Auditing the ICT Vocational Self-Efficacy of Teacher Education Undergraduates

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Abstract

This paper reports findings from an audit of the vocational self-efficacy of final year pre-service teacher education students from two universities in Queensland (Australia) with respect to their confidence to meet the Information Communication Technologies (ICT) professional competencies expected of teachers. It also describes their beliefs about the usefulness of their university learning experiences in assisting them to develop their Technological Pedagogical and Content Knowledge (TPACK) in comparison to other contexts in which they may have gained ICT confidence and competence necessary for teachers in the 21st century. Finally, the paper makes recommendations for the design of teacher education programs aimed at improving teacher graduates' TPACK and ICT vocational self-efficacy.

Introduction

The quality teaching agenda has become a strengthening theme throughout Australian education systems (Masters, 2009). Fundamentally underpinning the debate is research demonstrating that quality teachers are the most important determinant of high-level student learning outcomes. For example, the McKinsey report (Barber & Mourshed, 2007) indicated that "the quality of an education system cannot exceed the quality of its teachers" (p.7). Logically, by implication there is an expectation that pre-service teacher education programs should nurture and produce quality teachers who are most likely to be teaching their students in a world characterized by ongoing technological change. Many questions remain unanswered, among them: How well are we preparing our pre-service teacher education students for present and future technological teaching contexts? How are our current pre-service programs designed? What guidance can be provided for improving their design?

In Australia, the quality teaching agenda has been accompanied by the positioning of teacher education to capitalize on the technological potential for teaching in the 21st Century (DEEWR, 2008). However, even with the ready availability of hardware, software and broadband Internet connections, many beginning teachers are still unable to integrate ICT into the curriculum (Jamieson-Proctor & Finger, 2008) and often have limited technological knowledge (Jamieson-Proctor et al., 2010). Problematically for teacher educators, their graduates' lack of confidence and competence with ICT for teaching and learning may result from limited experiences with ICT during teacher preparation (Koehler, Mishra, & Yahya, 2007).

Problematically, the design of most teacher education programs in Australia continues to be informed by Shulman's (1987) concept of Pedagogical Content Knowledge (PCK). When Shulman was devising his PCK framework, computers were only beginning to appear in schools, however the Internet and many of the subsequent uses of technologies for teaching such as eLearning, mLearning, blended learning, Web 2.0 technologies, and uLearning were still to emerge. Consequently, the emphasis now being placed on training teachers to use ICT in the curriculum for teaching and learning (DEEWR, 2008) was not reflected in Shulman's PCK. Relatively recently, most Australian States and Territories have developed standards for

teachers which refer to ICT. For example, the ten professional standards developed by the Queensland College of Teachers (QCT, 2009) refer to ICT capabilities, along with references to Pedagogical Content Knowledge. Approximately 20 years on from Shulman's description of PCK, Mishra and Koehler (2006) have proposed Technological Pedagogical Content Knowledge (TPCK) as a framework for teacher knowledge with respect to teaching with ICT. They argue that "at the heart of good teaching with technology are three core components – content, pedagogy, and technology and the relationships between them" (Mishra & Koehler, 2008, pp. 11-12).

Further, the rapid rate of change of technology necessitates an understanding of its role in teaching and its impact on teacher beliefs. Sahin, Akturk and Schmidt (2009) found that TPACK positively affected pre-service teachers' vocational self-efficacy. Vocational self-efficacy refers to the pre-service teachers' perceptions of their competencies needed for their future profession. High self-efficacy is associated with lasting interests about an activity or career (Bandura, 1997). Further, self-efficacy has been shown to have a significant impact on an individual's interest in and decision to use technology (Sahin, 2008) and lack of self-efficacy has been linked to teachers' reluctance to integrate ICT into the curriculum for teaching and learning (Bednar & Sweeter, 2005). Therefore, it is realistic to presume that 21st century teacher education programs should provide pre-service teachers with the opportunity to enhance their ICT vocational self-efficacy along with their developing technological, pedagogical and content knowledge (TPACK).

This paper reports the results from an audit of the vocational self-efficacy of final year pre-service teacher education students from two universities in Queensland (Australia) with respect to their confidence to meet the Information Communication Technologies (ICT) professional competencies expected of teachers.

Research Methods

Participants

The participants in this study were 345 final year pre-service teacher education students from two universities in Queensland, Australia. The students were asked to voluntarily complete the *TPACK Confidence Survey (TCS)* online in August 2009. 79% of the participants were female, which is consistent with the teaching profession generally in Australia. Almost 48% of the pre-service teachers surveyed were not recent school leavers with ages in excess of 30 years. The participants were enrolled in either early childhood, primary, secondary or special education specializations in their undergraduate degree programs.

The Measurement Instrument

The instrument used was designed for the study and included items from the previously reported statistically robust *Learning with ICT: Measuring ICT Use in the Curriculum* instrument (Jamieson-Proctor, et al., 2007), which arguably measures two dimensions of TPACK, namely *enhancing* and *transforming* the curriculum through ICT use. Items were

also adapted from a previous study (Watson et al., 2004) measuring pre-service teachers' interest in and attitude towards using ICT; usefulness of contexts in which they acquired their ICT confidence and competence; and their technology knowledge (TK). The survey also provided for open-ended responses about the strengths and recommendations for improvement of their teacher education program with respect to developing their TPACK.

Participants' ICT vocational self-efficacy was measured using 12 items describing foundational competencies of ICT use for teaching in the 21st century that were derived from the Queensland ICT Pedagogical Certificate (DET, 2009) which is used as a guide to assist teachers to embrace digital pedagogy. Twelve indicators describing professional values, professional relationships, professional knowledge and professional practice were used to construct the *Self-efficacy* scale. The 12 items are displayed in Table 1. A four-point Likert-type response set was used for participants to indicate their level of confidence with each item (1=No confidence, 2=Some confidence, 3=Confident, 4=Very confident).

As the 12 items were hypothesized to measure one construct (ICT vocational self-efficacy) a factor analysis using Principal Components extraction with a Varimax rotation was used to assess the factor structure of the scale. Then, alpha coefficients were computed to evaluate the internal consistency of the scale and a Pearson Correlation was used to establish the relationships that exist between the individual items. The factor analysis revealed a single factor solution with an eigenvalue greater than one that accounted for 88% of the variance. All 12 items on this factor loaded between .92 and .96. The scale's internal reliability Alpha Coefficient was calculated at 0.99. Pairwise correlations between items ranged from 0.82 to 0.94 with all values significant at $p < 0.01$ (two-tailed). These very high correlations indicate that while the items appear theoretically distinctive, in empirical terms they are collinear.

Data Analysis

Statistical Package for the Social Sciences (SPSS 17.0) was used to calculate descriptive statistics. Participants' comments about the strengths of their teacher education program for developing their TPACK and their recommendations for improvement were analyzed using Leximancer 3 (2007). Leximancer identifies the salient dimensions of discourse by analyzing the frequency of use of terms and the spatial proximity of those terms. It uses a grounded theory approach to consolidate text into meaningful 'Themes', 'Concepts' and their associated relationships.

Results

ICT Vocational Self-efficacy

The 12-item *Self-efficacy* scale described above was used to measure the pre-service teachers' ICT vocational self-efficacy. Table 1 displays these results as means with standard deviations beside each of the items in the scale.

Table 1: Descriptive statistics for the pre-service teachers' ICT vocational self-efficacy (N=345)

	The Professional Capabilities of the ICT Vocational Self-efficacy Scale	Mean (SD)
	Professional Values:	
1	As a life-long learner, I will be able to set my own short and long term learning goals based on regular reflection of my own professional practice and determined needs. I will be able to devise and enact a plan to achieve these.	2.71 (1.17)
2	I will be able to collaborate with staff and/or students to critically reflect on and evaluate the learning opportunities and implications of digital resources, technologies and environments.	2.77 (1.14)
3	I will be able to operate safely, legally, ethically and in accordance with departmental policy when using digital resources, technologies and online environments. I will be able to teach and model these practices with students and colleagues.	2.91 (1.18)
	Professional Relationships:	
4	I will be able to use ICT to communicate with others for professional purposes.	3.09 (1.21)
	Professional Knowledge:	
5	I understand that ICT can be used to benefit teaching and learning and is most effective when used in the context of learning and not as an end itself.	2.94 (1.16)
	Professional Practice:	
6	I will be able to provide opportunities for students to use ICT as part of their learning.	2.77 (1.15)
7	I will be able to provide opportunities for students to use ICT to gather information and to communicate with a known audience.	2.81 (1.15)
8	I will be able to manage the access to and use of ICT resources in meeting student learning needs.	2.63 (1.12)
9	I will be able to use a range of ICT resources and devices for professional purposes.	2.75 (1.16)
10	I will be able to use ICT to locate, create and record information and resources.	2.88 (1.16)
11	I will be able to store, organize and retrieve digital resources.	2.94 (1.18)
12	I will be able to use ICT to access and manage information about student learning.	2.88 (1.16)

Overall, the final year pre-service teachers were not confident ($M \geq 3$) that they could meet the foundational ICT competencies described in the *Self-efficacy* scale ($M=2.84$; $SD=1.09$). Further, as can be seen in Table 2 only one item (I will be able to use ICT to communicate with others for professional purposes) resulted in a 'confident' response ($M \geq 3$) and problematically for teachers about to start their teaching career, the lowest mean ($M=2.63$) was recorded for the participants' perception that they 'will be able to manage the access to and use of ICT resources in meeting student learning needs'.

Contexts of Gaining TPACK at University and their Perceived Usefulness to Pre-service Teachers

Participants were asked where they had developed their TPACK while at university. If they indicated that they had experienced a particular learning context, an additional item appeared in the online survey that asked them to rate the usefulness of that context in developing their TPACK from not at all useful to very useful. Table 2 displays these results.

Table 2: Usefulness of University Contexts in Developing TPACK (N=345)

			Usefulness rating #(%)			
How students developed their TPACK at university:	**# of Students**	**%**	**Not at all Useful**	**Useful to some extent**	**Generally useful**	**Very useful**
A Specialist ICT Core Course:						
Yes	109	31.6	5(1.4)	36(10.4)	30(8.7)	38(11)
No	206	59.7				
Missing	30	8.7				
Total	**345**	**100**				
A Specialist ICT Elective Course:						
Yes	60	17.4	1(.3)	11(3.2)	25(7.2)	23(6.7)
No	255	73.9				
Missing	30	8.7				
Total	**345**	**100**				
School Practicum Experiences:						
Yes	209	60.6	8(2.3)	61(17.7)	69(20)	71(20.6)
No	105	30.4				
Missing	31	9				
Total	**345**	**100**				
University Computing Skills Workshop/s:						
Yes	92	26.7	4(1.2)	31(9)	36(10.4)	21(6.1)
No	222	64.3				
Missing	31	9				
Total	**345**	**100**				
University Online Tutorial/s:						
Yes	93	27	4(1.2)	31(9)	36(10.4)	22(6.4)
No	221	64.1				
Missing	31	9				
Total	**345**	**100**				

These results indicate that the students developed their TPACK most frequently while at university from school practicum experiences, and they considered this to be the most useful method of developing their TPACK with 40% finding practicum generally useful or very useful. Interestingly, ICT core courses were considered not much more useful in developing the students' TPACK than short computing skills workshops and online tutorials. Also, workshops and online tutorials were considered more useful than ICT elective courses.

Other Contexts for Gaining ICT Confidence and Competence and the Perceived Usefulness of these to Students

Participants were also asked to rate the usefulness of other contexts for gaining ICT confidence and competence. Table 3 displays these results.

Table 3: Usefulness of Other Contexts in Developing ICT Confidence and Competence (N=345)

			Usefulness rating #(%)			
	# of Students	**%**	**Not at all Useful**	**Useful to some extent**	**Generally useful**	**Very useful**
At Primary School:						
Yes	101	29.3	8(2.3)	29(8.4)	40(11.6)	24(7)
No	213	61.7				
Missing	31	9				
Total	**345**	**100**				
At Secondary School:						
Yes	178	51.6	7(2)	37(10.7)	75(21.7)	59(17.1)
No	136	39.4				
Missing	31	9				
Total	**345**	**100**				
At Work:						
Yes	206	59.7	4(1.2)	36(10.4)	74(21.4)	92(26.7)
No	108	31.3				
Missing	31	9				
Total	**345**	**100**				
At Home:						
Yes	298	86.4	0	34(9.9)	99(28.7)	165(47.8)
No	16	4.6				
Missing	31	9				
Total	**345**	**100**				

Of the other locations presented to participants, the two most frequently stated locations for gaining ICT confidence and competence were ‘work’ and ‘home’. Respondents also considered their ‘home’ to be the most useful context in which to develop their ICT capabilities. As 48% were mature-age students, this result may indicate that they had recent and lengthy exposure to ICT in the home and workplace prior to coming to university. However, 52% were recent school leavers and a relatively small percentages of students indicated either ‘primary’ or ‘secondary’ school as a context in which they developed their ICT capabilities. Generally, formal learning contexts (primary to tertiary) were not highly rated for providing opportunities to develop the ICT confidence and competence of these soon-to-be teachers.

Strength of the Program and recommendations for improvement

The pre-service teachers were asked to indicate the strengths of their undergraduate program in assisting them to develop their TPACK, as well as recommendations for improvement of their pre-service teacher preparation program. Comments were entered into Leximancer V3 for analysis. Figure 1 displays the major themes that emerged.

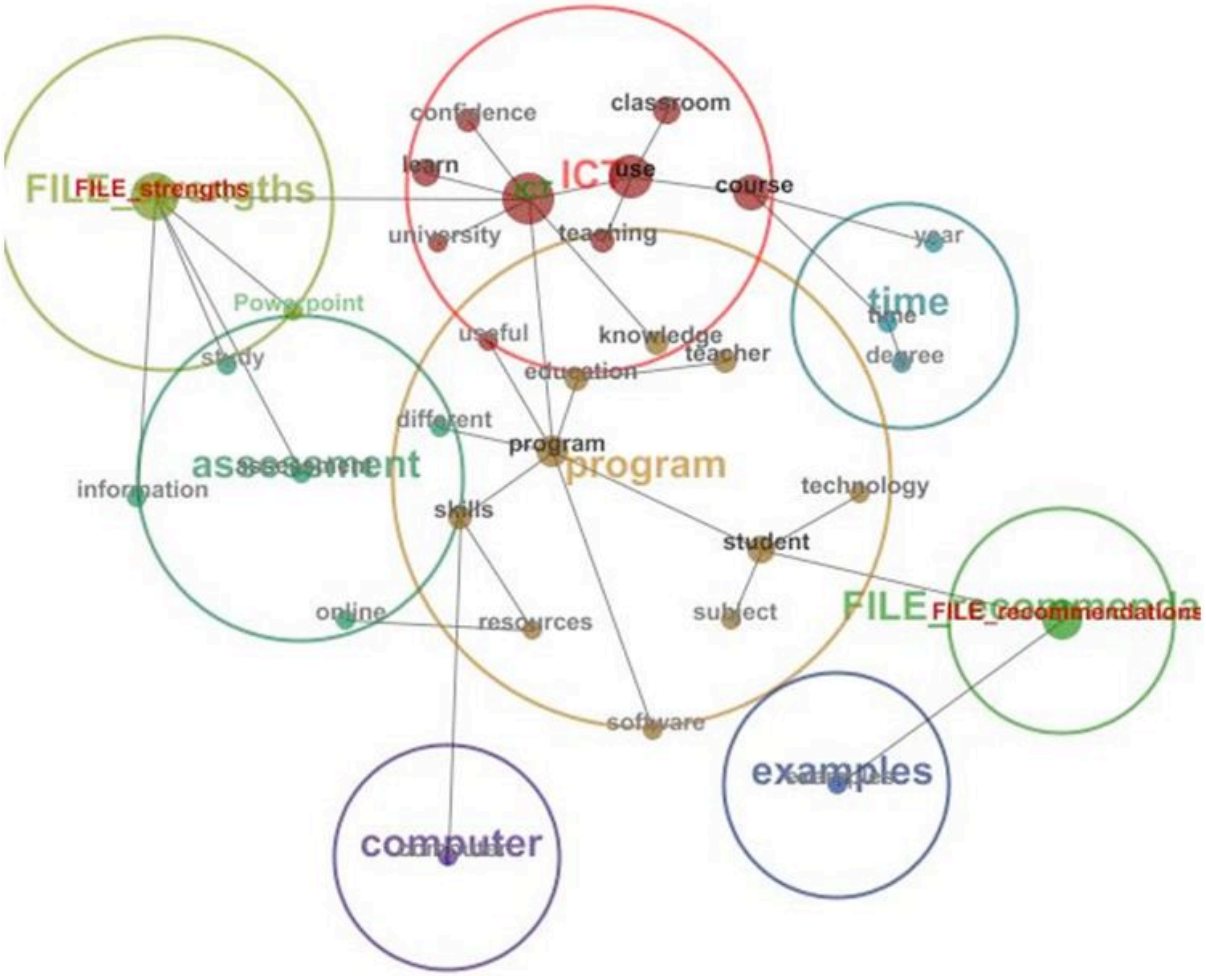

Figure 1. Composite image of major themes describing program strengths and recommendations for improvement

As indicated in Figure 1, major themes common to both the strengths and recommendations items include assessment, ICT, program, time, examples and computer. Comments related to strengths most immediately link with the assessment and ICT themes. These themes, in turn, link with themes related to program and time. In contrast, comments related to recommendations link most immediately to the themes of examples and program. The theme of program links directly to ICT, assessment, time and computer.

What the above composite image suggests is that students most often wrote about the strengths of their program in relation to competencies gained through *assessment* tasks (e.g., "Assessments that integrated ICT components in courses helped to create a necessity to learn the skills involved") and *use of ICT* in classrooms and university courses by academics (e.g., "The strength of this program rests in the modeling [sic] of the use of appropriate and relevant

technology from the Lecturers and Tutors"). A common theme in the students' responses indicated that they enhanced their TPACK by studying *online* (e.g., "Because all of my subjects are delivered online, I am constantly using ICT to study and learn ICT areas new to me" or "The greatest strength is that the course is primarily conducted online so I am forced as a student, to engage in online forums, blogs, retrieving, storing, presenting and sharing information").

Recommendations based on providing *examples* for students were also frequent comments (e.g., "Examples are the key, the more good examples of success in student learning and engagement the better", "I would have liked our lecturer in our key learning area to give us examples of things used so we could learn" and "Show us some programs, give us some examples, and provide us with some resources"). Forty-six recommendations linked to *program* suggested greater emphasis on teaching how to use specific software programs (e.g., "Would have liked to learn about more programs that are used in the classroom", "Offer some mini courses or support sessions with software or hardware that is commonly used in classrooms eg. Smartboards, moviemaker, photo story, features of Microsoft programs that can be used to assist student learning" and "It would be beneficial if ICT programs were focused around programs that are used throughout the education system: eg PowerPoint, publisher rather than Dreamweaver. Also an introduction to using Smartboards")

Conclusion

This study is one of many conducted by the authors over a number of years with pre-service and practising teachers aimed at evaluating the quality of student learning experiences as a result of the use of ICT in the curriculum. The 2009 pre-service teacher audit is more extensive than the results reported in this paper. However, this paper's results give a clear indication that, generally, final year pre-service teachers at two Australian universities have not acquired a 'confident' level of ICT vocational self-efficacy during their four-year undergraduate program. Thus, they may very well be reluctant to use ICT for teaching and learning in their classrooms after they graduate (Bednar & Sweeter, 2005).

The pre-service teacher education students in this study indicated more useful learning about educational technologies occurred in their home than through their core and elective ICT university courses. They indicated that the strengths of their program in developing their TPACK was mostly linked to the necessity for them to learn about new digital technologies in order to complete an assessment task, or to study online. Taken together, the results of this study indicate that providing students with an opportunity to study online from their home, while also supporting development of their technology skills, and providing them with continuing opportunities to use ICT for teaching and learning while on school practical placements, may enhance their TPACK self-efficacy more than dedicated university courses.

Teacher education programs are entrusted with the responsibility of ensuring that graduating teachers are prepared for learning and teaching in the 21st century. To achieve this, we believe that there needs to be a better, shared understanding of TPACK that should be used to inform and underpin the development of teacher education programs. We also believe that it is essential to measure pre-service teacher education students' TPACK capabilities regularly throughout their program of study to ensure their TPACK and vocational self-efficacy with regard to ICT use are developing.

Finally, it is obvious that further investigations are necessary to inform the development of 21st century teacher education programs which are able to provide pre-service teachers with the opportunity to enhance their ICT vocational self-efficacy alongside their developing technological, pedagogical and content knowledge bases (TPACK). The results of this study indicate that we have a long way to go in ensuring that pre-service teachers acquire confidence in their ability to use ICT in teaching and learning and the reason for this is probably that teacher education programs are still largely informed by PCK, as indicated by this student's comment "Universities need to practice what they preach. They speak of the importance of using ICT to enhance learning. They need to encourage most courses to use ICT. I feel as though, just like the standards, ICT have been tacked on to the end".

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