Auditing the ICT experiences of teacher education undergraduates

Abstract

The importance of teacher education graduates having appropriate information and communication technology (ICT) for learning competencies and experiences is well documented. However, without well developed processes for auditing the ICT experiences of undergraduates it should not be assumed that teachers will enter their profession with the required ICT competencies to support their students' learning. This paper reports on the first phase of a project to audit the ICT experiences of teacher education undergraduates. It finds that the individual experiences of undergraduates can vary considerably depending on their choice of majors, electives or specialist teaching areas. It further finds that high percentages of students perceive themselves to have no competency with a range of ICT applications that would support the more motivational and interesting aspects of ICT integration for student learning.

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Introduction

The importance of teacher education graduates having appropriate information and communication technology (ICT) for learning competencies and experiences is evidenced by a plethora of recent international, national, and state documents. At the international level, standards for measuring teacher performance in ICT are identified for the United States (ISTE, 2000) and the United Kingdom (Becta, 2003). In addition, a range of other research directed more at student standards with ICTs either imply, or directly refer to, concomitant ICT competencies required of teachers (IEA, 2003; NCREL, 2003; Norris, Soloway & Sullivan, 2002). Cox and Abbott (2004) consider in some depth issues of methodology relating to ICT and student attainment that have clear links to teachers ICT competencies and experiences.

At the national level, DEST (2002) has proposed a framework for teacher ICT competency. With respect to ICTs in tertiary teacher education programs, DEST (2001) reports on a survey of Australian Universities that found that: "while 75% [of the sample] expected all teacher education staff to integrate technology in the teaching of their subjects only 38% reported their staff actually doing so on a regular basis (p.39). Finger and Trinidad (2002) reviewed a raft of initiatives across Australia intended to increase the integration of ICTs into teaching and learning, most of which make direct references to the need for teacher ICT competencies. Furthermore, in New Learning a Charter for Australian Education, the Australian Council of Deans of EducationAss Prof (ACDE, 2001) propose that "technology will become central to all learning".

At the Queensland state level, the Board of Teacher Registration's (2002) professional standards requires that graduates are "confident with multiliteracies and proficient in the use of ICT in learning environments" (p.6). Education Queensland's (2003) ICTs for Learning Continua identifies key areas of ICT and curriculum integration, classroom planning and management; productive pedagogies through the use of ICT; ICT knowledge, skills processes and attitudes; and decision making and planning that are required of its teachers. An ICT curriculum integration performance measurement instrument (Finger, Jamieson-Proctor, & Watson, 2003; Proctor, Watson & Finger, 2003) has been prepared for Education Queensland that will feature in its annual accountability data collection. The Smart Classrooms Project (Education Queensland, 2004) which builds upon those initiatives, sees 'smart teachers' using ICTs as central to their Education and Training Reforms for the Future (ETRF).

Ongoing work by the Council of Australian University Directors of Information Technology (CAUDIT) seeks to identify information technology (IT) literacy required of all tertiary students and academic staff (Winship 2000, 2001). Included is a "University action plan for IT literacy" that identifies, among other requirements, the need to: "introduce means of auditing IT literacy levels of staff and students on an on-going basis and of monitoring performance in achieving the goal of IT literacy" (Winship, 2001, p.43).

In summary, the training and professional development of future teachers in the use of ICTs needs to be central to teacher education. Clearly, there are identifiable expectations that graduates from tertiary teacher education programs will have developed an array of ICT competencies. This paper reports on the initial phase of a project designed to audit the ICT experiences of students in undergraduate programs for the preparation of primary and secondary teachers within an Australian university. Following the initial audit phase, strengths and limitations will be identified with respect to current ICT standards required of teachers, which will then inform work with course convenors to identify ways of integrating ICT into the curriculum to enrich students' ICT experiences. (Note: the university in which this research took place uses the term "programs" to refer the complete degree undertaken by the student and "courses" to refer to the elements of study within it.)

Research context

Currently students in the primary undergraduate program complete a core first year course in Learning with ICT and have later options of completing a Learning Technology major or doing further electives in ICT courses. However, many students would complete their programs without further study in specialist ICT courses and are therefore dependent on non-specialist ICT courses for their ICT experiences. While this is a desirable feature, in that all courses need to address issues of ICT integration, there is no structured method of accounting for these ICT experiences or for ensuring a diversity of experiences. The secondary undergraduate program has no core ICT courses and, with the exception of students in the computing teaching strand, there is no structured process that ensures adequate attention to students' acquisition of ICTs for learning. The project is intended to inform the integration of ICTs within both programs to enhance student-learning outcomes in order to ensure that Australian and Queensland standards are being met. A secondary aim of the project is to supply the Faculty of Education at the university studied with documented evidence of these ICT experiences to meet the periodic demands of employers or statutory bodies in this regard.

Consistent with Education students and the teaching profession generally, the cohort is predominantly female (85% in the primary program and 60% in the secondary program). Many of the students who are the participants in this project are not recent school leavers (25% of primary and 13% of secondary are aged 30+years) who can be assumed to have had reasonable exposure to ICTs at school, although it should not be assumed that all school leavers have extensively used ICTs in their prior learning either. Differences in ICT competency for earlier cohorts from this program are recorded in Watson and Prestridge (2001). These differences in ICT experiences of incoming students are exacerbated, particularly in the secondary program, by different experiences arising from choice of electives or teaching areas, during their programs. The project was predicated on the notion that a more cohesive approach to the development of ICTs for learning in undergraduate programs would ensure that graduates uniformly have the required ICT competencies and are confident to use them in their classrooms to enhance their students' learning.

Research method

The data reported in the following section are drawn from a survey administered during regular class time in a core non-ICT course to students in the second semester of the fourth year of the respective programs, that is just prior to graduation. The participants were informed that the university was investigating the integration of ICT in their programs and that the survey would identify the skills, competencies and attitudes of students who are completing the programs and would inform the integration of ICTs across the programs to enhance student-learning outcomes. The survey was completed by 217 participants from the primary program and 68 participants from the secondary program.

The survey elicited general demographic information regarding gender, age and program details; interest in using computers on a four-point Likert scale from "not at all" to "very great extent"; current access to computers and the internet; self-identified competency with a range of ICT applications on a four-point Likert scale from "no competence" to "very competent"; self-identified confidence with a range of examples of ICT integration on a four-point Likert scale from "no confidence" to "very confident"; and open ended responses regarding strengths and recommendations for improvement of the program for preparing the participants to integrate ICT into their students' learning when they became a teacher.

The quantitative data were analysed using SPSS V11 and the qualitative data from the open-ended questions were analysed using a content analysis methodology. Content analysis is described by Silverman (2000) as a method "in which the researchers establish a set of categories and then count the number of instances that fall into each category" (p.128). While content analysis has been primarily used to quantitatively analyse texts, Robson (2002, p.351) notes the value of this method in the coding of open-ended questions in surveys. A key issue with content analysis is that the categories derived are "exhaustive" and "mutually exclusive" (p.355). Categories were established using an emergent coding procedure (Stemler, 2001) involving researchers doing a preliminary examination of the data and establishing checklists that were later consolidated to form coding categories. Individual student responses were regarded as the coding unit and up to three categories were identified for each unit. Weighting for each category was established by calculating the total number of codings for that category as a percent of the total codings for all categories.

Discussion

This section will consider data relating to the availability of, and interest in using computers; the competencies of the two groups of participants; the confidence of the two groups of participants with respect to using ICTs to support student learning; and conclude with an analysis of the open-ended responses regarding strengths and recommendations for improvement with respect to ICT experiences in the participants respective programs.

Availability of, and interest in using computers

The participants indicated very high levels of computer availability (99.5% of primary and 92.6% of secondary) and access to the Internet (89.9% of primary and 80.9% of secondary) in their present accommodation. They also expressed strong interest in computers with primary participants recording a mean of 2.80 and secondary a mean of 2.63; extensive use of computers (primary mean = 3.19, secondary mean = 3.04); and strong belief that computers can improve student-learning outcomes (primary mean = 3.02, secondary mean = 2.83). These means were calculated using a 4-point Likert scale where a mean of 1 = Not at all; 2 = Some extent; 3 = Great extent; and 4 = Very great extent. Of some consideration are the lower means for interest in computers compared with their belief in the value of computers to improve student learning, and the slightly lower means for secondary participants compared with primary on all three indicators. Interviews with students in the next phase of this research may reveal some insight into these differences.

Competence with ICT applications

Table 1 shows the range of applications for which participants were asked to rate their competence; the means for each of these applications for both the primary and secondary groups; as well as the percentage of participants in each group who perceived themselves as having no competence for the particular application. Both groups expressed high levels (mean >3) of competence with word processing, presentation software, email and web browsing. Very low levels (mean <2) of competence were perceived for multimedia development and authoring, visual thinking software, digital video editing, and web page development. An ANOVA was used to compare the means of the primary and secondary groups. Statistically significant differences were recorded for wordprocessing ($F = 7.41$, $df = (1,283)$, $p = .007$), desktop publishing ($F = 8.237$, $df = (1,280)$, $p = .004$),

Table 1. Perceived competence with ICT applications

ICT Application (Examples of Software)	Mean Primary	Mean Secondary	% No competence Primary	% No competence Secondary
Word Processing *(e.g. Microsoft Word)*	*3.66	*3.46	0	1.5
Desktop Publishing *(e.g. Microsoft Publisher)*	*2.82	*2.44	8.8	18.2
Presentation Software *(e.g. Microsoft Power Point)*	*3.17	*2.52	2.8	17.9
Spreadsheets *(e.g. Microsoft Excel)*	2.62	2.43	7.4	16.4
Databases *(e.g. Microsoft Access)*	2.09	2.04	25.6	34.3
Graphics creation and/or editing *(e.g. Paint Shop Pro, Adobe Photoshop)*	2.20	2.22	25.9	32.8
Digital image capture *(e.g. by Digital camera, scanning)*	2.38	2.33	22.6	28.8
Multimedia Development and Authoring *(e.g. Macromedia Director/Flash, Hyperstudio)*	*1.89	*1.64	36.6	61.2
Visual Thinking Software *(e.g. Inspiration, Kidspiration)*	1.54	1.52	64.7	70.1
Digital Video Editing *(e.g. iMovie, Adobe Premiere)*	1.47	1.65	68.2	62.1
Email *(e.g. Microsoft Outlook, Eudora)*	*3.43	*3.16	3.7	6.0
Web Searching *(e.g. Google, Altavista, Metacrawler)*	3.54	3.37	0.5	3.0
Web Page Development *(e.g. Macromedia Dreamweaver, Microsoft Frontpage)*	1.98	1.85	36.2	50.7

Note. * indicates the primary and secondary means are significantly different at .05

presentation software (F = 29.238, df = (1,282), p = .000), multimedia authoring (F = 4.256, df = (1,281), p = .04) and email (F = 5.423, df = (1,280), p = .021) indicating that primary participants rated their competence with these applications more highly than did secondary participants. Of particular concern are the high percentages of participants from the secondary program who perceived themselves as having no competence in databases (34.4%), graphics creation and/or editing (32.8%), digital image capture (28.8%), multimedia development and authoring (61.2%), and web page development (50.7%). Both primary and secondary groups recorded high percentages of no competence for visual thinking software (64.7% and 70.1% respectively), and digital video editing (68.2% and 62.1% respectively). Digital video editing was the only application where primary participants recorded higher levels (but not statistically significant) of no competence than did secondary participants.

Confidence with ICT integration

Table 2 shows the range of ICT integration examples for which participants were asked to rate their confidence from no confidence (1) to very confident (4). The table also shows the means for each of these ICT integration examples for both the primary and secondary groups as well as the percentage of participants in each group who perceived themselves as having no or limited confidence to support students using ICTs for the particular integration example. Again an ANOVA was used to compare the means of the primary and secondary groups. Statistically significant differences were recorded for Item 1 (F = 11.037, df = (1,281), p = .001), Item 2 (F = 8.718, df = (1,282), p = .003), Item 7 (F = 6.123, df = (1,281), p = .014), Item 9 (F = 5.719, df = (1,281), p = .017), Item 10 (F = 7.95, df = (1,282), p = .005), Item 11 (F = 5.496, df = (1,280), p = .02), Item 12 (F = 6.71, df = (1,280), p = .01), Item 20 (F = 4.494,

Table 2. Perception of confidence to integration ICT into student learning

	In my class, I could support students using ICTs to:	Mean Primary	Mean Secondary	% No or limited Confidence Primary	% No or limited Confidence Secondary
1.	develop the confidence and skills to operate computer hardware, software and peripherals.	*3.03	*2.69	20.0	44.1
2.	locate, record, organise and manipulate information.	*3.09	*2.79	17.1	33.8
3.	critically interpret ICT-based information and evaluate the worth of this information.	2.71	2.56	35.6	42.6
4.	actively construct their own knowledge in collaboration with their peers and others.	2.93	2.78	25.1	38.2
5.	develop deep understanding about a topic of interest relevant to the curriculum area/s being studied.	3.02	2.85	18.1	32.4
6.	provide motivation for curriculum tasks.	3.11	2.93	15.3	29.4
7.	plan and/or manage curriculum projects.	*3.00	*2.75	20.9	38.2
8.	integrate different media to create appropriate products.	2.81	2.66	31.2	44.1
9.	engage in sustained involvement with curriculum activities.	*2.88	*2.63	28.2	43.3
10.	support elements of the learning process.	*3.02	*2.74	19.9	38.2
11.	support their learning according to individual needs.	*2.99	*2.76	22.0	33.8
12.	demonstrate what they have learned.	*3.04	*2.81	17.3	33.8
13.	undertake formative, and/or summative assessment.	3.00	2.93	21.5	29.9
14.	develop an understanding of the role and importance of computers in the learning process.	3.00	2.82	19.7	35.8
15.	undertake self-directed projects.	2.97	2.79	22.5	33.8
16.	develop confident, responsible and ethical attitudes to the use of computers in their school and society globally.	2.96	2.79	23.9	38.2
17.	facilitate creativity.	3.05	3.03	20.4	25.0
18.	gain intercultural understanding.	2.77	2.87	33.3	33.8
19.	critically evaluate their own and society's values.	2.75	2.84	35.8	33.8
20.	solve authentic, life-like problems that require them to integrate curriculum areas.	*2.90	*2.69	27.7	42.6
21.	achieve equitable outcomes.	*2.93	*2.63	26.3	48.5
22.	communicate with others locally and globally.	3.14	3.03	14.5	26.5
23.	shape, respond and satisfy changing parent, community and employer expectations.	2.84	2.76	29.9	37.3

Note: * indicates the primary and secondary means are significantly differnt at 0.5

df = (1,279), p = .035), and Item 21 (F = 8.372, df = (1,279), p = .004) indicating that primary participants rated their confidence in integrating ICTs in learning more highly than did secondary participants in each comparison. These results are of particular concern as they include basic confidence in operating computer hardware and software and locating and organising information, as well as functional teaching skills such as planning curriculum projects, engaging students in curriculum activities, supporting the learning process and individual learners, and achieving equitable outcomes. Also of concern are the higher percentages (>30%) of secondary participants who perceived they had no or limited confidence to support students using ICTs in all but four of the integration examples. Particularly problematic would seem to be the difference between the percentage of primary (18.1%) compared with secondary (32.4%) who perceived they had no or limited confidence to "develop deep understanding about a topic of interest relevant to the curriculum area/s being studied", as secondary participants had completed eight courses in each of their two specialist teaching areas.

Table 3. Strength categories– Primary respondents

Strength Categories	% (N=100)
Provided practical real life experiences with immediate applicability to the classroom	48
Specific applications eg Powerpoint, webquests, hyperstudio, digital cameras	12
Theoretical component	11
Developed confidence in using it in classrooms	9
Teaching staff professionalism, commitment	6
Other	14

Strengths and recommended improvements of ICT experiences

The participants were asked to describe the strengths of their teacher education program for preparing them to integrate ICT into their students' learning when they became a teacher. These responses were analysed using a content analysis methodology that allowed the coding of up to three categories for each individual student response. For the primary participants 100 codings (0.46 per participant) were recorded and Table 3 provides an overview of the identified categories and the percentage of codings for each category. It can be seen that the participants particularly valued (48% of codings) their ICT experiences because they "provided practical real life experiences with immediate applicability to the classroom". Examples of this type of response include "very practical assignments and activities which prepared me for implementation in the classroom" and "provided real life situations that have been immediately useful in classroom practice". Also on a practical theme, participants saw as a strength (12% of codings) their experience with "specific applications" such as: "I developed confidence with programs I otherwise would probably never use such as powerpoint and photoshop. The experience I gained with powerpoint was valuable throughout university but also during pracs". However, participants also described as a strength (11% of codings) the "theoretical component" as exemplified by "the IT major contributed greatly to my understanding, interpretation, knowledge and creativity of the incorporation of ICT within the curriculum". In contrast, only seven codings were recorded by secondary participants (0.10 per participant) in two categories "teaching staff professionalism and commitment" and "provided practical real life experiences with immediate applicability to the classroom". An example of the latter category was "SOSE curriculum B made us develop a web based resource for practical implication in the classroom. I used it on prac".

The participants were asked to describe recommendations that would improve their teacher education program to better prepare them to integrate ICT into their students' learning when they become a teacher. For the primary participants 150 codings (0.69 per participant) were recorded and Table 4 provides an overview of the identified categories and the percentage of codings for each category. Included in these codings are responses that participants described under the strengths open-ended section but were clearly recommendations for improvement. It can be seen that the most frequently recommended improvement (22% of codings) is "more practical in relation to integrating computers into teaching" as exemplified by "I would like to see a 'computer'

Table 4. Recommendations for improvement categories – Primary respondents

Improvement Categories	% (N=150)
More practical in relation to integrating computers into teaching	22
Do more than one ICT course	17
Schedule an ICT course later in the program	12
Focus on unknown software programs	12
More integration across all courses	9
Access to resources	8
Course delivery – better pacing, streamed tute groups, varying levels for courses	6
Specific ICT devices for special needs students	5
Other	9

subject where students are shown how to present and teach a program to students. It is all well and good to be able to use these programs but how do we teach them to students???" and "would love to observe teachers who integrate ICTs well in their classroom. This would offer ideas and clarify the expectation of integration". Curiously this most frequent category of recommendation for improvement is very similar to the most frequent category of strength.

The next most recommended improvement (17% of codings) was to do "more than one IT course". Primary participants experienced one core ICT course and then had opportunities later to complete a four-course major in ICT or do individual ICT electives. An example was "I think that 'general teachers' need to know more of how and what they can do. Only 1 subject in 1st year is not really enough". Of similar sentiment was "Schedule an ICT course later in the program" (12% of codings) as exemplified by "we need more courses and later in the BEd degree - more relevant - in 1st year you are unable to as yet relate it adequately to the classroom".

For the secondary participants 60 codings (0.88 per participant) were recorded and Table 5 provides an overview of the identified categories and the relevant codings for each category. Included in these codings are responses that participants described under the strengths open-ended section but were clearly recommendations for improvement. As with the primary respondents, the most frequently recorded (22% of codings) recommendation for improvement was "more practical in relation to integrating computers into teaching" as exemplified by:

When doing curriculum subjects & looking at the integration of ICTs include some hands on time - not just talking about it. For example in the SOSE teaching area have someone come in and talk to us and show us how to use tools like webquests and then let us have a go at using them.

Another category with frequent response (17% of codings) was a recommendation for provision of a computers-in-learning course or for more courses with a computing base, for example "more courses with a computing base, in accordance with curriculum and syllabus requirements, would be helpful in preparing units of work and lessons which integrate ICT". Similar recommendations (18% of codings) were "more integration of ICT across all courses" as exemplified by "better integration of explicit teaching of ICT skills &

Table 5. Recommendations for improvement categories – Secondary respondents

Improvement Categories	% (N=60)
More practical in relation to integrating computers into teaching	22
More integration of ICT across all courses	18
Provide a computers-in-learning course	17
Make it compulsory, a core course	15
Incorporate ICT based assessment in each course	10
More relevant programs (for music composition and for computer programming)	10
Other	9

strategies ACROSS courses"; and "make it compulsory, a core course" (15% of codings) for example "there needs to be a mandatory ICT class to develop competencies in the integration of technology in classes. The program as it is now does not do this".

Conclusion

This paper has explored some aspects of auditing the ICT experiences of students in teacher undergraduate programs at one Australian university and provided data relating to the participants interest in using computers; their competence with ICT applications; their confidence with ICT integration; and their perceptions of the strengths and recommended improvements with respect to ICT in their programs. It has found that the participants had high levels of computer and Internet availability and, it was noted that they expressed slightly less interest in computers than they did in their belief that computers can improve student-learning outcomes.

Participants' self-perception of their competence with ICT applications revealed that participants from the primary program generally rated their competence higher than did participants from the secondary program. Of some concern is the limited band of applications with which the participants express high levels of competence and the high percentages of participants who perceived themselves to have no competence with certain applications. This particularly applied to applications such as multimedia development, visual thinking software and digital video editing which are arguably the applications that are playing larger and larger roles in learning at both primary and secondary levels.

Participants' self-perception of their confidence to integrate ICT into student learning also revealed that participants from the primary program generally rated their confidence higher than did participants from the secondary program. However, again the percentage of participants who rated themselves as having no or limited confidence with particular integration examples was of concern. The integration items in this section of the survey were adapted from items on the ICT curriculum integration performance measurement instrument (Proctor, Watson & Finger, 2003) that the prospective employing authority for the majority of graduates uses in its annual accountability data collection. That is, as teachers, the participants will be required to rate their frequency of use for these, and other, integration examples.

Unless you compare a composite mean for competence and confidence then just eyeballing the means is a dangerous thing. I'd leave this para out. Content analysis of the strengths of their ICT experiences in their program revealed that the primary participants valued the practical applicability to the classroom. Paradoxically, in their recommendations for improvement, this aspect also generated the highest percentage of comment. This emphasises the different perceptions, even the different experiences, of individual participants particularly in a situation such as that in which the research was conducted where the primary participants studied on three different campuses with different staff and across a range of majors and electives. Of particular concern is the high level of recommendations for improvements expressed by the participants from the secondary program compared with what they saw as the strengths of their ICT experiences.

In general, what this paper has drawn attention to is the need to audit the ICT experiences of students in undergraduate teacher preparation programs to ensure that all graduates will have the necessary competencies and confidence to integrate ICT into their students' learning. It cannot be assumed that an intention to integrate ICT into courses will result in appropriate and comprehensive ICT outcomes for graduates. While all course and program convenors share the responsibility for integrating meaningful ICT experiences into student learning, university academics may not be sufficiently ICT competent to do this effectively. Specialist ICT academics have a role in the planning of ICT experiences across programs and in the auditing of ICT outcomes.

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