Age-related differences in ICT access and confidence among pre-service teachers

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The Australian Government's Digital Education Revolution is directed at school education but, because teacher preparation is a significant factor in its success, there are implications for teacher education in Australian higher education. A national project, *Teaching Teachers for the Future*, has been funded to support change in teacher preparation programs based on the construct of Technological Pedagogical Content Knowledge (TPACK), which describes teachers' complex combination of knowledge of content, pedagogy, and technology. Knowledge of information and communication technology is a necessary, but not sufficient, foundation for TPACK. This paper presents data about ICT access and confidence reported by teacher education students in a regional university. Key findings included that teacher candidates had access to and confidence for using common forms of ICT but more limited access to and confidence for using less common forms, and that there were few significant differences in ICT access and confidence according to age.

Keywords: teacher education, TPACK, ICT integration, digital generation

Background

Australian school education is in the throes of a government-sponsored *revolution*. The change of government in 2007 was followed by a series of initiatives collectively known as the *Digital Education Revolution* (DER) (DEEWR, 2008). This continued, and intensified, the commitment of successive Australian governments to broad goals for information and communication technology (ICT) in education, namely that young people should complete their schooling with relevant knowledge and skills for using ICT, and that ICT should be used to improve student learning across the curriculum (Toomey, 2001). Achievement of these goals depends upon

multiple conditions, most importantly students in schools having access to sufficient current ICT for learning about and with ICT, curriculum being adapted to incorporate greater use of ICT, and teachers being adequately prepared to work with ICT in their classrooms.

Early phases of the DER included promises of funding to schools to achieve a computer to student ratio of 1:1 for years 9 to 12 by 2011, and improved broadband Internet connections to schools. Despite some challenges in implementation this aspect of the DER has substantially increased access to ICT in schools. At the same time the first phase of the Australian Curriculum (http://acara.edu.au) is being implemented for English, Mathematics, Science and History with other subjects to follow. ICT competence is included as one of seven general capabilities to be addressed across the National curriculum, indicating some progress on the second of the three conditions mentioned above.

The DER has been guided by a roadmap (AICTEC, 2009) that recognized that "educators require the pedagogical knowledge, confidence, skills, resources and support to creatively and effectively use online tools and systems to engage students" (p. 6). The roadmap noted that there would be need to provide professional learning opportunities for existing teachers and to ensure that graduate teacher standards include the use of ICT in teaching. An *ICT Innovation Fund* was established and applications were invited for funding of projects in the areas of improving capability of pre-service teachers, enhancing capacity of in-service teachers, and driving innovation through leadership (DEEWR, 2010a). A group established through the Australian Council of Deans of Education (ACDE) submitted a successful proposal in the pre-service area which attracted funding of $7.8 million for an unprecedented national project, *Teaching Teachers for the Future* (TTF) (ALTC, 2010). TTF involves all Australian Higher Education Institutions (HEIs) that have a teacher preparation program, together with the Australian Learning and Teaching Council (ALTC), Education Services Australia (ESA), the Australian Institute for Teaching and School Leadership (AITSL), and the Australian Council for Computers in Education (ACCE). As submitted, the project was to be led by ALTC but changes to ALTC in early 2011 resulted in ESA assuming the role of lead partner.

The TTF project has three major components that are intended to delineate standards for ICT capabilities of graduating teachers; develop resources to support teacher preparation to meet these standards; and revitalize teacher preparation programs to prepare teachers for integrating ICT in the new national curriculum. The first component is being led by AITSL and ACCE with input from the other partners and the second is being undertaken by ESA, again with input from other partners as appropriate. The third, and by far the largest, component is directly involving the 37 HEIs offering teacher preparation in a process of reviewing and revitalising the ways in which new teachers are prepared to work with ICT. This work is being supported by direct funding to the HEIs to engage personnel who are highly accomplished in teaching with ICT and the development of a National Support Network (NSN) to facilitate the sharing of relevant practice among HEIs. The NSN is intended to continue to function beyond the life of the TTF project which ends in June 2012.

All three components of the TTF project will affect teacher preparation programs in HEIs. Clarification of how ICT capability is demonstrated in the AITSL standards for graduates will affect curriculum and assessment for teacher preparation programs and the resources being developed by ESA will affect how certain elements of such courses are offered. However, the most direct and immediate effect will be through the third component as courses are progressively examined for their contribution to developing ICT capability and appropriately adjusted. This paper addresses some background to course revision by examining some pre-existing factors that may influence the changes that will be required.

Technological Pedagogical Content Knowledge

The teacher preparation component of TTF has adopted Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006) as its underpinning conceptual framework and will draw upon previous work (Albion, Jamieson-Proctor, & Finger, 2010; Jamieson-Proctor, Finger, & Albion, 2010) in developing its evaluation strategy. Koehler, Mishra and Yahya (2007, p. 741) have argued that:

> intelligent pedagogical uses of technology require the development of a complex, situated form of knowledge [called] Technological Pedagogical Content Knowledge (TPCK). At the heart of

TPCK is the dynamic, transactional relationship between content, pedagogy and technology. Good teaching with technology requires understanding the mutually reinforcing relationships between all three elements taken together to develop appropriate, context specific strategies and representations.

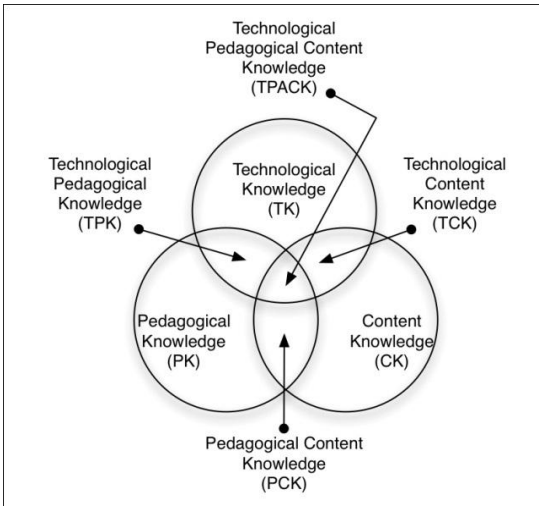

Figure 1: TPACK Conceptualization (After Mishra & Koehler, 2006)

According to Mishra and Koehler (2006) TPACK encapsulates knowledge of content, pedagogy, and technology, as well as an understanding of the complex interaction between these three main knowledge sets. They argue that teachers who have this level of understanding are characterized by the creative, flexible, and adaptive ways in which they navigate the affordances, constraints, and interactions within and among the TPACK framework elements.

More recently, Graham (2011) has examined the theoretical underpinnings of TPACK and has identified areas that require further development to ensure adequately shared understanding among researchers and practitioners. One issue that he identified was whether the areas of intersection should be understood as *integrative*, representing a combination of the intersecting kinds of knowledge, or *transformative*, representing a new synthesised form of knowledge that is more than the sum of its parts. Graham notes that although the descriptions offered by Mishra and Koehler (2006) imply a transformative understanding the conventional diagram is generally understood as integrative.

A further issue identified by Graham (2011) is with the understanding of *technology* in the TPACK model. Mishra and Koehler (2006) included older technologies such as the pencil and chalkboard, implying that technological knowledge and TPACK would be required for every teaching situation. Graham refers to work from Cox (2008) who distinguished between *transparent* and *emerging* technologies, with the former being familiar technologies in ubiquitous use (pencil, chalkboard, etc.) and the latter referring to being the newer, less familiar and mostly digital technologies being introduced. This is a useful distinction in relation to how knowledge of transparent technologies may be subsumed into pedagogical and content knowledge.

The TPACK framework almost suggests a new form of literacy for teachers, a literacy that emphasizes an active role for the teacher as a producer, a designer, which is very different from the traditional static idea of teachers as consumers or users of technology. Further, the TPACK model implies a 'system' which is in a constant state of flux and this system requires teachers to make thoughtful decisions related to content, pedagogy and technology within their unique teaching contexts. Teachers therefore need to be able to problem solve and think creatively about the interactions described by the TPACK framework in order to maintain the equilibrium of the overall system.

It might be argued that good learning outcomes for school students ensue from a teacher's ability to maintain the equilibrium that is the TPACK system in 21st century classrooms. It might be argued further that teacher education programs that compartmentalise the three knowledge bases described by the framework (technology, pedagogy & content) and attempt to develop them separately from or in parallel with each other, undersell the value to be gained from using an integrated approach that requires the teachers in training to "think to learn and thereby learn to think" (Sternberg, 1999, p. 7) in relation to transforming pedagogy and content with technology.

Clearly, the conceptualization of the TPACK framework as a system suggests strongly that no one element is more or less important than the others but that they are interdependent. In previous decades it was sometimes assumed that it would be sufficient to graduate technology-competent new teachers and expect them to apply their skills in the classroom. That is no longer sufficient. Australia is progressing towards an understanding of the necessary skills for teachers to make them 'TPACK ready' for their professions and, as a first step, most Australian States and Territories have developed standards for teachers, including standards which refer to ICT. For example, the ten professional standards developed by the Queensland College of Teachers (2009) refer to ICT capabilities, along with references to pedagogical content knowledge. However, there is still much to be done to ensure that teacher educators and teacher education programs are ready and able to assist their students, soon to be teachers, to develop the new TPACK literacy that they will require in order to be able to facilitate and inspire student learning and creativity; design and develop digital-age learning experiences and assessments; model digital-age work and learning; promote and model digital citizenship and responsibility; and engage in professional growth and leadership (International Society for Technology in Education, 2008).

Generational change and the DER

One of the prevailing myths of our age is that there is a generational gap related to ICT such that the rising generations are 'digital natives' in contrast to their elders who are 'digital immigrants' (Prensky, 2001). Researchers report that students are "media literate" (Dodge, et al., 2008) and suggest that the solution to increased use of ICT in education is for educators to harness the skills of their technologically competent students (Harris & Rea, 2009). When teachers' use of ICT in classrooms appears limited, proponents of the digital generation gap are inclined to explain it in terms of the generational difference between teacher and student. In that view, a solution to the problem lies in generational change so that new teachers will use the new technologies. However, recent research has questioned the existence of the generational gap in relation to ICT (Margaryan, Littlejohn, & Vojt, 2011; Salajan, Schönwetter, & Cleghorn, 2010).

Australian university undergraduate cohorts, including those in teacher preparation programs, are not uniformly drawn from the new generation of school leavers. Most cohorts now include a variable, but sometimes substantial, proportion of mature students seeking career change opportunities. Of students studying for a Bachelors degree in Australian universities during 2009, 24% were aged 25 or older including 15% who were older than 30 years (DEEWR, 2010b). A survey of final year teacher education students found 45% were aged 25 or older and 10% were aged 40 or older (DEST, 2006). The presence of mature students in teacher preparation programs has many potential benefits but it makes any hope that a generational change in graduates entering the teaching profession will result in any desired changes in the uptake of ICT by teachers questionable.

Preparing teachers for the DER

If the Australian Digital Education Revolution is to be successful in achieving its goals, it will be necessary to ensure that newly graduating teachers are well prepared to make effective use of ICT in their future practice. For the reasons noted above, relying upon generational change is unlikely to provide a solution. Hence, it is important that teacher preparation programs respond to the need by adapting their curriculum and pedagogy. The *Teaching Teachers for the Future* project is intended to catalyse those changes.

The adoption of TPACK as the conceptual framework for TTF signals a clear understanding that the future of ICT in education cannot be based simply upon enhancing teachers' ICT capabilities whether through generational change or preparation programs. In the TTF project, as in professional practice, technology, pedagogy and content (curriculum) will be interlinked to create the complex professional knowledge that is

TPACK. However, as is evident in the TPACK model, the knowledge in the intersections of the domains does not exist independently of the knowledge characteristic of each domain. It is not possible to teach content or technology without demonstrating pedagogy in the process and neither can technology be learned effectively without using it, which necessarily involves dealing with content and learning something about pedagogy as a side effect of the process. There will be a continuing requirement for specialized knowledge of content (curriculum), pedagogy and technology but it is important to recognize that knowledge is interlinked across the domains, is developed in combination, and may be rearranged and applied in different combinations.

In the case of technology knowledge, it will be important that graduates have skills for the fluent use of a variety of ICT hardware and software and have the capability to learn more as the need arises and as technology continues to evolve. Teacher preparation programs seeking to enhance graduates' ICT capabilities will benefit from availability of data about students' access to ICT and existing capabilities with current and evolving software applications to inform their provisions so that programs neither needlessly replicate prior experiences nor assume too much as a foundation on which to build. This paper reports such data for a sample of students in the teacher preparation programs at a regional Australian university. It will seek to provide answers to the following research questions:

1. What levels of access do teacher candidates have to ICT hardware and services?
2. What levels of confidence do teacher candidates report for use of a variety of ICT applications?
3. What, if any, differences are found for responses of teacher candidates from different age groups (generations) or other identifiable groups?

Method

The data reported in this paper were collected as part of a larger study conducted as an extension of previous work on auditing the TPACK confidence of teacher preparation candidates (Albion, Jamieson-Proctor, et al., 2010; Jamieson-Proctor, et al., 2010). The instrument used was adapted from that used in the previous study and reported in those papers with the addition of an item about access to ICT based on one originally reported by Kennedy et al. (2009) and adapted for use elsewhere (Albion, Loch, Mula, & Maroulis, 2010).

The questionnaire was administered online using LimeSurvey® (http://www.limesurvey.org/) with email invitations sent to 3200 students enrolled in teacher preparation programs at two participating universities in Queensland. One of the universities is located in a largely urban area and the other is classified as a regional university. The survey software supported anonymous tracking of responses so that reminders could be sent to students who had not responded. Two rounds of reminders were sent during the October-November 2010 period in which the survey was active. Data were downloaded and transferred to PASW Statistics 18 for analysis.

Results

The questionnaire recorded a total of 891 responses (28%) from the 3200 invitations sent to students at the two universities. Some students exited the questionnaire without completing it and, because the data were collected to guide internal university operations as well as for research, the final question sought student consent to use the data for research, further reducing the data available for analysis. This paper reports on data from 450 completed questionnaires that included research consent received from the 2170 invited students (21% response) at the regional university.

Table 1 presents data for gender and age of survey respondents. As is common in teacher preparation programs, the vast majority of respondents were female (86%). This proportion is somewhat higher than the 80% reported from a national study of final year teacher education students (DEST, 2006). Slightly more than half (58%) of the respondents reported being aged 30 years or older, confirming that the teachers in preparation at this regional university could not be presumed to be members of the 'digital natives generation'. This proportion is higher than the approximately 30% reported from a national study of final year teacher education students

(DEST, 2006) but is representative of the teacher preparation enrolment at the study university.

Table 1: Percentage distribution of respondents by gender and age (N = 450)

	< 20	20-29	30-39	40-49	>=50	Total
Female	7.3	29.3	28.9	16.7	4.0	86.2
Male	1.6	4.2	3.6	4.4	0.0	13.8
Total	8.9	33.6	32.4	21.1	4.0	100.0

The regional university delivers its teacher preparation programs on three campuses as well as fully online. Responses to the questionnaire represented all four locations, with 27% reporting that they were studying at the main campus located in a provincial city, 9% at the smaller regional campus, 12% at the newer outer-metropolitan campus, and 52% studying predominantly online. Respondents were distributed across all years of the four-year teacher preparation program with 35% in first year, 23% in second year, 26% in third year, and 16% in fourth year. In respect of these general demographic variables the respondents appear to be representative of the population of the teacher preparation program more broadly.

Table 2: Percentage of respondents reporting different levels of access to types of ICT (N = 450)

	Access exclusively for my own use	Access any time I need it, shared with other people	Limited or inconvenient access	No access	Not sure	χ^2 statistics for differences by age (df = 16)		
						χ^2	*p*	V
Desktop computer	40.2	37.6	8.2	13.3	0.7	15.66	.477	.093
Portable computer	68.4	14.4	3.6	13.1	0.4	27.20	.039	.123
MP3 player	54.4	10.2	5.1	28.4	1.8	64.32	< .001	.189
Video MP3 player	29.3	6.4	6.7	54.2	3.3	37.90	.002	.145
iPod Touch	13.8	5.1	4.7	74.2	2.2	19.51	.243	.104
Digital still camera	69.3	21.6	2.0	6.2	0.9	29.46	.021	.128
Digital video camera	34.2	20.0	10.0	34.0	1.8	25.34	.064	.119
Mobile phone	75.8	4.7	3.3	14.9	1.3	19.04	.267	.103
Smart phone	24.2	1.8	3.1	67.8	3.1	20.18	.212	.106
Portable data storage	92.4	3.6	0.4	2.9	0.7	15.58	.482	.093
Video game console	30.0	34.2	6.2	28.2	1.3	36.34	.003	.142
Web cam	53.8	15.1	4.9	23.8	2.4	18.12	.317	.100
Printer	65.6	31.1	2.4	0.4	0.4	33.55	.006	.137
Scanner	57.3	28.9	6.9	6.4	0.4	24.58	.078	.117
eBook reader	3.8	2.9	4.0	85.6	3.8	16.14	.443	.095
iPad	2.2	2.2	2.2	90.0	3.3	22.92	.116	.113
Dial-up Internet	6.4	4.2	4.4	80.9	4.0	37.03	.002	.143
Broadband Internet	63.8	31.8	2.0	2.2	0.2	39.22	.001	.148

Participants were asked to indicate their levels of access to different types of ICT. Where appropriate, to assist interpretation, the items included examples such as “iPhone, Android, Blackberry” for smartphones or “Kindle, Kobo, iPad” for eBook reader. Table 2 reports these data as percentages of responses in each category for all respondents.

When the data for desktop and portable computer access were examined together, just 2 respondents (0.4%) reported no access to either and 5 respondents (1%) reported that they had no access or only limited or inconvenient access to a computer. In all, 278 respondents (62%) reported that they had exclusive or convenient shared access to both desktop and portable computers. In regard to Internet access, just 8 respondents (1.8%) reported limited, inconvenient or no access to either dial-up or broadband connections and only 11 respondents (2.5%) with dial-up access did not also have convenient access to broadband. Of the 440 respondents (2.2%) who reported some level of broadband access, 202 (46%) reported that the quality of the service they accessed, in speed and data capacity, was acceptable with most reporting speeds of 512 kbps or better and data capacity of at least 5 GB per month or speeds and data volume they considered acceptable for their purposes.

These high levels of access to basic forms of ICT contrast with more limited access to newer forms of ICT such as eBook readers (86% no access), basic MP3 players (28% no access) and MP3 players able to play video (54% no access) that might have application for access to study material. Although a small proportion of these students may be equipped to take advantage of study materials packaged for mobile access, many or most are not and this should be considered as a factor in future development of instructional materials.

The responses were further examined using cross-tabulation with age and statistics from the associated chi-squared tests are also reported in Table 2. Numbers of responses and degrees of freedom did not vary and are not reported in the columns. Cramer's V is included as a measure of effect size. The chi-squared tests found significant differences by age ($p < .05$) for MP3 players (with and without video playing capability), video game consoles, printers, Internet connections (dial-up and broadband), digital cameras, and portable computers. All of the effect sizes as measured by Cramer's V are small (< .2) and, other than for the MP3 players, game consoles, and portable computers, where there was a clear pattern of higher levels of access among younger respondents, the patterns of different access levels by age were unclear. There were some indications that the differences for printers and Internet connections might be related to higher levels of exclusive access among older respondents but there were also higher numbers of older respondents who reported being unsure of their access to those forms of ICT. On the basis of these results, other than for a small subset of devices (MP3 players, games consoles) typically associated with the younger generation and portable computers, there appears to be limited evidence of a significant generational gap in access to ICT among these teachers in preparation.

Table 3: Percentage distribution and means of confidence for ICT applications (N = 450)

	No confidence (1)	Some confidence (2)	Confident (3)	Very confident (4)	Mean	SD	ANOVA statistics for differences by age		
							F	***p***	**η^2**
Word Processing	0.2	5.3	31.3	63.1	3.57	0.61	3.04	.017	.027
Desktop Publishing	12.4	31.8	32.7	23.1	2.66	0.97	1.79	.130	.016
Presentation Software	4.0	15.3	38.0	42.7	3.19	0.84	3.62	.006	.032
Spreadsheets	16.0	30.7	30.4	22.9	2.60	1.01	3.55	.007	.031
Databases	41.8	36.7	16.9	4.7	1.84	0.87	0.64	.636	.006
Graphics creation and/or editing	26.0	44.2	20.7	9.1	2.13	0.90	1.99	.094	.018
Digital image capture	3.1	20.9	37.6	38.4	3.11	0.84	4.23	.002	.037
Multimedia Development and Authoring	50.0	34.2	12.4	3.3	1.69	0.82	2.96	.020	.026
Visual Thinking / Concept Mapping Software	57.1	29.3	10.9	2.7	1.59	0.79	1.37	.243	.012
Digital Video Editing	36.2	36.7	17.3	9.8	2.01	0.96	4.23	.002	.037
Email	0.4	3.6	26.0	70.0	3.66	0.57	1.07	.372	.010
Web Browsers	1.6	8.4	28.9	61.1	3.50	0.72	1.30	.271	.012

Web Searching	0.4	2.9	26.4	70.2	3.66	0.56	1.29	.273	.011
Web Page Development	50.4	32.0	12.9	4.7	1.72	0.86	1.13	.344	.010
Web 2.0 and Social Networking	9.1	20.0	29.3	41.6	3.03	0.99	16.60	< .001	.130
Web 2.0 and Creativity	34.9	35.8	20.4	8.9	2.03	0.95	7.63	< .001	.064
Reading eBooks	29.3	34.2	22.9	13.6	2.21	1.01	3.67	.006	.032
Online learning management systems	10.7	27.6	37.8	24.0	2.75	0.94	7.38	< .001	.062
Online publishing	21.1	41.1	24.7	13.1	2.30	0.95	6.45	< .001	.055
Create reusable learning objects	26.2	39.1	23.8	10.9	2.19	0.95	3.16	.014	.028
Access repositories of reusable learning objects	28.4	35.8	22.9	12.9	2.20	1.00	2.71	.030	.024

Participants were asked to rate their confidence for using various types of ICT applications. To assist with clarifying meaning, examples of applications were provided for each item but they are omitted from the table for reasons of space. Responses were recorded on a 4-point scale from 'No confidence' to 'Very confident' and means and standard deviations were calculated by scoring the points from 1 to 4. Table 3 reports these data as percentages of responses in each category together with means and standard deviations.

Results indicated that the students were confident to very confident with common applications such as word processing, email, and web browsing. However, most respondents were not confident with less commonly used or more complex ICT applications such as spreadsheets, databases, multimedia development, web page development, and video editing. These results are consistent with the finding reported in the earlier study (Jamieson-Proctor, et al., 2010) which reported that final year students tended to be confident in only a limited range of ICT applications, such as word processing, email and web browsing. Similarly, many were not confident in using applications that might be used to enhance learning and teaching, such as accessing repositories of learning objects, online publishing, and visual thinking software.

The results were examined using ANOVA for differences by age group and the relevant statistics are also reported in Table 3. Numbers of responses and degrees of freedom were consistent at 450 and (4, 445) across all items. Eta squared (η^2) is included as an estimate of effect size. Analysis using ANOVA found significant differences ($p < .05$) by age group for 13 of the 21 application categories as shown in Table 3. Post hoc analysis using Tukey HSD revealed that the significant differences in means were related to respondents in the 40 to 49 years age group and, less often, the 30 to 39 years group, reporting lower levels of confidence than those in the 20 to 39 years and less than 20 years age groups. In all cases the effect sizes given by η^2 were small (< .2). Although the effect sizes are small, the pattern of results suggests that, in addition to the whole population of teachers in preparation having limited confidence with newer ICT applications, there may be some specific differences related to age that should be considered in the design and implementation of teacher education programs.

A further ANOVA was used to investigate any relationship between confidence with ICT applications and progression in the teacher preparation program. Significant differences were found for presentation software ($F(3,425) = 16.24$, $p < .001$, $\eta^2 = .103$), visual thinking and concept mapping ($F(3,425) = 5.42$, $p = .001$, $\eta^2 = .037$), and accessing learning object repositories ($F(3,425) = 11.87$, $p < .001$, $\eta^2 = .077$). In each case students in later years of the program reported higher mean levels of confidence. For presentation software and access to

learning object repositories there was a pattern of growth from year to year whereas for visual thinking software there was a more pronounced increase for respondents in their fourth year.

Discussion

The analysis presented in this paper was intended to address three key questions related to levels of access to ICT hardware and services, confidence for using ICT applications, and related differences by age or year of study. Most of the teachers in preparation who responded to the questionnaire have convenient access to basic ICT hardware and services and are confident in working with common ICT applications. However, their experience of increasingly common forms of ICT and software applications appears to be more limited. Many reported having little or no access to devices such as MP3 players, especially those with capability to view video, digital video cameras, smart phones or similar devices such as the iPod Touch, or eBook readers. Similarly, low levels of confidence were recorded for some ICT applications, especially those that are in less common use or are more complex, such as authoring multimedia or web pages.

Analysis revealed some areas in which there were significant differences by age group for access to different forms of ICT and confidence in using some applications. However, the effect sizes were small. Although it would not be appropriate to assume age-related differences as a basis for program planning, it would be important to recognize that such differences in access, related experience, and confidence do exist between and within age groups and to ensure that any teacher preparation program offers opportunities for access that will assist students to extend their experience of ICT and build their confidence with a wider range of applications. There is limited evidence of growth in confidence with some ICT applications from year to year within the program but there remains ample scope for further development of opportunities.

When considered alongside broader trends in ICT and its adoption in Australian society these findings have implications for the design and implementation of teacher preparation programs. ICT, both hardware and software, continues to develop quickly and the uptake by households is widespread. Among Australian households with children the proportion with Internet connected computers grew from 20% to 86% between 1998 and 2009 (ABS, 2011). In 2009 31% of children owned a mobile phone with the proportion varying from 2% for 5-8 year olds to 76% among 12-14 year olds (ABS, 2011). Although only 4% of children had used their mobile phone to access the Internet, that proportion can be expected to increase rapidly as Internet-connected smartphones become more common. Similar trends exist for other forms of ICT. The implication is that the ICT capabilities required by teachers will be a moving target and teacher preparation programs need to respond by ensuring that graduates have had opportunities to develop skills and confidence for working with newer forms of ICT that are likely to be increasingly familiar to the children they will be teaching and to continue learning about new forms of ICT beyond graduation. It will not be sufficient to rely upon the skills that teacher candidates possess on entry or to address only the forms of ICT that are most commonly available during their program of study.

The *Teaching Teachers for the Future* project is directed toward the development of graduating teachers' TPACK, which, as indicated in Figure 1, is a complex construct comprising the intersection of different knowledge domains. Given that complexity, the successful development of TPACK will not be accomplished by developing separate strands of content, pedagogical and technological knowledge and expecting those to be appropriately melded in the future practice of graduates. As noted above, it is not possible to teach content without demonstrating pedagogy nor to learn technology without using it with content and observing pedagogy in the process. Nevertheless, data such as presented in this paper, about the current access of teacher candidates to ICT and their confidence for using them, provide an important foundation for guiding the development of teacher preparation programs.

An important element of the TTF project is the auditing of teacher preparation programs to determine how ICT is integrated and presented in various elements of the program. The information from the audit is intended to provide a basis for planning appropriate changes that will enhance the ICT capabilities of graduates. In doing so it will be important to ensure that teacher preparation programs include ample opportunities for students to experience working with a variety of ICT devices and applications using content from the curriculum areas in a

variety of pedagogical modes. No doubt such opportunities already exist in some sections of the programs and it will be important to identify, recognize, and preserve existing effective elements. It will be equally necessary to identify what opportunities are missing and to provide those in ways that model the effective application of TPACK and provide both models for students to emulate and the experience from which to build their own TPACK. If *technology* in TPACK is understood in the way advocated by Cox (2008) with an emphasis placed on *emerging* ICT, then it will be important to ensure that programs are designed so that they can continue to evolve by offering students opportunities to work with new ICT both in curriculum areas, for development of TCK, and in pedagogy, for development of TPK. This requirement will challenge teacher preparation programs to find the means to support and encourage teacher educators to work at the intersections of new ICT with both content and pedagogy.

In the case of the regional university in which this study was located, the audit of subjects in the program is considering how ICT is used to help students understand the concepts in a course, how it is used to contribute to course delivery and assessment, and the degree to which the ICT pedagogy used in the course is made explicit to the students. The latter is important for ensuring that graduates develop appropriate insights into how and why they might use ICT in their own classrooms. The results of the audit, being facilitated by the experts funded by the TTF project, will be used as the basis for discussion about how courses might be revised to contribute more effectively to the development of graduates' ICT capability. Initial results of the audit have been encouraging. Possibly as a consequence of teacher preparation courses having been offered online in recent years, academics responsible for designing and implementing courses demonstrate willingness to consider new approaches and courses are already incorporating ICT in ways that facilitate development of relevant capabilities in graduates. Data such as that reported in this paper will be used to inform decisions about the relative ease with which students may be able to participate in activities requiring access to specific forms of ICT, and about the need to include opportunities for some or all students to develop experience with specific ICT.

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