Integrating ICT into pre-service teacher education programs: Challenge and Response

New teachers in New South Wales are required to have enough ICT skills to allow them to be proficient in the use of computers professionally and pedagogically. At the same time, Schools of Education in Australia are functioning within budgetary and timetabling constraints that do not allow them to provide their students additional courses. One of the largest teacher education schools in Australia has introduced an innovative initiative where ICT skills were offered to their students within their regular education sequence. This study reports the evaluation of the first phase of this initiative.

The study is based on the experiences of 421 students enrolled either in the Primary or Secondary teacher programs. The data were collected from the students at the beginning and the end of their experience in the initial education course in Semester One, 2006. Data were gathered through questionnaires, an ICT skills survey and group interviews.

Data analyses of Phase 1 indicate an improvement in students' perceptions of their skills and confidence in the use of common programs such as word processing, presentation and drawing. However, their skills in the use of computers to reason and solve problems have not significantly changed. Implications for program modification for subsequent cohorts of students are identified.

Introduction

The use of Information and Communication Technology (ICT) in teacher education programs is gaining momentum and interest throughout the world. A good indicator of such an interest is the large number of reports and studies published in Australia, Europe and USA that involve aspects of ICT and teacher education. There is a widespread recognition of the potential of computers in the classroom. The federal Department of Education, Science and Training (DEST) report of 2005 aptly summed up this recognition by stating that "the need to better exploit the teaching and learning potential of ICT is widely accepted and supported" (p. 3).

This interest in the use of ICT is associated with the striking developments in computing software and hardware, phenomenal growth of the internet, the standards movement in assessment in general and teachers' professional standards in particular. Standards for measuring teacher performance in ICT are identified in the USA, UK, and Australia (Watson, Proctor, Finger and Lang, 2004). The New South Wales Institute of Teachers produced its Professional Teaching Standards in 2004 which contained seven elements that describe the areas that encompass the domains of teachers' work. The first element, "Teachers know their subject content and how to teach that content to their students." is made up of four aspects, one of which is "Knowledge of information and communication technologies." This knowledge extends from knowledge and proficient use of basic operational skills and related pedagogical skills for classroom management for the new teacher to leading roles in the integration of ICT for the professional leadership (see Table 1).

The issue of these standards and the notion that they represent the expected knowledge and skills of graduate teachers places pressure on the various Faculties of Education in New South Wales to include ICT components in their teacher education programs. This paper identifies the various models used to develop ICT skills within teacher education programs and describes the experience of one of the faculties of education in responding to the expectations outlined above.

ICT and Teacher Education Programs

There is an expectation that contemporary teacher education programs prepare graduates to use ICT effectively as an integral dimension of their teaching and their students' learning. The most obvious, and probably the most direct response to meet these expectations of the graduate teachers, is to include units (subjects) with a focus on computer skills and computer education. Such units focussed initially on teaching Basics and Logo and basic computer operations during the 1980's. With the phenomenal development in software, teacher education programs shifted their focus to the use of commonly available applications such as word processing, spreadsheet and web authoring. Albion (2000) summed up the components of many of the computer education units that are offered to students in primary and secondary teacher education programs as follows:

- Fluency in the use of common software tools; and
- Skills in the evaluation, selection and integration of software for the classroom (p. 756).

Table 1: Element 1 in the Professional Standards of NSW Teachers

GRADUATE TEACHER	PROFESSIONAL COMPETENCE	PROFESSIONAL ACCOMPLISHMENT	PROFESSIONAL LEADERSHIP
Demonstrate current knowledge and proficiency in the use of the following: • Basic operational skills • Information technology skills • Software evaluation skills • Effective use of the internet • Pedagogical skills for classroom management.	Apply current knowledge and skills in the use of ICT in the classroom to meet syllabus outcomes in the following: • Basic operational skills • Information technology skills • Software evaluation skills • Effective use of the internet • Pedagogical skills for classroom management.	Exhibit and share current skills in the use of ICT in the classroom to meet syllabus outcomes in the following: • Operational skills • Information technology skills • Software evaluation skills • Effective use of the internet • Pedagogical skills for classroom management.	Initiate or lead the implementation of policies and processes to integrate ICT into the learning environment.

Australian Catholic University (ACU), a public university with six campuses across the Eastern States of Australia, has embedded within its teacher education programs similar computer education units since its foundation in 1990. In addition to these core units teacher education students would have opportunities to use specialised computer software within their curriculum units and to take up a Minor in computer education. The Faculty of Education (ACU) has a further challenge as the six campuses are across four different states and territories, each with their own expectations for ICT components in teacher education programs. Recently these programs have undergone an extensive review. The faculty was required to review courses within the context of government funding cuts. One outcome was the reduction in the number of units that are offered to the students within funded programs. The review also challenged the assumptions that underpinned the presentation of ICT competencies for teacher education in segregated units of study, rather than integrated into other units focussing on pedagogy and curriculum.

The available literature suggests, as indicated earlier, that the ICT skill development programs do not necessarily lead to their transfer to the classroom (Albion, 2000; Watson, Proctor, Finger and Lang, 2004; and Steketee, 2005). Modelling is recognised as a power source for skill transfer. It is a cornerstone concept of apprenticeship. The recognition of the impact of modelling led to the call for the integration of ICT into the teacher education program. Graduating teachers imitate their lecturers at least in the first few years of their careers as teachers. Therefore, it seems logical to deduce that the vicarious learning of ICT skills will be enhanced by integrating ICT within the education and curriculum units that are offered in teacher education programs.

In a review of the literature, Steketee (2005) classified ICT integration under four approaches:

1. ICT skills development approach - inclusion of a core computer education unit to the teacher education programs;
2. ICT pedagogy approach - inclusion of pedagogical units to show students how to integrate ICT in the classroom;
3. Subject-specific approach - integration of ICT into specific subject areas (curriculum units such as Mathematics, English, Science, and Human Environment); and
4. Practice-driven approach - where students design ICT resources for their practicum experiences (p.102).

These four approaches are summarised further in Table 2 below.

Table 2: Approaches to ICT integration[1]

Integration Approach	Format	Features	Limitations
Skill Development approach	One or more unit dedicated to relevant ICT skills and competencies	- Opportunities for students to gain ICT skills regardless of their past experience. - Potential to transfer to the classroom - Emphasis on basic computer operations and programs	- ICT units and skills are viewed by students as discrete components of their programs - ICT skills are perceived as targeted learning outcomes without any emphasis on their applied values to the classroom - Research does not indicate any evidence of skill transfer to classrooms
Pedagogy approach	Inclusion of one unit or more to teach students how to integrate ICT skills into their teaching	- Opportunities to learn ICT skills as well as how to implement them in the classroom - Potential to transfer to the classroom	- ICT skills are perceived as targeted learning outcomes without any emphasis on their applied values to the classroom - Research does not indicate any evidence of skill transfer to classrooms
Curriculum units approach	Inclusion of specialised software within the curriculum unit	- Opportunities to model to participating students actual integration within authentic settings - Potential to transfer to the classroom	- Use of software as tools for learning rather than as medium of learning - Confining the use of the specialised software to their particular curriculum areas rather than the classroom as a whole
Practice-driven approach	Inclusion of the design ICT resources to be used in their practicum experience	- Opportunities to the student teachers to monitor their own learning through the use of tools such as digital portfolios	- Limited to student teacher professional learning - Dependent upon student teacher's prior ICT experience

[1] Based on Steketee, (2005); Albion, (2000); McNair and Galanouli, (2002); Brown, (2002); Watson, Proctor, Finger and Lang, (2004); Karagiorigi and Charalambous, (2006); McNair and Galanouli, (2002); Baki, (2000); Wang, (2002); and Loughland and Meyenn, (2003).

The evidence that is presented in the reviewed literature does not dispute the value of these approaches in facilitating the ICT skill acquisition. However, none of the studies provides evidence that such training leads to the transfer of the ICT skills to the classrooms. (Steketee, 2005) seems to believe that the practice-driven approach may have such a potential. She states that the approach "has been successful to the extent that pre-service teachers are motivated to design ICT experiences for authentic learning purposes and for genuine audience" (p. 106).

The four identified approaches should help the students gain the personal and professional skills in the use of use of computers. However, none of these approaches individually are comprehensive enough to equip students with the personal and pedagogical ICT skills at the same time. It seems logical that there is a need for an integrative approach that combines skill development and the theoretical and practical pedagogical skills. In 2006 ACU implemented an integrative program providing students with the opportunities to develop their personal and pedagogical ICT skills and at the same time experience ICT being integrated in their own learning. This integrative program is described below.

ACU Integrative ICT Program

The ICT integration program that was implemented in 2006 was designed to present a core of ICT competencies across their four year program. The ICT competencies were developed in three modules and intergrated with three education studies unit sequence across their program. The modules included the following targeted learning outcomes:

Module 1 (First Year Level: Integrated within Contexts for Learning and Development)

- Understanding the scope of ICT for learning: Processes, application and equipment
- Introducing ICT as a medium for evidence of professional practice
- Managing personal and shared ICT spaces
- Developing ICT skills for learning
- Developing information skills for effective learning
- Considering a pedagogy for learning with ICT

Module 2 (Second Year Level: Integrated within Teaching and Managing Learning Environments)

- Understanding learner-centred online learning environments
- Defining, locating, selecting, organising, presenting and assessing online learning environments
- Identifying issues relating to safe and ethical online learning environments
- Developing web authoring knowledge and skills to plan, develop, implement and evaluate online learning environments

Module 3 (Fourth Year Level: Integrated within Transition to the Profession)

- Developing a culture of evidence of professional practice
- Authoring the media for digital portfolios
- Designing and developing digital portfolios

ICT integration was implemented in the four Schools of Education that run teacher education programs within the Faculty. The largest two schools in the Faculty of Education opted to organise the implementation of the integration programs using two different models:

- School A opted to organise the weekly sessions into one lecture and two tutorial sessions. One of these sessions was conducted in the computer laboratories. The focus

of these laboratory sessions was the facilitation of the development of students' ICT skills. ICT specialists were included in the teaching teams of the integrated courses along with education tutors.
- School B opted to organise the weekly sessions into one lecture and a two-hour tutorial session that were facilitated by education tutors. The ICT specialists were assigned as support teaching staff to the tutors and their students.

The two models included assigning activities to students that integrate concepts and principles of learning and human development with ICT. The Education sequence units under both models incorporate various WebCT facilities into their structures such as discussion, announcements, links to resources, and assessments. They also incorporate the practice-driven approach in the fourth year of the program.

The two models target identical learning outcomes that include computing knowledge and skills. They provide the students with the opportunity to develop relevant ICT skills and gain competency in the use of common programs that might be used in the management and the facilitation of student learning. They link the various ICT skills into an essential repertoire of teaching strategies, learning principles and child development constructs. However they differ in:

- Dedication of weekly activities in the computer laboratories. In Model A, students are provided with direct opportunities to develop their ICT skills in the computer labs. Model B students do not have supervised dedicated lab sessions, though computer laboratories are available to them.

- Exposure of the students to specialist tutors in educational computing. Model A students' ICT skills development is facilitated by experienced tutors with specialisation in computer education. Model B students have the opportunity to consult such tutors as they need them.

The primary purpose of this paper is to report the outcomes of the ACU integrative ICT model after the first year of implementation. Provisions were made to gather data on the project on an annual basis. The first phase of data gathering has been completed. This paper will report on the perceptions of the participants in the project at the end of the implementation of Module 1 of the program.

The implementation of the integrative program differed between the two schools (A and B). Model B is based on the assumption that students would develop the ICT skills through their ICT integrated pedagogical experience. Model A does not make that assumption and provides the students with direct and supervised opportunities to develop these skills. Therefore this paper compares the perceived outcomes of both models. Specifically, the paper will address the following questions:

- Do the participating students in the integrative ICT program perceive that they have gained the targeted knowledge, skills and competence in ICT at the completion of the first module?

- Is there a relationship between the implemented ICT integration model and students' perceptions of their ICT skills?

Research Method

The ICT integration program was implemented in Semester 1 of 2006 in two formats in School A and School B's primary and secondary teacher programs. The units (subjects) were coordinated by a lecturer and teams of tutors and/or support specialists in educational computing. The units (subjects) ran for 12 weeks and were prepared by the teaching teams. The authors met with the teams prior to the teaching to plan the process of data gathering. Bi-weekly review meetings were held with the teaching teams in School A. Although similar meetings were planned with the teaching teams in School B, none were held beyond the planning sessions.

The data were gathered through a questionnaire, ICT knowledge and skills inventory (ICT Inventory), group interviews with the participating students, reflective diaries, and individual and group interviews with the teaching teams (see Table 4).

The questionnaire was adapted from an ICT Capabilities and Attitudes Questionnaire (ICTCAQ) that was designed and administered at Sydney University (Markauskaite, 2005; 2006). The questionnaire was made up of seven parts. Two parts gathered students' background information and ICT-related experience, the other five parts used a Likert type scale to measure students' perceptions of their:

- general problem-solving capabilities (a scale ranging from 0 for *Do not have the capability* to 5 for *Totally confident of having the capability*)
- ICT capabilities (a scale ranging from 0 for *Do not have the capability* to 5 for *Totally confident of having the capability*)
- self-learning to use ICT (a scale ranging from 0 for *Not able to complete the job* to 5 for *Ttotally confident of being able to complete the job*)
- ICT coping strategies (a scale ranging from 1 for *Unlikely to employ the strategy* to 5 for *Very likely to employ the job*)
- ICT in your future job (a scale ranging from 1 for *Unlikely to take the action* to 5 for *Very likely to take the action*)

The ICT capabilities and attitudes questionnaire was administered twice for the students who were in attendance in Weeks 3 and 11 of the course.

Table 3: Data sources by variable of interest

Data Source	Data Gathering Stratigies			
Students' perceptions and attitudes	ICTCAQ	ICT Inventory:	Focus groups	Unit Evaluation
Lecturers' Experience	Reflection diaries	Individual/group interviews		

The ICT Inventory was developed by the researchers. It was made up of 40 multiple-choice and short-answer items. It reflected the targeted learning outcomes at the end of Module 1. Several sources were used in the development of the inventory. These included New South Wales Board of Studies trial papers in computing. The inventory was administered online to the participating students on a voluntary basis (See Table 4).

Two groups of students, one representing primary teacher education and the other representing secondary education, were invited to meet with the researchers to reflect on their ICT experiences in the course. Eight students from each group were selected at random from a list of volunteers. However, of the sixteen students only eight actually participated in the

group interviews. Five students participated in the first group and three students in the second group. The interviews were held at the end of the semester.

A short instrument made up of 13 items was developed and administered in Week 11 to gather students' perception of the achieved outcomes of the course and the quality of the integration of the ICT modules within the course.

Table 4: Distribution of participating students by school and teacher education program

Campus	Primary Teacher Education	Secondary Teacher Education		Total
		B Teach/BA	Grad. Dip	
School A	134	147	6	287
School B	102	32	0	134
Total	226	189	6	421

Teaching teams in the unit (subject) were asked to keep reflective diaries. These diaries were sent to one of the researchers in Weeks 3, 6 and 12. Participation was voluntary. Respondents were asked to reflect on their personal and professional use of the computers, integration of ICT, students' experience with the integration, as well as the type and quality of support they received and ways of improving support to meet their needs. Eight lecturers/tutors submitted their reflection journal at least twice. Most of the participants came from School A. Two participants came from School B.

The lecturers were invited to participate either in group or individual interviews in both schools. Eight lecturers participated in five interviews. Five of these lecturers represented School A and the rest represented School B.

Results and Discussion

The integrative ICT program is scheduled for implementation over four years. The current data analysis is based on the outcomes of the first year of the program. The results will be presented by the learning outcomes that are expected to be achieved at the end of the first module. This paper reports on a subset of the data collected thus far at the end of the first ICT integrated module that relate to the research questions.

The first research question seeks to identify if the participating students in the integrative ICT program perceive that they have gained the targeted knowledge, skills and competence in ICT at the completion of the first module. The targeted ICT skills by the end of the first module are measured by three sets of learning outcomes. These are: managing personal ICT spaces; managing shared ICT spaces; and ICT skills for learning.

Table 5: Perceived competencies with managing personal ICT spaces

Managing Personal ICT Spaces	Mean	SD
Operate a computer and software	4.45	0.78
Manage files, folders and handle other computer storage tasks	4.33	0.81
Maintain a computer	3.52	1.23
Perform basic tasks common to many software applications	4.41	0.82
Perform advanced tasks common to many software applications	4.16	1.03

The students seem to feel at the end of the first module that they have gained the targeted ICT skills that enable them to use computers and to support their own learning. All the items that represent these skills have a strong positive rating (see Tables 5, 6, and 7).

Specifically, the post-experience measurement indicates that the students perceive that they have developed ICT skills that allow them to manage personal and shared ICT spaces. The mean score that was based on aggregating students' ratings for the skills that translate this outcome is 4.18 out a possible score of 5 and with a standard deviation of 0.78. The mean ratings on the individual items that compose the outcome of managing personal and shared ICT spaces appear in Table 5.

The post-experience measurement indicates that the students perceive that they have developed ICT skills that allow them to manage shared ICT spaces such as Internet and WebCT. The mean score based on aggregating students' ratings for the skills that translate this outcome is 4.10 out of a possible score of 5 and with a standard deviation of 0.90. The mean ratings on the individual items that compose the outcome of managing personal and shared ICT spaces appear in Table 6.

Table 6: Perceived competencies with managing shared ICT spaces

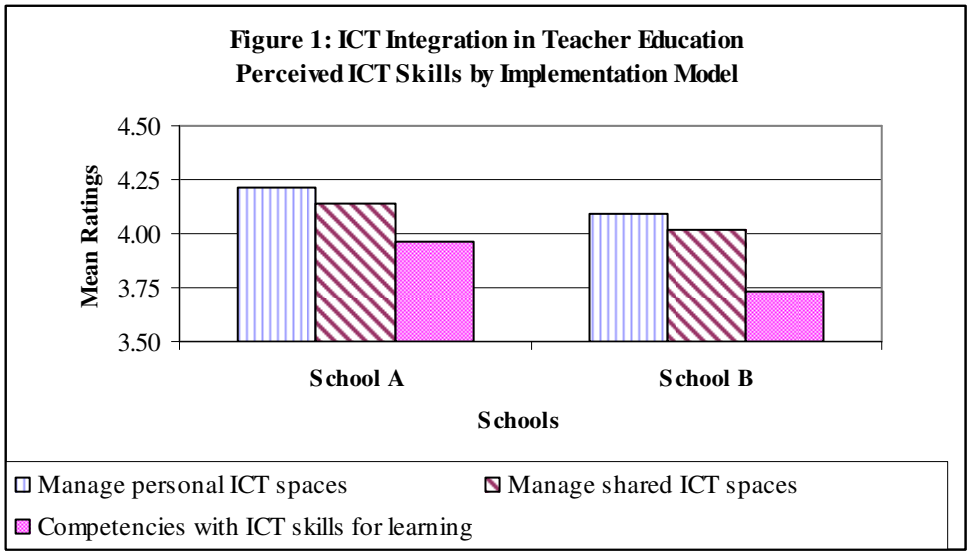
Managing Shared ICT Spaces	Mean	SD
Navigate the Internet and access other digital resources	4.13	0.98
Search and gather information from the Internet and other digital resources	4.08	0.93

The students seem to perceive that they have developed ICT skills that may be used in learning such as word processing, presentation and mediated communication. The mean score based on aggregating students' ratings for the skills that translate this outcome is 3.89 out of a possible score of 5 and with a standard deviation of 0.79. The mean ratings on the individual items that compose the outcome of ICT skills for learning appear in Table 7.

Table 7: Perceived competencies with ICT skills for learning

ICT Skills for Learning	Mean	SD
Perform basic word-processing tasks	4.49	0.81
Perform advanced document formatting tasks	3.88	1.15
Create simple computer slide presentations	4.24	0.93
Design presentations with multimedia elements	3.75	1.19
Create simple images	4.17	1.00
Edit and design graphics	3.64	1.21
Communicate with others via email and other network tools	4.40	0.88
Publish and deliver the results of a research activity using ICT presentation tools and networks	3.18	1.13
Collaborate with others using various ICT tools	3.27	1.19

To determine the differences in the perceptions of the students by school or model of implementation, the mean scores were computed for each student who responded to the majority of the items within the outcome. Students from School A seem to have higher mean scores on the three sets of outcomes (See Figure 1).



The t-test analyses (see Table 8) for the differences between each pair of means (School A and School B) indicate that the only statistically significant difference is in the students' perceptions of their competencies with ICT skills for learning (p=0.2).

Table 8: Differences between students' perceptions of their ICT competencies by model

Independent Samples Test	t-test	Degrees of Freedom	Significance Level
Manage personal ICT spaces	1.16	274	0.25
Manage shared ICT spaces	0.98	274	0.33
Competencies with ICT skills for learning	2.32	274	0.02

The analysis of the ICT skills inventory, an online test developed by the researchers, has confirmed that the differences between the two groups were not significant. Unfortunately, the majority of the students in School B did not take the test because of an administrative error at that campus; therefore, the data set by itself might not be reliable.

It should be noted that the teaching team in School B have found the support they were required to provide unmanageable. Therefore, they introduced other means to provide more structured and group-based support such as computer clubs. The senior ICT lecturer in the school wrote in her diary:

> *A group of students came to me last week and said they were floundering. I offered to set up a weekly 'computer club' tutorial for them. They were very excited at that prospect and passed the word around. My list for this extra class is now up to 16 students, all by word of mouth.*

Students' interviews and staff interviews have shown that as the unit progressed, the ICT skills component with its dedicated tutorial sessions or voluntary "clubs" became a parallel unit by itself. Perhaps the following response by one of the ICT tutors in School A expresses accurately the changes that have taken place in the unit, though she presented it from a students' point of view:

> *In this course: it seems that there have been three phases: segregate IT – IT is naturally exclusive to particular content, secondly they have tried to integrate*

IT into context, such as using Word to explore Bloom's – but this results in content confusion. The third phase concentrates on activities of how we would use IT. We have developed resources, the primary and secondary teams themselves were in together.

The students seem to agree that the integrated unit has helped them develop both subject and ICT bases. For example, one student said to that effect:

At the end of the unit I had a better understanding of how children learn and how the ICT programs can use this information to facilitate lessons

Conclusion

The results of the first phase of a three-module ICT integration program with Education sequence unit would indicate perceived benefits of the program adopted in School A. This program combines all the ICT approaches that are currently used in teacher education programs in Australia and many other regions and countries such as Europe, North America and China. The program provides a basic foundation for all units in education that have ICT components. The ICT components are made available to the students through, lectures and learning activities, WebCT facilities, assessment and targeted ICT skills development tutorial sessions. This final component , while more resource intensive , appears to be more effective in building students' sense of ICT capacity.

The focus of the first phase is ICT skills for students' learning. Later phases or modules will include practice-driven approach through the various practicum formats that are already linked with the Education sequence units.

The results of the first phase indicate that students perceive that they have gained the targeted ICT skills at the end of their unit. However, the results indicate that the pedagogical approach by itself seems impractical. Students will need structured support that target ICT development but within the context of the pedagogical approach.

References

Albion, P. (2000). Setting course for the new millennium: Planning for ICT in a New Bachelor Degree Program. In *Society for Information Technology and Teacher Education International Conference*, San Diego: California, February 8-12, 2000.

Angeli, C. & Valanides (2004). The effect of electronic scaffolding for technology integration on perceived task efforts and confidence of primary student teachers. *Journal of Research on Technology in Education*. *37*(1), 29-43.

Baki, A. (2000). Preparing student teachers to use computers in Mathematics classroom through long-term pre-service course in Turkey. *Journal of Information Technology for Teacher Education.* 9(3), 343-362.

Baxter, A., Olney, I., Brown, C. & Ferry, B. (2003). Shifting focus on integration: Use of ICT to support community learning in a re-structured one-year teacher education course. In G. Crisp, G., Thiele, D., Scholten, I., Barker, S. and JBaron, J. (Eds), *Interact, integrate, impact: Proceedings of the 20th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education*, Adelaide, 7-10 December 2003.

Department of Education, Science and Training (DEST). (2005). *A Proposal for the Development of an ICT Competency Framework for Teachers*. Canberra: Author.

Finger, G., Charleston D., O'Brien R. & Pugh L. (2003). Conceptualising the information and communication technologies (ICT) journeys of future teachers and practising teachers : findings, challenges and reflections. In *Educational research, risks and dilemmas: NZARE/AARE Conference.* Auckland: New Zealand, 29 November - 3 December 2003.

Ho, W. (2004). Use of information and music learning in the search for quality education. *British Journal of Educational Technology*, *35*(1), 57-67.

Karagiorgi, Y. and Charalambous, K. (2006). ICT in-service training and school practices: in search for the impact. *Journal of Education for Teaching*. *32*(4), 395-411.

Lim, C., Hung, D., Wong, P. and Hu, C. (2004). The pedagogical design of ICT integration in online learning: A case study. *International Journal of Instructional Media*, *31*(1), 37-47.

Markauskaite, L. (2005). Exploring differences in trainee teachers. ICT literacy: Does gender matter? Sydney: Author.

Markauskaite, L. (2006). Gender issues in preservice teachers' training: ICT literacy and on line learning. *Australasian Journal of Educational Technology*. *22*(1), 1-20.

McNair, V. & Galanouli, D. (2002). Information and Communications technology in teacher education: Can a reflective portfolio enhance reflective practice? *Journal of Information Technology for Teacher Education*, *11* (2), 181-196.

New South Wales Institute of Teachers (2004). *Professional teaching standards.* Sydney: Author

Steketee, C. (2005). Integrating ICT as an integral teaching and learning tool into pre-service teacher training courses. *Issues in Educational Research*, *15*(10), 101-112.

Steketee, C. (2006). Modelling ICT integration in teacher education courses using distributed cognition as a framework. *Australasian Journal of Educational Technology*, *22*(1), 126-144.

Wang, Y. (2002). When technology meets beliefs: Pre-service teachers' perceptions of the teachers' role in the classroom with computers. *Journal of Research on Technology in Education*, *35*(1), 150-162.

Watson, G., Proctor, R., Finger, G. & Lang, W. (2004). Auditing the ICT experiences of teacher education undergraduates. *Australian Educational Computing*. *19*(1), 3-10.