacy

1. Introduction

The use of technology in education continues to be at the forefront of government reforms and initiatives both within Australia and internationally. A catalyst of this focus is the perceived need to equip students with 21st-century skills, of which technology is a primary facilitator for the development of such skills (Kereluik, Mishra, Fahnoe, & Terry, 2013; Koehler, Mishra & Cain, 2013). The predicted increase in occupations based in Science, Technology, Engineering and Maths (STEM) fields (Office of the Chief Scientist, 2016) has further reinforced the necessity for students to demonstrate proficiency in these 21st-century skills. While schools have the responsibility to implement these mandates, it is the technological pedagogical practices

[*] Corresponding author: kim.rowston@students.mq.edu.au

demonstrated by teachers within their classrooms that will determine the success of these reforms. Effective technological pedagogy has been defined by Jonassen (1995) as teacher practices which display the use of technology-enhanced learning activities to facilitate meaningful learning experiences for their students. However, studies have shown that despite understanding the principles behind technological pedagogy, intrinsic barriers such as technological beliefs, remain a significant influence upon teachers' technological pedagogical practice (Abbitt, 2011; Kim, Kim, Lee, Spector, & DeMeester, 2013; Teo & Schaik, 2012).

Intrinsic or second-order barriers are defined by Ertmer (1999) as teacher's beliefs concerning teaching epistemology, the role of technology in teaching, and the ability to change existing pedagogy. Ertmer's study built upon earlier research concerning the relationship between barriers: first-order (hardware, software and training); and second-order (confidence, skills and preconceptions) affecting teachers' integration of computers in their practice (Hadley & Sheingold, 1993; Hannafin & Savenye, 1993). Findings indicated that despite school's and government's best efforts to address first-order barriers, second-order barriers continued to exert a major impact upon the achievement of effective technology pedagogy.

Subsequent studies have identified similar issues for pre-service teachers and their struggle to demonstrate an alignment of their technological pedagogical practice with their espoused beliefs (Anderson & Maninger, 2007; Williams et al., 2009). While pre-service teachers understand how technology can enhance teaching and learning (Funkhouser & Mouza, 2013), many have doubts regarding their own capacity to execute meaningful technology integration in their teaching (Abbitt & Klett, 2007). For technology to support meaningful learning, Howland, Jonassen, & Marra (2011), suggest teachers adopt an authentic approach regarding technology integration to reflect real-world issues, concerns, and applications. Pre-service teachers blame a lack of hands-on experience and modeling of effective technology pedagogy during their teacher-training program and practicum experiences, as a significant contributing factor to their reservations regarding their own technology pedagogical practice (Brown, Alford, Rollins, Stillisano, & Waxman, 2013; Hsu, 2013; S.-K. Wang, Hsu, Reeves, & Coster, 2014). Mastery of a particular skill, together with the observation of successful vicarious experiences demonstrating that specific skill, are key factors that promote the development of high self-efficacy beliefs (Bandura, 1986, 1997). If there were no provision for these experiences within teacher-training programs and practicum experiences, then the opportunity for pre-service teachers to develop high self-efficacy beliefs would be limited. However, graduate-entry pre-service teachers may possess higher levels of technological expertise from successful experiences using technology within previous occupation/s. As such their self-efficacy and beliefs may differ from those of undergraduate pre-service teachers.

2. Background

Technology in schools

Various strategies and reforms have attempted to address teacher use of technology in classrooms. Past examples of such strategies include the Digital Education Revolution (Commonwealth of Australia (CofA), 2009) and the Teaching Teachers for the Future project (DEEWR, 2012). Each strategy focused on delivering technology to students and schools along with development for teachers and initial teacher education strategies. In the most recent

Kim Rowston
kim.rowston@students.mq.edu.au

initiative: Inspiring all Australians in Digital Literacy and STEM, the government narrowed its focus on the necessity to encourage students' engagement in specific STEM subjects (National Innovation and Science Agenda [NISA](Commonwealth of Australia, 2015)). A key component of NISA's agenda is the cultivation of relationships between schools and industry experts or other such STEM professionals who (presumably) have the capacity to provide meaningful technological learning experiences for students. Similar strategies to fulfill such objectives have been implemented globally such as the US-based Activities to Support the Effective Use of Technology of Every Student Succeeds Act (U.S. Department of Education, 2016) and the UK's focus on the teaching of coding through the new Computing curriculum (UK Department of Education, 2014). Despite the value placed on such initiatives, first-order and second-order barriers may restrict teachers in the realisation of such reforms (Prestridge, 2012; Tondeur, Pareja Roblin, van Braak, Voogt, & Prestridge, 2016).

Schools have also implemented various frameworks to provide teachers with the knowledge, skills and understanding to demonstrate best technology pedagogy. Such frameworks include Technological Pedagogical Content Knowledge (TPACK), developed by Mishra and Kohler (2006) as an adjunct to Shulman's (1986) Pedagogy Content Knowledge (PCK) theory and Jonassen's (1999; Jonassen, Carr, & Yueh, 1998) constructivist epistemology regarding using technology as a mind tool to foster meaningful learning experiences. In his seminal paper exploring the use of technology as a cognitive tool, Jonassen (1995) recognised the potential for the meaningful integration of technology to expedite student's development of critical thinking skills. Further studies have confirmed Jonassen's views concerning the relationship between meaningful learning experiences and the development of 21st-century skills (Ertmer & Ottenbreit-Leftwich, 2013; Reeves, Lee, & Hung, 2013). For this relationship to be successful, teacher's pedagogical practices to develop and foster critical thinking competencies need to preface the integration of technology tools.

Teacher technological pedagogical practice and self-efficacy beliefs

The use of technology to engage learners in critical and creative thinking is not a new concept. This notion of technology as a tool to amplify cognitive function in learners has been argued by constructivists for over two decades (Collins, 1989; Jonassen, 1995; Yang & Wu, 2012). In the early phases of technology integration in classrooms, Becker (1987) identified drill and practice activities as the most common use of computers in the classroom. This technological practice of using technology as a tool to replace pen and paper continued to occur into the 1990's (Hadley & Sheingold, 1993). The evolution of technological pedagogical frameworks such as TPACK (Koehler & Mishra, 2005; Mishra & Koehler, 2006) were developed to tackle the disconnect between the increased availability of technology in schools, and the ineffectual technological pedagogical practice. Yet, current research indicates teachers are still using technology as a supplementary tool within their current practice rather than promoting the development of 21st-century skills through meaningful technological pedagogy, (Lim, Zhao, Tondeur, Chai, & Tsai, 2013; Tondeur, Kershaw, Vanderlinde, & van Braak, 2013; S.-K. Wang et al., 2014). When investigating the use of technology to develop transformational learning spaces, Veletsianos (2011) observed teachers still using technology as a tool substitute within traditional teacher-directed lessons such as using the computer as an alternative note-taking tool. Few teachers were using emerging technologies such as augmented reality (virtual reality

Kim Rowston
kim.rowston@students.mq.edu.au

duplicating the environment using technology), to support and enhance student-directed learning through experiences not previously possible. While teachers acknowledge the importance of technology within educational contexts, research has consistently identified a lack of synergy between their technological pedagogical beliefs and their actual practice (Anderson & Maninger, 2007; Williams et al., 2009).

When investigating teacher's technological pedagogical beliefs and practice, researchers have identified the significant role intrapersonal factors play in fostering a cohesive relationship between the two elements. Ertmer (1999) identified the existence of second order (internal) barriers that were impeding teachers from successfully integrating technology within their teaching practice. The role that beliefs play in affecting teaching practice has been well documented (Dewey, 1933; Nespor, 1987; Pajares, 1992; Woolfolk & Hoy, 1990). Researchers have studied the relationship between intrapersonal/second order barriers including technology self-efficacy beliefs, and acknowledge how these can shape a teacher's technological pedagogical practice (Ertmer, Gopalakrishnan, & Ross, 2001; Ertmer & Ottenbreit-Leftwich, 2010b; Watson & Watson, 2006). Results from Ertmer, et al's, (2012) study further highlighted the role of beliefs as a faciliative factor to effectual integration of technology. Similarly, findings from Celik & Yesilyurt (2013a) study revealed attitudes about technology, levels of computer anxiety and perceived computer self-efficacy were important predictors of teacher's technological practice.

Self-efficacy is defined by Bandura (1997) as a person's perception of their capacity and capability to successfully perform set tasks within a specific domain. This construct reflects an internal state of self-belief that promotes or inhibits subsequent behaviour. In his seminal paper 'Self-Efficacy: Toward a Unifying Theory of Behavioural Change', Bandura (1977) states that whilst everyone is capable of goal setting, it is those with a high sense of self-efficacy that are more likely to be successful in their endeavours. An individual's perceptions of self-efficacy are generated from four principal sources: enactive mastery experience, vicarious experience, verbal persuasion, and physiological and affective states (Bandura, 1997). The main axiom behind this theory is that successful experiences (mastery) promote a heightened sense of self-efficacy. A high sense of self-efficacy supports and drives behaviour including greater persistence on tasks and willingness to accept challenges. Compeau and Higgins (1995) recognised the link between self-efficacy beliefs, and an individual's use of information technology in the workplace. Subsequently, self-efficacy theory has been applied to examine teacher's pedagogical practice (Ertmer & Ottenbreit-Leftwich, 2010; Govender & Govender, 2009; Kreijns et al., 2013; Watson & Watson, 2006). Those teachers with strong beliefs regarding the role of technology in the classroom, together with high self-efficacy levels using technology, were more likely to act upon these beliefs, demonstrating meaningful technology pedagogical practice (Abbitt, 2011). Similar studies have revealed that teachers who were confident in their technology pedagogical capabilities, were more inclined to attempt higher levels of technology integration, further building their self-efficacy beliefs in this domain (McCormick & Ayres, 2009; Mueller, Wood, Willoughby, Ross, & Specht, 2008).

The findings of Ertmer and Ottenbreit-Leftwich (2010a) identified several factors that contribute to the development of teachers' technology self-efficacy beliefs. These include: previous use of technology (Mastery); perceived skill level using technology (Mastery and social persuasion); colleagues demonstrated use of technology (Vicarious experiences); perceived usability and relevance of technology to own teaching pedagogy. These factors have also been shown to impact upon the self-efficacy beliefs of pre-service teachers and their ability to demonstrate effective integration of technology in their teaching practice (Niederhauser & Perkmen, 2010; Tondeur et al., 2012; Wang, Ertmer, & Newby, 2004). Some studies have also attributed lower technology self-efficacy beliefs to poorly designed teacher-training courses that fail to incorporate technology in context, thus limiting opportunities to enhance self-efficacy beliefs through mastery and vicarious experiences (Goktas, Yildirim, & Yildirim, 2008).

Pre-service teachers technological pedagogical beliefs and practice

Reflecting the concerns reported for the wider teaching profession, Tondeur et al.,(2016) assert that pre-service teachers use of technology may also fail to meet mandated expectations and standards. Pre-service teachers claim the primary reason for failure to demonstrate meaningful integration of technology in their practice is a lack of adequate preparation in their teacher education programs (Sang et al., 2010a; Teo & Noyes, 2014). Further research highlights additional reasons why this cohort struggles to integrate technology effectively. These include: a lack of technological skills; little or no mentoring of effective technological integration strategies within the classroom setting; poor modelling of technology integration at a tertiary level; and a lack of synergy between what is taught during their teacher-training programs and what is expected in actual classrooms (Chesley & Jordan, 2012; Hughes, 2013; Ottenbreit-Leftwich et al., 2012). As a sizable proportion of the present pre-service teacher cohort were born within the 1990’s (ABS, 2013a), these findings correlate with earlier research highlighting the disparities between the technological pedagogical capabilities of this generation despite their exposure to and use of technology in everyday life (Donnison, 2009; Lei, 2009; Zhou, Zhang, & Li, 2011).

In Sweeney & Drummond's (2013) study investigating the preparedness of pre-service teachers at an Australian university to integrate technology, results showed an increase in TPACK scores from the commencement to the conclusion of the course. Despite this improvement, final scores were comparatively low relative to the midpoint, with the technological knowledge scores demonstrating no improvement over the same time period. Their recommendations included the provision for support to assist pre-service teachers to make the connections between technological knowledge, technological pedagogy and content knowledge. Interestingly, the TPACK scores were lower for those participants who relied upon portable digital devices such as iPads. Similarly, in their study exploring the use of technology in pre-service education, Stobaugh & Tassell's (2011) stressed the need for effective modelling of technology by teaching training institutions to assist pre-service teachers understanding of effective technology pedagogy.

Graduate-entry pre-service teachers

Teacher recruitment initiatives designed to overcome the shortage of teachers within mathematics, science and technology subject areas (NSW Department of Education and Communities, 2011; Victorian Department of Education and Early Childhood Development, 2013), have contributed to the increase in the number of enrolments of graduate-entry students in teacher-training courses (Australian Bureau of Statistics (ABS, 2013a, 2013b). Research identifies the diversity of skills, beliefs and knowledge that graduate-entry teachers bring with them from their previous occupational experiences (Arthur, 1994; Laming & Horne, 2013; Powell, 1994). Evidence suggests that the previous occupational experiences of graduate-entry

Kim Rowston
kim.rowston@students.mq.edu.au

teachers' enable them to integrate subject specific content within their teaching practice in authentic, motivational and meaningful ways (Greenwood, 2003; Powell, 1997). In an earlier study, Powell (1992) found that those graduate-entry teachers, who were successful in their previous occupation/s, relied on their prior work habits when designing and implementing their classroom practice in the early stages of their teaching. This was assisted by their mastery of subject specific knowledge and skills gained from previous occupational experiences; together with an understanding of Pedagogical Content Knowledge (PCK) obtained through coursework and practicum experiences completed during their teacher-training program (Snyder, Oliveira, & Paska, 2013). Could this same principle apply to those graduate-entry pre-service teachers who possess a high level of technological self-efficacy from previous occupational experiences?

The type of work experience held by graduate pre-service teachers, their use of technology within these roles, the length of occupational experience and positions held, may also influence their technological pedagogical self-efficacy beliefs. Examples could include graduate-entry pre-service teachers from engineering backgrounds who may possess mastery in computer-aided-design (CAD) software from previous occupational experiences; visual artists with competencies using graphical design software and tools; journalists and scientists with researching capabilities using technology; and musicians with proficiencies using composition software and applications. Marakas, Yi, & Johnson's (1998) review of computer self-efficacy beliefs and the factors that contribute to these beliefs, found a significant relationship between professional orientation and computer self-efficacy beliefs. Earlier studies have shown the length of experience using technology also influences existing technology self-efficacy beliefs (Bandura, 1977, 1982; Compeau & Higgins, 1995, as cited in Marakas et al., 1998). Building upon these research findings, Marakas, et al (1998) identifies the reciprocal relationship between successful experiences mastering technology, which then further increases technology self-efficacy, and in turn leads to improved performance in technology specific domains.

3. Purpose of Study

This study sought to investigate the relationship between previous occupational experiences and the technology pedagogical self-efficacy beliefs and practices of graduate-entry pre-service teachers at the commencement of their teacher-training program. This study sought to answer the following three research questions:

1. What are the occupation-based technology experiences of graduate-entry pre-service teachers?
2. What is the relationship between the occupation-based technology experiences of graduate-entry pre-service teachers and their general technology and technology pedagogy self-efficacy beliefs?
3. Does the occupational rank held by graduate-entry pre-service teachers in previous occupations affect their general technology and technology pedagogy self-efficacy beliefs?

Participants

Participants (N = 146) were 55 males and 91 females, enrolled in graduate teacher training courses, with ages ranging from 20 to 48 years (M = 27.01, SD = 6.76). Participants were

Kim Rowston
kim.rowston@students.mq.edu.au

enrolled in a number of courses in a single University including a one-year Graduate Diploma (Secondary) (62.3%, n = 91), and two-year Masters courses in primary (n=46) and secondary teaching (n=9).

There was a broad representation of disciplines studied in the undergraduate degrees held by participants, with a third (30.1%, n=44) holding qualifications in the humanities field, followed by Creative Arts (21.2%, n=31), and only a minority representing STEM based subjects (6%, n=9).

Methods

A questionnaire was administered to collect data for this study. Demographic information and scores from each instrument used in this study were analysed to identify the characteristics of the participants in this study.

Measures

Background and demographic details: Participants were asked to provide details of their age, gender, previous degree qualifications and previous employment experiences including most recent occupation.

Occupational ranking: The occupation of each participant was assessed using the Australian Bureau of Statistics: Australian and New Zealand Standard Classification of Occupations Ranking (ANZSCO) ((Australian Bureau of Statistics (ABS), 2016). The ANZSCO scheme groups and ranks occupations according to skill level and skill specialisation. There are eight major groups with Managers identified as the highest-ranking occupation (Level 8) and Labourers categorised as the lowest ranked occupation (Level 1).

Specialised and complex technological experience: Participants were asked to nominate additional specific technological skills or tools they had used in their previous occupations. Two categories were then generated from their responses: Category 1 reflected lower level of operator skills or user cognition in tools such as cash registers, scanners and printers; Category 2 reflected skills or tools that required higher levels of user control and cognition such as computer-aided drawing programs (CAD.

Computer self-efficacy beliefs: General technology self-efficacy beliefs were assessed with a 12-item Computer Technology self-efficacy survey (Teo & Koh, 2010). This survey contains three subscales that assess basic computer skills (BCS), media-related skills (MRS) and web-based skills (WBS). Example items included: “I am able to use the internet to search for information and resources” and “I am able to use word processor to create, edit and format documents for specific purposes (e.g. Microsoft Word)”. All questions were rated on a 7-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (7). Each subscale in the current study attained a high level of internal consistency: BCS (α = .884), MRS (α =.843) and WBS (α = .791).

Self-efficacy beliefs for technology pedagogy: Pre-service teachers’ self-efficacy to integrate technology into their teaching practice was assessed with a 16-item Computer Technology Integration self-efficacy survey (Wang et al., 2004). The items in this single factor measure included computer technology capabilities and strategies (Wang et al., 2004). Examples

Kim Rowston
kim.rowston@students.mq.edu.au

included: “I feel confident that I can successfully teach relevant subject content with appropriate use of technology” and “I feel I can consistently use educational technology in effective ways”. All questions were rated on a 5-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (7). This scale attained a high level of internal consistency in the current study (α = .94).

4. Results

This section first presents results from descriptive analysis identifying the types of occupations previously held by participants, together with the technological skills, expertise and beliefs they bring with them from previous occupational experiences. Secondly, we present findings from correlation analysis to measure the relationship between participant’s technological experience from previous occupations and their self-efficacy beliefs both using general technology and to integrate technology into their teaching. T-tests are reported to examine differences between groups of pre-service teachers with experience in previous roles and occupational rankings since graduation and frequency use of technology, technological tools used, general technology and technology pedagogy self-efficacy beliefs.

Previous occupations held by participants:

The demographic data revealed that ninety two percent (n = 136) of participants were employed in paid or voluntary positions before the commencement of their teacher-education course. Only 1.3% of participants (n = 2) stated they had never held any positions: paid or otherwise; while the remaining participants (5.5%, n = 8), had not provided any information in this field.

Positions previously held by participants were ranked in accordance with the Australian and New Zealand Standard Classification of Occupations (ANZSCO, 2013). As indicated in Table 1, 56.2% of participants (n = 82) had held professional or managerial positions (Group 7 and 8) prior to the commencement of their teacher-training course.

Table 1. *Occupation ranking of participants*

Group		Frequency	Percent
1	Labourers	4	2.7
2	Machinery Operators and Rivers	2	1.4
3	Sales Workers	17	11.6
4	Clerical and Administrative Workers	15	10.3
5	Community and Personal Service Workers	18	12.3
6	Technicians and Trades Workers	8	5.5
7	Professionals	74	50.7
8	Managers	8	5.5
	Total	146	100.0

Technology knowledge and skill expertise

Participants’ responses to questions about the technological skills and expertise from their

Kim Rowston
kim.rowston@students.mq.edu.au

previous occupational experiences are reported in Table 2. The use of technology as a tool to communicate and collaborate with others was the main skill reported with most (88.4%) of participants reporting this application of technology on a weekly basis.

Table 2 - *Technology use in previous occupations*

Task	*Used Weekly (%)*	*N*
Communicate with Colleagues & business associates.	88.4	129
Maintain records and draft letters	67.1	98
Work with colleagues creating reports, documents or letters	62.3	91
Research issues and work related questions.	60.3	88
Capture digital photos	54.8	80
Provide assistance for colleagues to use technological tools.	50.0	73
Banking, travel arrangements	45.2	66
Edit Photos or create diagrams	43.2	63

N = 146

Of the technology tools/applications used in previous occupations on a weekly basis (see Table 3), email was the highest application selected by participants (92.5%, n=135). This corresponds with the figures presented in Table 1 regarding the high percentage of participants who used technology weekly to communicate with business colleagues.

Table 3. *Technology tools / applications used in previous occupations*

Tool / Application	*Used Weekly %*	*N*
Email	92.5	135
Social Media (*LinkedIn, Twitter, Facebook)*	54.8	80
Video Conferencing (*Skype, Google Chat)*	26.0	38
Data Projectors	23.9	35
Web Site design and/or creation	21.9	32
Computer Programming and/or Coding	17.8	26
Smart Board *(Interactive Whiteboard)*	11.6	17

N = 146

When asked to nominate specialised additional software or technological tools used within their previous occupation, most participants' reported database management systems as the most highly used occupation-specific software (see Table 4).

Kim Rowston
kim.rowston@students.mq.edu.au

Table 4. *Specialised and complex technological experience*

Tool / Application	*n*	%
Database Management Systems	25	43.1
Graphic Software *(CAD, Photo editing)*	10	17.2
Music applications	6	10.3
Cloud Sharing applications	5	8.6
Accountancy Applications	4	6.9
Web Site design and/or creation	4	6.9
Computer Programming and/or Coding	4	6.9

n=58

General technology and technology pedagogy self-efficacy beliefs.

Participants were asked to indicate their levels of self-efficacy using general technology, and their beliefs regarding integrating technology into their teaching. The sample size, mean, standard deviation and range for each of the self-efficacy measures are presented in Table 5.

Table 5. *Descriptive statistics for self-efficacy instrument scores*

Variable	*N*	*M*	SD	Range	
				Min	Max
General Technology Self-Efficacy Score	146	15.26	3.11	5.37	21.00
Technology Integration Self-Efficacy Score	146	63.54	10.35	29.00	80.00

The relationship between demographic data and self-efficacy beliefs

A Pearson's product-moment correlation analysis was conducted to explore the relationship between the demographic data, occupation-based technology experiences of graduate-entry pre-service teachers, and general technology and technology pedagogy self-efficacy beliefs (Table 6).

Table 6. *Pearson product-moment correlation of the relationship between demographic data, technological experience, and self-efficacy beliefs.*

	1	2	3	4	5	6
1. Age	_					
2. Graduation Year	.750**	_				
3. Occupation Rank	.368**	.342**	_			
4. Frequent Technology Use	.210*	.117	.234**	_		
5. Total Technology Used	.115	.033	.107	.627**	_	
6. General Technology Self-Efficacy Score	-.215**	-.151	-.105	.259**	.334**	_

7. Technology Integration Self-Efficacy Score	-.166*	-.064	-.081	.218**	.210*	.669**

N=146 **p*<.05; ***p*<.01.

There was a significant negative correlation between participant's age and their general technology self-efficacy score indicating that the older the participant, the lower their general technology self-efficacy beliefs. Frequent use of technology and the number of technological tools used was positively and significantly associated with both efficacy measures. Conversely, there were no significant correlations between the graduation year, or occupation rank, and their use of technology in their previous occupation or either measure of self-efficacy. Both self-efficacy measures were strongly correlated suggesting that general technology self-efficacy and technological pedagogy self-efficacy are closely related beliefs about ability and competence.

Table 7. *Pearson product-moment correlation of the relationship between technological experience and self-efficacy for participants with specialised technology experience.*

	1	2	3	4	5
1. General technology self-efficacy score	_				
2. Technology integration self-efficacy score	.679**	_			
3. Frequent technology use	.335*	.325*	_		
4. Total technology used	.468*	.424**	.667**	_	
5. Graduation year	-.036	-.032	-.033	-.033	_
6. Occupation Rank	.037	-.023	.116	.029	.245

N=58; **p*<.05; ***p*<.01.

A total of 58 (43%) participants indicated they used specialised technological tools and applications in their previous occupations. An additional Pearson product-moment correlation was conducted to investigate the relationship between technological tool use and self-efficacy beliefs for these participants (see Table 7). The significant positive correlation between both SE measures (p=.679, n=58) closely resembled results from calculating this relationship using all cases. The frequency of use of technology and total number of technology tools used was found to demonstrate a positive correlation with both general technology and technology pedagogy self-efficacy measures for those participants that identified use of specialised technology in their previous roles.

Differences in occupation rank and self-efficacy.

An independent-samples t-test was also conducted to compare the frequent use of technology, total technology used, general technology self-efficacy beliefs and technology pedagogy self-efficacy beliefs in participant's who previously held occupations ranked 6 or below, to participant's who previously held occupations ranked 7 or above.There was no statistically significant difference in technology integration self-efficacy beliefs between participants who previously held occupations ranked 6 or below (M=65.40, SD=10.18) and participants who previously held occupations ranked 7 or above (M=62.09, SD=10.32) *t*(144)=1.94, p=.055. In contrast there was a statistically significant difference in the scores for

Kim Rowston
kim.rowston@students.mq.edu.au

general technology self-efficacy beliefs for participants who previously held occupations ranked 6 or below (M=15.91, SD=2.89) and participants who previously held occupations ranked 7 or above (M=14.74, SD=3.19); *t* (144)=2.29, p=.023. The total technology use scores for participants who previously held occupations ranked 6 or below (M=13.95, SD=4.32) and participants who previously held occupations ranked 7 or above (M=14.91, SD=3.88) *t*(144)=-1.413,p=.160 were not significantly different. Conversely, there was a statistically significant difference in frequency of use of technology scores for participants who previously held occupations ranked 6 or below (M=22.75, SD=6.05) and Group 2 (M=25.21, SD=5.86); *t* (144)=-2.48, p=.014. The results suggest that participants with occupation ranks of 6 and below (e.g. non-professional and non-managerial professionals) have higher general technology self-efficacy beliefs but there were no significant differences in technology integration self-efficacy beliefs. Participants with higher occupation ranks did have greater frequency of technology use but there were no significant differences between the occupational groups for total technology use.

5. Discussion

This phase of the study sought to identify the technological skills and experiences of graduate-entry pre-service teachers from their previous occupations, and to investigate the relationship between their technological pedagogical beliefs and these experiences. The knowledge and expertise graduates bring with them from previous occupational experiences has been documented through various studies' (Anthony & Ord, 2008; Etherington, 2011; Quintrell & Maguire, 2000).

The technological skills and use of technology by these participants revealed close to 50% had used a variety of technology applications in their previous occupations on a weekly basis, with 43% having used specialised technology in their previous roles. Frequent use of technology and use of technology applications had a positive significant influence upon both general technology and technology pedagogy self-efficacy beliefs. A strong relationship was also evident between the two self-efficacy measures. This suggests those graduate pre-service teachers with high general technology self-efficacy scores strongly believed they could successfully integrate technology into their teaching practice and vice versa. These findings reflect the results consistently shown in earlier research (Abbitt, 2011; Celik & Yesilyurt, 2013b; Ertmer et al., 2012) regarding the influence mastery of technology has upon technology self-efficacy beliefs. While these results augur well for the future practices of those graduate pre-service teachers with high levels of self-efficacy, concerns remain for those with low self-efficacy beliefs given the identified links to practice recognised in the literature (Anderson, Groulx, & Maninger, 2011; Kim, Kim, Lee, Spector, & DeMeester, 2013; Mueller & Wood, 2012).

It is promising that the total number of technological tools used and the frequency of use of technology were significantly related to self-efficacy beliefs for participants (n = 58), who used specialised technology applications in their former roles (Table 7). However, it is also important to note that although these correlations were of a greater magnitude when compared to the general population, the correlations were only weak to moderate in magnitude for the specialised use of technology group. This association suggests the use of specialised technology in previous roles for those graduate pre-service teachers does support their self-efficacy beliefs. Identification of a connection between use of specialised technology and technological applications to the

Kim Rowston
kim.rowston@students.mq.edu.au

demonstration of meaningful technology integration in teaching remains to be measured (Jonassen et al., 1998).

Conversely, the negative correlations between age and both general technology and technology pedagogy self-efficacy could highlight possible problems for those older participants in this cohort and their ability to develop and demonstrate meaningful integration of technology in their teaching practice. Earlier studies has identified that while graduate-entry pre-service teachers may bring with them maturity, motivation, knowledge, skills and professionalism from their past occupational experiences (Richardson & Watt, 2006), they can also experience difficulties when making the transition from past occupations due to preconceived notions and beliefs regarding teaching (Kember, 2008; Snoeyink & Ertmer, 2002). In a later study exploring the relationship between prior career experience and instructional quality amongst Maths and Science teachers, Scribner & Akiba (2010), found career length, number of prior careers and career relevance to subject area were not related to the quality of pedagogical practice.

Mayotte (2003) highlighted the benefits and disadvantages that previous occupational experiences provide career-change beginning teachers through a case study investigating how competencies developed in previous careers benefit teaching practices. Participants in Mayotte's study acknowledged that previous occupational experiences did not facilitate the successful transition into teaching (p. 11). Similarly, the results of this study show the level of occupational rank held within participant's previous roles, did not necessarily contribute to higher self-efficacy beliefs to integrate technology into their teaching. This is despite the greater frequency of use of technology for these higher ranked managerial and professional groups. In Snyder, Oliveira, & Paska's (2013) longitudinal study investigating scientists who decided to become teachers, findings confirmed the complex cognitive and emotional transformations involved with the transition into teaching, which may serve to inhibit effective pedagogical practice.

Implications of this study highlight the need for teacher-training institutions to consider that graduate-entry teachers with higher levels of occupational ranks, specialized technology use, or greater 'maturity' (e.g. age) may not necessarily hold higher levels of self-efficacy beliefs. Assessment of technology pedagogy self-efficacy beliefs held by pre-service teachers at the commencement of their program may prove illuminating in this regard. This understanding could serve to remedy shortcomings in pre-service teacher's ability to meaningfully integrate technology into their teaching practice influenced by preconceived beliefs (Stobaugh & Tassell, 2011).

Limitations:

This study has several limitations that need to be considered. The size of study is small and results may not reflect the technological pedagogical beliefs and practice of other graduate cohorts enrolled in teaching training courses. Additionally, the previous occupational experiences of this cohort may not be the only factors that may contribute to their general technology and technology pedagogy self-efficacy beliefs. The correlation results for those participant's with specialised technology experience, compared to those for to the general population, only quantifies this relationship. Finally, there is a need to conduct longitudinal studies to identify the impact initial technology pedagogy self-efficacy beliefs have upon long-term technological pedagogical practices. Do these espoused beliefs translate to actual practice?

Kim Rowston
kim.rowston@students.mq.edu.au

Future research

As recommended by earlier research (Ertmer et al., 2012; Ertmer & Ottenbreit-Leftwich, 2012; Lemon & Garvis, 2016), further phases of this study will facilitate investigation of the relationship between perceived technology pedagogy self-efficacy beliefs and actual practice. In particular, whether the graduate cohort's ability to use specialist software translates into the ability to demonstrate technological pedagogical proficiency. Self-efficacy beliefs, once established, are hard to change. According to Bandura (1997) 'Powerful enactive mastery experiences eliminate defensive behaviours, physiological stress reactions and faulty thought patterns' (p. 333). The remaining stages of this research will serve to identify whether the general technology and technology pedagogy self-efficacy beliefs of this cohort measured at the commencement of their teacher-training course will change. The findings of this future research aim to identify the catalyst for such changes and confirm if graduate entry teachers general technology self-efficacy beliefs are predictors of their actual technology pedagogy practice.

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Kim Rowston
kim.rowston@students.mq.edu.au

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Kim Rowston
kim.rowston@students.mq.edu.au

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