

# Information Technologies (IT)

## Competency requirements and development of IT skills in an Australian degree for K-6 teachers

### ABSTRACT:

*Developing Information Technology (IT) skills in pre-service teachers and identifying IT competencies required of practising teachers is an issue challenging most developed nations. This paper looks at IT capabilities required by a number of educational systems and discusses IT skills developed in the Bachelor of Education (Primary) degree at the University of Melbourne, Australia. Students graduating from this degree will be K-6 (also known as primary or elementary) teachers. The paper illustrates the development of IT skills over the four years of the course with the students progressively developing both generic IT skills and IT skills specific to curriculum areas.*

### Introduction

The Bachelor of Education (Primary) [B.Ed.(P)] degree is the principal vehicle for training primary teachers at the University of Melbourne in the Australian state of Victoria. In Victoria, as in many parts of the developed world, there is a strong emphasis on the uses of information technologies (IT) or learning technologies in the classroom (Victorian DoE, 1999a) with a number of major IT initiatives in place that make it critical that our graduates have good IT skills. This paper will look at some ways IT capabilities or competencies have been addressed in Australia and the USA and will discuss how IT skills are developed in the four year B.Ed.(P) course for pre-service K-6 teachers at the University of Melbourne.

In 1995 the B.Ed.(P) degree at the University of Melbourne was restructured and updated extensively with a move from an activity-based course to emphasise a scholarly, research-informed basis for teaching and learning. New first year subjects were introduced in 1996 and later year subjects were progressively implemented from 1996 to 1999. [See Table I for the titles of subjects undertaken by students in the new course.] In the 1999 academic year the first cohort of students of the revised course completed their final year. Over the period of the development and implementation of the new course structure there has been an ever-increasing impetus to prepare our students - as much as is possible in the changing world of IT - for significant uses of IT in their teaching careers, which may extend to 2040!

In addition to the restructuring of the course for the above reasons, budget constraints imposed a rethinking of the delivery of the course and of the ways in which students undertake practical experience in schools. From 1997, a reduction of

20% was made to the number of days of supervised practical work in schools. In response, interactive multimedia has been used in some subjects to make 'experiences' with children a well-integrated part of the university course and to maximise the learning experiences of our students while on teaching rounds. Development of multimedia resources has been undertaken within the Faculty of Education and has been progressing as funds and time allow it (see Chambers & Stacey, 1999; Asp, Chambers, Scott, Stacey & Steinle, 1997; Chambers, Asp, Scott, Stacey & Steinle, 1997 for descriptions of some of the multimedia projects for use in teacher education). Using such multimedia resources as part of their course work also models to our students some of the ways that IT can be used to facilitate learning.

### Statements about the IT capabilities of teachers

In the years leading up to 2000 an increasing number of school systems and groups involved in the uses of computers in education have developed documents indicating, or in some cases mandating, the IT skill levels that are expected of teachers. In Victoria, the then Department of Education (now the Department of Employment, Education and Training, DEET) developed the 'Learning Technologies Capability Guide' (Victorian DoE, 1999a) that suggests goals for skill development in a full range of learning technologies and includes a 'Skills Development Matrix' that identifies six key skill areas for Victorian teachers for using IT

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**Table I**  
Subjects undertaken by students in the Bachelor of Education (Primary) degree at the University of Melbourne, Australia.

**The 8 first year subjects are:**

- Studies of Society and Environment
- Arts 1
- Health & Physical Education 1
- Language & Literacy 1
- Mathematics 1
- School Experience 1
- Science and Technology 1
- Children, Schools and Society

**The 8 second year subjects are:**

- Indigenous Australian Studies
- Educational Theories and Practices
- Arts 2
- Health & Physical Education 2 [standard or advanced]
- Language & Literacy 2
- School Experience 2
- Maths 2 [standard or advanced]
- Computers in the Primary Classroom

**The 10 third year subjects are:**

- Science and Technology 2 [standard or advanced]
- Arts 3 [option]
- Children's Literature [option]
- Mathematics 3 [standard or advanced]
- School Experience 3
- Studies of the Australian Environment [option]
- Curriculum and Teaching [standard or advanced]
- Children with Special Needs [standard or advanced]
- Health & Physical Education 3 [option]
- Language & Literacy 3 [standard or advanced]

**The 10 fourth year subjects are:**

- Issues and Contexts in Education [standard or advanced]
- Research Project / Honours Research Project
- Curriculum Integration [standard or advanced]
- Arts 4 [option]
- Health & Physical Education 4 [option]
- Language & Literacy 4 [standard or advanced]
- School Experience 4
- Science & Technology 3 [standard or advanced]
- Mathematics 4 [standard or advanced]
- IT in Schools [option] (This subject is new and will run for the first time in 2001).

(Victorian DoE, 1999b). The key areas defined by this document are: (i) using and managing technology; (ii) using basic computer applications; (iii) using desktop publishing and presentation software; (iv) using multimedia; (v) using communication technologies; and (vi) using learning technologies in the key learning areas (Victorian DoE, 1999b). Similar documents have been developed in Australia and the USA (and elsewhere) and those looked at here are the *Minimum Standards - Learning Technology* from the Australian state of Queensland (Education Queensland, 1999), the *ISTE National Educational Technology Standards and Performance Indicators* from the International Society for Technology in Education of the USA (ISTE, 2000); and the *Mankato Skills Framework* from Minnesota, USA (Johnson, 1997). The key areas of IT skills for teachers have been abstracted from these four documents with the headings used within the documents interpreted as defining the key areas of importance (Table II). The documents, as expected, show much similarity in the areas of IT skills that are expected of teachers from Australia and the USA (Table III). Thus, in addition to the raft of other skills expected of teachers, it is an expectation of many education systems that new teacher education graduates will have a wide range of IT skills when they enter their first classroom.

**Methodology and rationale**

A survey was undertaken at the end of the 1998 academic year regarding uses of Information Technology (IT) in all subjects of the Bachelor of Education (Primary) course. Information was gathered in most cases through an interview with the subject coordinator and, for the small number of subjects where a suitable interview time could not be arranged, the subject coordinator completed a survey checklist without interview. Data for Years 1 to 3 reflect actual usage of IT for the subjects in 1998, whereas information for Year 4 was a projection of intended usage, as 1999 was the first time Year 4 of the revised course was taught. Note that the subject, 'IT in Schools', an elective subject for third and fourth year students, has been added to the course since this survey was undertaken. This subject will run for the first time in 2001 and was developed in response to student requests for an additional subject that looked at IT issues, including planning and school-wide issues,

The reasons for undertaking this study were:

- to establish use of IT in the course in 1998 so that these data could be used for comparison in later years;
- to inform subject coordinators of students' exposure to IT and the skills that could reasonably be expected of students entering a subject; and,
- to gain an overview of IT skill development in specific subjects so that development of IT skills could progress over the four years students were in the course so that students would graduate with the full complement of IT

<p>Learning Technologies Capability Guide Australia - Victoria</p> <ul style="list-style-type: none"> <li>Using &amp; managing technology</li> <li>Using basic computer applications</li> <li>Using desktop publishing and presentation software</li> <li>Using multimedia</li> <li>Using communication technologies</li> <li>Using learning technologies in the key learning areas</li> </ul> <p>(Victorian DoE, 1999)</p>	<p>Minimum Standards - Learning Technology Australia - Queensland</p> <ul style="list-style-type: none"> <li>IT skills - hardware, software, telecommunications</li> <li>Curriculum applications including classroom planning and management</li> <li>School planning</li> <li>Student centred learning</li> </ul> <p>(Education Queensland, 1999)</p>
<p>ISTE National Educational Technology Standards and Performance Indicators USA</p> <ul style="list-style-type: none"> <li>Technology operations and concepts</li> <li>Planning and designing learning environments and experiences</li> <li>Teaching, learning, and curriculum</li> <li>Assessment and evaluation</li> <li>Productivity and professional practice</li> <li>Social, ethical, legal, and human issues</li> </ul> <p>(ISTE, 2000)</p>	<p>Mankato Skills Framework USA - Minnesota</p> <ul style="list-style-type: none"> <li>Basic computer operation</li> <li>File management</li> <li>Word processing</li> <li>Spreadsheet use</li> <li>Database use</li> <li>Graphics use</li> <li>Internet use</li> <li>Telecommunications use</li> <li>Ethical use understanding</li> <li>Information searching</li> <li>Video production</li> <li>Presentation skills</li> <li>Technology integration</li> </ul> <p>(Johnson, 1997)</p>

**Table II (Right)**  
Headings used in various IT capabilities statements from Australia and the USA. [It must be noted that the purposes of these documents vary.]

	Functional skills	Pedagogical skills included	Stresses underlying educational theory	Recognised qualification	Recognised skills acquired through experience	Includes technical IT management skills	Achievable by every teacher
Learning Technologies Capabilities Guide Victoria, AU	✓	✓	✓		✓		✓
Minimum Standards Learning Technology Queensland, AU	✓	✓			✓		✓
NCATE/ISTE competencies USA	✓	✓	✓	not currently	✓	✓	✓
Mankato Skills Framework Minnesota, USA	✓	✓			✓		✓

skills required of teachers.

The IT skills documented are those that were *required* to complete the subject; although many students within a subject may have used other forms of IT these were not included in this study. For example, students may have emailed lecturers, developed Power Point presentations, or used the Internet for research while undertaking a subject, but these are only documented if they were a specific requirement of the subject. The reason for this was so that we could confidently say that *all* students had made the stated uses of IT while undertaking a subject. It must be noted that most students probably used IT in a wide range of other ways beyond the requirement of subjects.

## Results

Basic IT skills such as file creation and management, using word processors and spreadsheets, and using electronic resources such as the WWW and CD-ROMs for research are developed during the four year course, with some subjects such as Science & Technology, Mathematics, and Arts introducing students to IT tools specifically relevant to that learning area. (See Figure 1 for a summary of findings.)

### Uses of IT in Year 1

All first year subjects of the B.Ed(P) required students to submit word processed assignments which incorporates the basic IT skills of file creation and management, entering and formatting text, word processing, and printing. Other basic IT skills and experiences were developed in most subjects with students required to use spreadsheets in four out of eight subjects, to

access the Internet for lecture notes and teaching materials in five subjects and to use CD-ROMs to find information for four subjects. Using email and participating in electronic discussions was part of two subjects, with students in 'Mathematics 1' required to report to the electronic discussion forum about their analysis of interviews about children's understanding of decimal numbers they undertook while at a school. Students then had to respond to the findings of other students.

First year students were introduced to the Education Faculty's web site in both 'Mathematics 1' and 'Science & Technology 1' subjects, which included establishing and logging into a university computer account, using a web browser, and using an electronic student discussion forum. Using databases was introduced in two first year subjects; 'Health and Physical Education 1' required students to upload data they had collected while in schools into a database via a web interface and using databases was also introduced in 'Science & Technology 1'. The uses and evaluation of IT resources in schools was included in three subjects.

As expected, some subjects introduced students to IT tools specifically relevant to their learning areas. In the subject 'Science & Technology 1' sensors and probes were used for data logging to measure and record temperatures, and in 'Mathematics 1' graphics calculators were introduced.

Table III Attributes of some IT capability statements from Australia and the USA. [Data extracted from Table 1, p 24, ACCE, 2000.]

**Uses of IT in Year 2**

The second year of the course built on skills developed in first year and, as with first year, all subjects required students to use computers to prepare work submitted for assessment. In general, in the second year of the course there was a greater emphasis on students developing skills in using electronic resources available via the Internet, particularly the World Wide Web (WWW) or on CD-ROM. Most second year subjects required students to use the Internet in some way, whether it was accessing the Faculty home page, using

email, or searching the WWW for course-related information.

Education library staff introduced students to the local university library system, which includes paths to access ERIC in both 'Educational Theories and Practices' and in 'Computers in the Primary Classroom'. The ability to access and evaluate information from the Internet is seen as both crucial to the future teaching careers of our students and an area that was new to most students. As in first year, a number of subjects required students to use or evaluate software for classroom use.

**Figure 1: The uses of IT in subjects of the B.Ed.(P) course grouped by year of course.**

Use of IT in BEd(P) subjects [1998]	BASIC USES OF IT													SUBJECT-SPECIFIC USES OF IT																												
	creating files	managing files	word processing	printing	using web to access lecture notes	using spreadsheets	using web to access locally created materials	finding information on a CD-ROM	finding information on the web	using email	using electronic discussion forum	accessing database to find info	entering data into a database	use technology in schools	using/evaluating software for classroom use	developing presentations	creating images	using a scanner	using a digital camera	manipulating images	creating web pages/site	developing multimedia	datalogging	using sensors and probes	using algebraic/graphing software	using graphic calculators	creating a database	undertaking statistical analysis	creating software models	using simulation software												
<b>First year subjects</b>																																										
School Experience 1																																										
Studies of Society and Environment																																										
Arts 1																																										
Children, Schools and Society																																										
Language & Literacy 1																																										
Health & Physical Education 1																																										
Mathematics 1																																										
Science and Technology 1																																										
<b>Second year subjects</b>																																										
School Experience 2																																										
Indigenous Australian Studies																																										
Educational Theories and Practices																																										
Arts 2																																										
Language & Literacy 2																																										
Health & Physical Education 2 [std or adv]																																										
Maths 2 [std or adv]																																										
Computers in the Primary Classroom																																										
<b>Third year subjects</b>																																										
Children with Special Needs [std or adv]																																										
Health & Physical Education 3 [option]																																										
Language & Literacy 3 [std or adv]																																										
School Experience 3																																										
Arts 3 [option]																																										
Children's Literature [option]																																										
Mathematics 3 [std or adv]																																										
Science and Technology 2 [std or adv]																																										
Curriculum and Teaching [std or adv]																																										
Studies of the Australian Environment [option]																																										
<b>Fourth year subjects</b>																																										
School Experience 4																																										
Issues & Contexts in Education [std or adv]																																										
Research Project [std or hon]																																										
Curriculum Integration [std or adv]																																										
Language & Literacy 4 [std or adv]																																										
Health & Physical Education 4																																										
Arts 4 [option]																																										
Mathematics 4 [std or adv]																																										
Science & Technology 3 [std or adv]																																										



As expected, the subject 'Computers in the Primary Classroom' introduced a wide range of uses of IT and developed IT skills upon which other subjects could build. For example, the programming language Logo (as part of the computer software *MicroWorlds*) was introduced in 'Computers in the Primary Classroom' and the uses of Logo in developing children's mathematical understanding was developed in 'Mathematics 2'. Using HyperStudio to develop simple multimedia resources suitable for use in a K-6 environment and all that it entails – including using a scanner, creating and modifying images, and working with sound files – developed in students a range of both practical IT skills and the IT concepts relating to object oriented programming. Creating web pages also allowed students to consolidate their uses of a range of file types and develop another avenue for electronic communication. All lecture and weekly workshop notes for this subject were available online and a CD-ROM (Chambers & Dobbins, 1997) with other multimedia resources developed for the subject available to supplement the weekly lecture and workshop. Through this regular access to resources via technology, by the end of second year access to the Internet and WWW was a routine part of all students' academic tasks. This was not true of the students when entering second year.

### **Uses of IT in Year 3**

By the third year of the course the IT skills of students were well developed. All subjects assumed basic IT skills and most subjects expected students to use databases, the Internet and CD-ROMs as a routine part of the research process. Again, using and evaluating IT resources for use in schools was required in a number of subjects. Intensive use of web sites was made by a number of third year subjects with 'Mathematics 3' having all lecture notes, a bibliography, workshop feedback and a weekly on-line quiz available only via the WWW. In one subject, 'Studies of the Australian Environment', students consolidated a range of IT skills by developing a multimedia resource and creating a web site.

### **Uses of IT in Year 4**

The fourth year of the revised course was not taught in the 1998 academic year so the information supplied was of predicted uses of IT in these subjects. All fourth year subjects will have information about the subject and lecture notes available via the web and will expect students to be able to use databases such as ERIC for assignment research. Most fourth year subjects expect and develop basic IT skills and a number, particularly 'Arts 4', 'Science and Technology 3', and 'Mathematics 4' make extensive uses of IT in a subject-specific way. For example, in the subject

'Arts 4' students scan, create and manipulate digital images and in 'Science and Technology 3' intensive usage of IT is required to demonstrate scientific understanding through multimedia resources and to create and use simulation software.

## **Discussion**

### **Needs of Victorian teachers**

Unlike in the USA or the UK, it is the usual practice for Australian university students to go to a university in their home state, with over 90 per cent of Australian students attending a university in their home state (data extracted from Table 10, p.26, DETYA 1998). Thus, it is a reasonable expectation that most students undertaking a teacher education course at the University of Melbourne will be from Victoria and are likely to start and, for many, continue their teaching careers in Victoria. Because of this, the initiatives of the Victorian Department of Employment, Education and Training (DEET) and its requirement of IT skills of teachers (Victorian DoE, 1999b) are very likely to be of direct relevance to teacher education graduates of the University of Melbourne as the Victorian DEET is the major employer of teachers in the state. Like Education Departments across the developed world, the Victorian DEET has encouraged the use of IT in the classroom. Among the initiatives of the Victorian DEET is a program started in 1998 to provide up to 36,700 notebook computers to all principals and teachers in Victorian Government schools over a period of five years. This is a three-year lease arrangement with teachers paying AUD\$450 over the three year period - approximately AUD\$3 (US\$2) per week (Victorian DoE 1998). This is to encourage teachers to have their own laptop computers so that IT skills can be developed and so that IT tools become a standard part of all teachers' 'toolbox'.

### **IT skill development of our teacher education students**

In combination with increasing availability of computers - almost all students have access to a computer at home - and the increasing use of computers for recreational activities, our students now regard IT tools as 'nothing special' and use them as a routine part of any piece of work without thinking twice. This is a very different situation from even a few years ago (as recently as 1997) when, for many students, turning on a computer was an uncommon activity. In more recent years students are entering the course with more advanced IT skills and significantly greater exposure to IT, usually through using the WWW for recreational purposes. This change in the students' attitudes and abilities with IT is both a mirror of the changes in the local community and

the developed world and a reflection of the continued exposure and uses of IT required in the subjects the students are studying.

This study describes an example of the introduction and yearly reinforcement of basic IT skills in an Education degree course for primary teaching with some subjects introducing IT tools of specific relevance to that learning area. That IT skills were not further developed and more use made of IT in the third year of this particular course, especially in the year following a year-long subject specifically about using computers in K-6 teaching, became evident through this study. Greater use of IT in the third year of this course is desirable to consolidate and extend the IT experiences and skills developed by students in the first two years of the course. Now that this is evident, later year subjects can respond by increasing the range of IT skills students develop. In addition, as the IT skill levels of students entering the course rise, more emphasis can be placed in the area of using IT with children in classrooms to enhance teaching and learning, rather than the mechanics of using IT tools. We are confident that students graduating from this course have continued exposure to using IT in their own teaching and learning experience and develop the IT skills required of teachers during the four years of their study in the course.

### Conclusions

Throughout the developed world it is now demanded that new teachers will be competent and capable of using IT both for their own professional purposes, such as research and administration, and for enhancing teaching and learning in their classrooms. Guidelines exist in many education systems that outline desirable or required teacher capabilities or competencies in using IT in teaching. This overview has shown that the IT skills required by four education groups have much in common and that an investigation of IT skills developed in one teacher education course for prospective K-6 teachers has demonstrated that, over the course of four years, even the most technologically reluctant student must engage with IT and develop the skills demanded of a teacher in the new millennium. This study has identified some areas where greater uses of IT could be made in this particular course (which are being addressed) and has highlighted the need to keep 'raising the bar' of IT skill development to keep up with the ever-increasing IT skills of entering students and the demands of education systems of their teachers.

### Acknowledgments:

The data gathering for this study was supported by a Summer Research Scholarship funded by the Department of Science & Mathematics Education at the University of Melbourne, Australia.

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# Musical Composition

## and creativity in an advanced software environment

*This paper serves as a brief description of research into the use of professional level music software as a learning tool for creativity and composition by primary school children. The research formed the basis of a Master of Information Technology in Education degree at the University of Melbourne. The paper examines the physical environment, the thinking behind the research, and the connections between art and computing. Finally, the article presents a portrait of one of the participants, which includes an analysis of one of her compositions.*

### Introduction

The use of computers in the generation, creation and editing of music in schools, especially primary schools, seems to be a largely untouched area of educational computing. Children in today's rich computer environments are exposed to programs that allow the creation of pictures, text, sound, video – all areas of multimedia, as well as simulations and games that explore many varied curriculum areas. If one is to look into the sound aspect of multimedia, it is more than likely restricted to single track waves recorded at very low quality frequency (11khz), pre-recorded sound clips (midi, wave or mpeg) or use of teacher generated files.

Questions about this situation need to be asked. Why do we place children in a rich computer environment with state of the art equipment and software and deprive them of the creative aspect of music? Why do programs that can be used for multimedia development to a very high level, such as HyperStudio, MicroWorlds and PowerPoint, fail to provide adequate audio editing? Perhaps the most important questions are "what can be done about it?" and "can children and teachers be taught to use high-end, professional level music programs in a task appropriate manner and in consideration of age, computer literacy and musical ability?"

A ten week study at an outer Melbourne primary school placed eight children from grades three to six (approximate ages 9 to 12 years old) in an advanced music software environment. The study sought to investigate ways in which professional level music software could be used as an effective learning tool for creativity and composition by primary school children.

This paper presents some of the data from that study and addresses some of the questions raised above.

### The software

The use of the term 'professional' was important to the context of the study. Since this study focused on creativity and composition, not on learning music, it was not appropriate to use 'teaching' software that was designed to follow strict compositional and musical guidelines. Inherent to the design of this study was the exposure of children to content free software that placed no restrictions on their creative potential. The study required a rich musical software environment; an environment that provided a full set of features to allow complete creative and compositional freedom.

The study used two commercially available products, Cool Edit 2000 and Cakewalk Pro Audio 9, both of which were provided by the companies, free of charge, to conduct the research. Neither company placed restrictions on the use of the software nor did they set, or seek to set, any outcomes from the research.

Cool Edit 2000 is a four track recorder that provides advanced filtering, effects and mixing. It is restricted to four tracks but allows for recording of tracks within tracks and mixing of tracks to create additional space. It can play and record in many wave formats including .wav and .mp3. Multi-track recording allows composers to build layers within their compositions (see figure 1). It is possible to record the drums on one track, bass on another, voice on a third and accompaniment on the fourth. The main difficulty experienced by the participants in using this program was in file management.

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