

# Come the Revolution: Pre-service Teachers' Access to, Attitudes toward, and Skills with ICT

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**Abstract:** Pre-service teachers can benefit from the new learning opportunities offered by information and communication technology (ICT) both immediately for their own study and, in the longer term, for use in their own classrooms. However, to benefit from those opportunities they must have ready access to ICT, some skills, and positive attitudes toward its usefulness for learning and teaching. This paper reports some results from analysis of data obtained from surveys of ICT access, and related attitudes, among pre-service teachers at an Australian university in late 2009. The survey was conducted as part of a larger investigation of ICT for student learning with the intention of informing adoption of new digital technologies and provision of professional development for staff. This paper reports data collected from students in teacher preparation programs with implications for program development.

Digital Education Revolution (DER) is the name given to an initiative of the Australian Government (DEEWR, 2008) that seeks to achieve a national vision for Information and Communication Technology (ICT) in schools. It is the latest manifestation of a continuing commitment by Australian governments to overarching goals for school education in the information economy first articulated a decade ago, namely, that students should graduate with relevant knowledge and skills for using ICT, and that ICT should be integrated to improve student learning (Toomey, 2001).

The most visible aspects of the DER are funding to increase the numbers of computers in schools, to a ratio of 1:1 for years 9 to 12 by 2011, and provision of high-speed broadband connections to schools. However, the DER roadmap (AICTEC, 2009) notes 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) and refers to “professional learning opportunities for existing teachers to upgrade or develop proficiency in the effective and innovative/creative educational use of ICT” and ensuring “that the national graduate teacher standards include rigorous requirements regarding the use of technology in teaching” (AICTEC, 2009, p. 8). Those standards are still in development (<http://www.aitsl.edu.au/>) but the Australian government has invited submissions for funding for projects to improve the capability of pre-service teachers, enhance the capacity of in-service teachers, and drive innovation through leadership (DEEWR, 2010).

Programs preparing pre-service teachers will need to address the new national standards for teachers and ensure that their graduates are prepared for the changes that are occurring in classrooms as the DER rolls out. The general educational goals articulated previously (Toomey, 2001) remain relevant for teacher education and ICT should be incorporated in ways that both prepare graduates to work effectively with ICT in their own classrooms and that use ICT to enhance student learning within the programs. These goals can be complementary to the extent that teacher preparation programs model the effective use of ICT for learning and teaching, an element that has been highlighted in recent years as the teacher preparation programs at the university have been progressively made available online, necessitating the use of a wider variety of digital tools across courses.

There is widespread belief that students entering university from school are different from previous generations, as implied by labels such as Millennials (Howe & Strauss, 2000), Digital Natives (Prensky, 2001), and Net Generation (Oblinger & Oblinger, 2005). In this view students entering university are assumed to be “media literate” (Dodge, et al., 2008) and technologically competent, simply needing educators to harness those skills (Harris & Rea, 2009). However, the changing demography of higher education means that there are members of previous generations among the student body. Moreover, previous studies have questioned the evidence for such generational differences

(Sue, Karl, & Lisa, 2008) and found that students' use of ICT for learning is variable and limited to a narrow range of familiar ICT (Jones, Ramanau, Cross, & Healing, 2010; Kennedy, Judd, Churchward, & Krause, 2008). Other research has reported on the differences between students' social use of ICT and their ability to effectively use those skills for learning (Kollikant, 2010), noting that students saw themselves as less able learners than the preceding generation of book-learners and attributing these contradictory attitudes to values perpetuated by school that resulted in low self-efficacy for using ICT in learning.

Over the past decade university education has become increasingly reliant on ICT. Students are now routinely expected to manage their enrolments online, access resources from a learning management system (LMS), use an electronic library catalogue, and often access library resources as ebooks or electronic journals. More than a decade ago Australian universities began to record lecture and other material for access by students who could not attend the actual class for reasons including enrolment on a distant campus or other commitments. Such systems have now become relatively common to the point where many students expect access to such recordings as the norm. Research has found that distance and on-campus students use such recordings in similar ways, listening more than once but with different purposes. Where on-campus students were paced by scheduled classes and used recordings to review content they had missed in class, distance students used the recordings to set their own pace (Woo, et al., 2008).

Although fewer than half of the students in teacher preparation programs at the university enroll fully online, many students chose to study some courses online and most courses have about half of their enrolment online. The drivers for this include participation in higher education by a broader segment of the population and student engagement in substantial paid employment or other commitments such as family (Albion, Loch, Mula, & Maroulis, 2010). As more students participate online it is important to know what ICT they can access for study, how their attitudes to ICT may affect their study, and what skills they have for working with ICT. Using data obtained as part of a broader study this paper seeks to cast light on the access, attitudes, and skills of pre-service teachers in relation to ICT that is important for their own study and future effectiveness as teachers.

## **Method**

The instrument used in this study was adapted from one originally developed and used in a large study of first year students in three Australian universities (Gray, et al., 2009). Similar instruments have been used in subsequent studies (Newton & Ellis, 2009; Thinyane, 2010) and they were adapted for this study to facilitate comparison of results where that was relevant. Most items were retained in their original form but some were adapted or added to reflect different demographics and developments in technology.

LimeSurvey® (<http://www.limesurvey.org/>) was used to administer the questionnaire online, a process that, compared to printed forms, was both environmentally responsible and labor saving. Data were downloaded and transferred to SPSS 18 for analysis. Participants were recruited in November 2009 using a notice in the university student portal offering entry to a draw to win one of 5 iPod Shuffles.

## **Results**

In all, 623 students completed the questionnaire and gave research consent for their responses. Of these students 177 reported being enrolled with the Faculty of Education, comprising 99 undergraduate, 62 postgraduate coursework, and 16 postgraduate research students. This paper reports results for the 99 undergraduate Education students. Because the data were collected using an online questionnaire in the period immediately following the spring semester and at the beginning of summer semester it is likely that the responses over-represent students who are more comfortable with ICT which is important for summer courses that are studied almost entirely online.

Most of the responses were from students in their first (46.5%) or second (26.3%) year of university but their ages (18.2% less than 21 years, 26.3% between 21 and 30 years, 35.4% between 31 and 40 years, and the remainder older than 40 years) indicated that the majority had not progressed direct to university from school. Slightly less than half (46.5%) reported being enrolled on one of the three campuses of the university, with the balance being enrolled in distance or online mode although most (62.6%) reported that they were full-time students. The proportions of part-

time (37.4%), off-campus (53.5%) and female (90.9%) students among the respondents were higher than might be expected for a random sample of undergraduate Education students. They appear to be more representative of the substantial number of women who, in recent years, have begun to take advantage of new online programs to obtain a teaching qualification while continuing in employment or taking care of a young family at home. Although the respondents may not be completely representative of the pre-service teachers enrolled at the university, their responses provide useful insights into the access to ICT and related attitudes among a significant group of students who might be expected to be no more familiar with ICT than more recent graduates from secondary schools.

The essential requirement for students to access learning materials and activities provided online is convenient access to a networked computer. The university advises students that most courses require a computer with Internet access and publishes recommended specifications that are updated annually. The questionnaire did not ask about details of computer hardware specifications but used items equivalent to those from the original questionnaire (Gray, et al., 2009) to assess convenience of access to desktop and laptop computers other than those provided on the university campus. Table 1 presents data from these items, cross-tabulated to demonstrate the very small proportion (2%) who reported limited, or no access to a computer and the considerable proportion (51.5%) who have relatively convenient access, either exclusive or shared, to both desktop and portable computer. Although this is lower than the proportion (61%) reported for students across all faculties with access to both desktop and portable computers (Albion, et al., 2010) it still represents a high degree of access to multiple computers. Although there is no surprise that a group of students, the majority of whom are studying off-campus, responding to an online survey have convenient access to a networked computer, the proportion who have access to at least two computers is high. The high level of access to portable computers (77% with shared or exclusive access) suggests a potential for mobility that reflects trends identified in the *2010 Horizon Report* (Johnson, Levine, Smith, & Stone, 2010).

		Portable computer				Total
		No access	Limited or inconvenient access	Any time, shared with others	Exclusive for own use	
Desktop computer	No access	0.0	1.0	4.0	15.1	20.2
	Limited or inconvenient access	0.0	1.0	1.0	5.1	7.1
	Any time, shared with others	9.1	0.0	8.1	27.3	44.4
	Exclusive for own use	11.1	1.0	3.0	13.1	28.3
	Total	20.2	3.0	16.2	60.6	

**Table 1: Percentages of students with access to desktop and portable computers (N = 99)**

The university has a long tradition of providing printed study materials for distance education but in recent years that has evolved to distribution on CD-ROM and the Web. Since 2009 the Faculty of Education has offered all of its programs in online mode and every course has a space allocated in Moodle that is used for distribution of resources and course communication even for students who are attending classes on campus. Hence, Internet access is effectively a requirement and, because most courses offer at least some recorded lectures and other multimedia material, reasonable speed and data capacity are required for downloading and viewing. Table 2 presents cross-tabulated responses for items about dial-up and broadband Internet access. As reported previously, the very small proportion of students (9%) reporting limited or inconvenient Internet access apart from that offered by the university were likely to be on-campus students with access via the campus LAN (Albion, et al., 2010). Almost all students reported having some access to broadband Internet.

		Broadband Internet access				Total
		No access	Limited or inconvenient access	Any time, shared with others	Exclusive for own use	
Dial-up	Not sure	0.0	0.0	1.0	3.0	4.0
Internet access	No access	1.0	5.1	30.3	44.4	80.8
	Limited or inconvenient access	1.0	1.0	0.0	6.1	8.1
	Any time, shared with others	0.0	0.0	1.0	1.0	2.0
	Exclusive for own use	0.0	1.0	0.0	4.0	5.1
	Total	2.0	7.1	32.3	58.6	

**Table 2: Percentages of students with access to broadband and dial-up Internet (N = 99)**

Where courses provide audio recordings of weekly classes, the volume of data to be downloaded each week could easily approach 50 MB and a student taking multiple courses could easily use at least 1 GB per month allowing for some other Internet use. If the recordings incorporate video material, the requirement could be substantially greater. On a slow broadband service at 256 kbps under good conditions it would take about 30 minutes to download 50 MB. If, as is sometimes the case, a file must be completely downloaded before it can be played, such wait time is unlikely to be acceptable for a student downloading study material. On this basis, the speed and data allocation available on a broadband connection are likely to be significant determinants of the satisfaction of students with their online study experience.

Respondents who indicated access to broadband were presented with two additional questions dealing with connection speed and data allocation. The items included alternatives to accommodate those who might not know the technical capacity of their connection but could report on their experience of using it. Table 3 cross-tabulates nominal broadband speed and monthly data allocation. Respondents most likely to experience difficulties are those in the first two columns for speed or the first three rows for data allocation. About one-fifth (20.7%) of respondents fall in that region. If course materials were to include substantial video content, the region could be expanded one column to the right and one row down to encompass 60% of respondents. Course designers need to be conscious when preparing materials that a substantial proportion of students may experience difficulty in accessing large files. Where possible, recordings should be produced in short segments and in formats with good compression characteristics.

		Nominal speed					Don't know, fast enough	Total
		Don't know, too slow	256 kbps	512 kbps	1500 kbps	8000+ kbps (ADSL2)		
Monthly data allocation	Don't know, too little	1.0	0.0	0.0	0.0	0.0	1.0	2.1
	< 500 MB	1.0	1.0	0.0	2.1	0.0	0.0	4.1
	500 MB to < 1 GB	0.0	1.0	1.0	1.0	0.0	1.0	4.1
	1 GB to < 5 GB	0.0	1.0	9.3	3.1	1.0	11.3	25.8
	5 GB to < 10 GB	1.0	1.0	5.2	0.0	2.0	3.1	12.4
	10 GB or more	1.0	1.0	7.2	5.2	2.1	13.4	29.9
	Don't know, but enough	4.1	1.0	1.0	0.0	0.0	15.5	2.1
Total		8.2	6.2	23.7	11.3	5.1	45.4	

**Table 3: Percentages of students reporting broadband access characteristics (N = 97)**

On access to other ICT that might be relevant to learning these pre-service teachers reported generally similar levels to those reported by respondents from other sections of the university. About half (51%) had convenient access to an MP3 player (62% for other students), 97% to a mobile phone (94%), and 60% to a webcam (63%). The respondents from other parts of the university included larger proportions from younger age groups, which may explain the difference in access to MP3 players. Overall, the data suggest that many of these pre-service teachers have access to a variety of common forms of ICT, although there are others who lack the access and experience necessary for them to have developed relevant skills. It will be necessary for teacher preparation programs to offer opportunities to gain experience with forms of ICT likely to be important in classrooms.

To what extent ...	Not at all	Some extent	Great extent	Very great extent
... are you interested in using ICT for personal purposes?	2.0	23.2	43.4	31.3
... are you interested in using ICT for study?	2.0	16.2	40.4	41.4
... do you currently use ICT for personal purposes?	1.0	28.3	45.5	25.3
... do you currently use ICT for study?	1.0	10.1	45.5	43.4
... do you believe that ICT can improve your success in study?	2.0	18.2	41.4	38.4
... do you feel confident about your ability to use ICT for study?	2.0	30.3	50.5	17.2

**Table 4: Interest in and attitude toward using ICT for learning (% responses, N = 99)**

As might be expected based on access, and is evident in the responses to items about interest in and attitudes to ICT (Table 4), these pre-service teachers were generally positive about ICT. They believed to a great or very great extent

that ICT could improve their success in study, were mostly confident about using ICT for study, and, while positive about the use of ICT for personal purposes, were even more so about using it for study.

Their reasons for wanting to use ICT in their study (Table 5) were generally utilitarian rather than educational. Items (3 to 6) related to convenience for completing work or development of skills that might improve career prospects attracted ‘agree’ or ‘strongly agree’ responses from 88% to 91%, where items (1 and 2) related to subject learning attracted only 65% and 59% agreement.

I want to use ICT in my studies because it will ...	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
help me get better results in my subjects	1.0	7.1	27.3	39.4	25.3
help me understand the subject material more deeply	1.0	10.1	30.3	39.4	19.2
make completing work in my subjects more convenient	3.0	1.0	7.1	37.4	51.5
improve my IT / information management skills in general	0.0	0.0	9.1	47.5	43.4
improve my career or employment prospects in the long term	0.0	0.0	11.1	47.5	41.4
provide me with essential skills for my future career	1.0	1.0	8.1	42.4	47.5

**Table 5: Reasons for using ICT in study (% responses, N = 99)**

Table 6 presents selected data from an item in which respondents were asked to indicate how useful they thought particular applications of ICT would be for study purposes. The most highly rated activity was access to university services online with 97% of responses rating that as very useful. Downloading audio and video recordings of lectures and other course materials were almost universally regarded as very useful. This result is consistent with reports in the literature of positive responses from students to availability of recorded material which they use to enhance flexibility and for revision purposes (Woo, et al., 2008). Although the emergence of items reflecting content consumption as most useful may reflect a lingering view of learning as knowledge transfer, students were also generally positive about some forms of content creation such as simple multimedia or audio and video and sharing such files on the web, which may reflect a more constructivist view of learning.

In your studies, how useful do you think it would be to ...	Not at all useful	Moderately useful	Very useful	Don't know
Use the web to access University based services (e.g. enrolment, sign up for classes, pay fees)?	1.0	10.1	96.9	2.0
Access audio/video recordings of lectures you did not attend?	0.0	8.1	89.9	2.0
Download or access online audio/video recordings to revise the content of lectures you already heard?	1.0	13.1	84.8	1.0
Download or access online audio/video recordings of supplementary content material?	0.0	15.2	83.8	1.0
Create and present multimedia shows as part of course requirements	0.0	28.3	67.7	4.0
Create and present audio/video as part of course requirements	4.0	41.4	48.5	6.1
Use the web to share digital files related to your course	5.1	45.5	43.4	6.1
Use web-conferencing or video-chat to communicate/collaborate with other students in the course?	14.1	34.3	46.5	5.1
Design and build web pages as part of your course	22.2	42.4	25.3	10.1
Contribute with other students to the development of a wiki as part of your course requirements?	22.2	46.5	25.3	6.1
Keep your own blog as part of your course requirements?	44.4	25.3	19.2	11.1
Contribute to another blog as part of your course requirements?	42.4	29.3	18.2	10.1
Receive pre-class discussion questions from your Lecturer via text message on your mobile phone?	28.3	28.3	35.4	8.1
Use your mobile phone to access web-based University services information or services (e.g. enrolment, sign up for class, pay fees)?	30.3	29.3	26.3	14.1
Access web-based university study material on your mobile phone?	36.4	31.3	22.2	10.1

**Table 6: Perceived usefulness of selected ICT for study (% responses, N = 99)**

Slightly more students doubted the utility of web-conferencing or video-chat but almost half rated them as very useful, possibly a reflection of the substantial proportion who reported access to webcams that would be required to use such methods. There was less enthusiasm for web page or wiki construction, though almost half saw those as at least moderately useful and it is possible that some had experience of using a wiki in one of their courses. Publishing and contributing to blogs were viewed considerably less favorably, possibly indicating a view of blogs as being unreliable as sources of information and unworthy of serious attention. Students placed some value on the use of mobile phones for access to university material but mostly tend to see more conventional means of access to the web as more useful. That may change as mobile technologies mature.

The questionnaire included a considerable number of items that asked about frequency of use of ICT for particular purposes and about self perceived level of skill for that purpose. Frequency of use (How often, on average, ... over the past year?) offered 8 options – ‘not used’, ‘once/twice a year’, ‘every few months’, ‘once/twice a month’, ‘once a week’, ‘several times a week’, ‘once a day’, and ‘several times a day’. For compact display of data for selected applications in Table 7 these have been compressed to 3 options – ‘not used’, ‘seldom’ incorporating the next two options, and ‘regular’ comprising the remainder. Results are reported as percentages of users in each category. Skill was gauged on a 5-point scale from ‘not very skilled’ to ‘very skilled’ and respondents could also select ‘N/A’. For the percentage results presented in Table 7, in each case the total will be less than 100% with the balance represented by ‘N/A’ implying a lack of reportable skill.

ICT application use	Frequency (%)			Skill levels of users (%)				
	Not used	Seldom	Regular	Not very skilled	2	3	4	Very skilled
				1				5
Use a computer to manage digital photos	2.0	29.3	68.7	8.1	16.2	29.3	26.3	19.2
Use a computer to manipulate digital images	19.2	34.3	46.5	15.2	24.2	25.3	15.2	12.1
Use a computer to create presentations	5.0	58.6	36.4	14.1	10.1	29.3	25.3	19.2
Use a computer to create or edit audio and video	47.5	41.5	11.1	30.3	14.1	15.2	9.1	5.1
Use the web to upload and/or share photographs or other digital material	41.4	23.3	35.4	5.1	13.1	20.2	13.1	10.1
Use the web to publish podcasts	88.9	6.0	5.0	10.1	2.0	3.0	2.0	1.0
Use the web to subscribe to and download podcasts	47.5	22.2	30.3	12.1	6.1	18.2	10.1	11.1
Use the web to build and maintain a website	83.8	12.1	4.0	13.1	6.1	3.0	4.0	3.0
Use the web to contribute to development of a wiki	49.5	30.3	20.2	20.2	9.1	21.2	6.1	2.0
Use the web to keep your own blog or vlog	83.8	10.2	6.0	11.1	6.1	3.0	2.0	4.0
Use the web to read other people’s blogs or vlogs	68.7	16.2	15.2	11.1	5.1	8.1	6.1	7.1
Use the web for web-conferencing	63.6	15.2	21.2	12.1	8.1	12.1	6.1	4.0
Use a mobile phone to access information / services on the web	62.6	14.2	23.3	6.1	3.0	8.1	7.1	18.2
Use a mobile phone to access university study material	91.9	2.0	6.0	5.1	0.0	1.0	2.0	7.1

**Table 7: Frequency of use and skills for selected ICT (% responses, N = 99)**

The highest levels of skill are reported for managing digital photos and creating presentations, for which about three-quarters of respondents reported skill levels of 3 or above. They reported less confidence in skills for manipulating images and very little for working with audio and video. When these results are aligned with perceived usefulness (Table 6) it appears that students’ positive response to producing simple multimedia as part of their study is backed by skills but that more extensive work on audio and video creation would require skills development. The data for items about uploading or sharing digital material and publishing podcasts reflect similar trends. Many students will have some familiarity with uploading images or other material to sites such as Facebook but only a minority will have attempted more technically demanding activities such as creating and publishing podcasts which will depend on having some audio skills. The higher level of skill reported for downloading podcasts is consistent

with that activity being simpler than creating material, often managed by an application such as iTunes, and related in some ways to accessing recorded study material.

A large majority (84%) of these students reported no experience of building and maintaining a website but considerably fewer (50%) reported no experience of wiki construction. That difference likely reflects the use of the Moodle wiki within one of the core courses and, although the levels of skill reported are not strong, this probably points to a strategy for exposing students to technologies and building skills through inclusion as course requirements. The two items related to blogs reflect the same balance between consumption and creation as is evident in other activities. Substantially more students report not having kept their own blog (84%) than not reading blogs published by others (69%) though the frequency of use for reading blogs and modest differences in reported skills for the two activities suggests that experience of reading blogs is limited. Although the levels of skill reported for web-conferencing are limited, the relatively strong perception of its usefulness for study (Table 6) suggests that including it more substantially in courses might result in a substantial increase in experience and skills.

Using a mobile phone to access general information services was beyond the experience of a majority of students (63%) and accessing university study material on a phone was limited to a small minority (8%). In each of these cases the reported skills levels displayed a bimodal distribution with a group of students claiming to be very skilled and most others reporting limited skills. These data contrast with the perceived usefulness of mobile phones for accessing study material (Table 6), which may reflect more hope than reality. More recent mobile phones (iPhone, Android, etc.) have made web browsing on the phone much more user friendly but there is still a good deal of work required before many services, including university study materials, are formatted for convenient access on the small screen. Given the latent interest in using mobile phones for such access (Table 6), it is likely that as technology and websites evolve to work more effectively together, experience and skills will also increase.

## Conclusion

Australia's Digital Education Revolution is still in its early stages and it is not entirely clear what it will mean in the typical classroom. In addition to computers, broadband connectivity and the provisions for teacher development outlined above, the roadmap (AICTEC, 2009) includes provision for support of the new national curriculum (<http://www.acara.edu.au/>) that is being developed and implemented at the same time. It is possible that the minds of some politicians and bureaucrats still harbor dreams of larger network 'pipes' enabling more rapid delivery of prepared content to support improved results on national testing programs (<http://www.naplan.edu.au/>). Such a vision of education as consumption could certainly be supported by the infrastructure being rolled out. However, many schools have already taken significant steps toward implementation of alternative pedagogy that promotes education as creation and is more consistent with ideas such as developing 21<sup>st</sup> century skills (Partnership for 21st Century Skills, 2010).

Teacher preparation will be important to the success of the DER but what is required for a 21<sup>st</sup> century curriculum, in which learners create rather than simply consume, is necessarily different from what has sufficed in the past. Teachers will need to develop capability for creating digital content in a variety of formats. The data presented in this paper suggest that our pre-service teachers have access to connected computers and other ICT for working with digital content and have positive attitudes toward the use of ICT in their own learning and as important tools in their future careers. However, their experiences and resulting skills appear to be balanced more toward consumption of digital content than creation. Nevertheless, there are indications, as in the data related to wiki development, that capability can be developed when the use of new ICT is embedded in the context of a course. One way forward may be to review the design of courses across teacher preparation programs to ensure that they include opportunities for students to engage in learning through development of digital content using a wider variety of tools and formats.

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