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Information Technology and Australian Teachers: *Real Time: Computers, change and schooling - National Sample Study of the Information Technology Skills of Australian School Students*

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Abstract:

There have been unprecedented demands for changes in the preparation of teachers in the use of information technology (IT) in the classroom. This paper reports relevant findings from *Real Time: Computers, change and schooling - National Sample study of the Information Technology Skills of Australian School Students* (DEETYA, 1999) in which a representative sample of 400 schools from all Australian states and territories were surveyed to establish baseline information about both students' and teachers' experience and skills in information technology. The survey provided information from 6213 students, 1258 teachers and 222 principals. Although teachers surveyed reported that technology was very important for their students, for their own professional development, and that it was important to integrate technology in the curriculum, there were significant issues identified associated with the pre-service preparation and ongoing professional development of teachers. Teachers identified barriers to using technology in the classroom, reported low levels of confidence about their ability to keep themselves informed of information technology

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developments, low levels of support for IT professional development, and the majority of teachers indicated that they require more and higher quality IT professional development. While some of these barriers, such as access to computers and the Internet, poor levels of technical support and availability of multi media software might have been predicted, the teacher comments on the inadequacy of pre-service and professional development provision of computer education courses was not expected and raise serious issues which need addressing. By reviewing and interpreting the findings of the survey, suggestions are made for future directions for the preservice teacher education programs and professional development in IT for teachers.

Introduction

The new and emerging technologies referred to as information technology (IT) and characterised by computer-based technologies have become the focus for policy priorities for governments across Australia. Overseas, recent changes to national policies have made information technology in education a priority with the rationale that those countries need their people to have the knowledge and skills needed to participate in knowledge-based economies (USDE, 1996; NZDE, 1996; CMEC, 1997; OECD, 1997; NCIHE, 1997). In addition, there is growing evidence that there are good educational reasons for using information technology in education (Evans-Andris, 1996; Sivin-Kachala and Bialo, 1996).

In reports of successful use of IT in schools, effective professional development for teachers in IT is critical. This was highlighted in the United States of America in 1996 when President Clinton (CEO Forum, 1999) presented a clear vision for improving teaching and learning in the 21st century education through the use of technology in American schools. Clinton defined 'Four Pillars' as part of his Technology Literacy Challenge and called for broadening educational technology objectives to include *hardware*, *connectivity*, *digital content* and*professional development* (CEO Forum, 1999, pp. 1-3).

The CEO Forum in the United States is an important and widely respected industry based lobby group which collects and collates information on the use of computers in US schools (see http.www.ceoforum.org). The CEO Forum's research in American schools shows that technology presence in schools is increasing rapidly with the national student-to-computer ratio being one computer for every nine students, representing more than a 50% improvement over the last five years. More American schools have internal networks and access to the outside world than ever before with the number of schools reporting Internet access nearly doubling from 1994 to 1996. However, while progress is evident in providing computers and establishing electronic networks in American public schools, the CEO Forum's research indicates inadequate attention and resources have been directed to quality IT curriculum applications and professional development of teachers relating to technical training and classroom technology use. The CEO Forum argues that, without improvements to professional development programs for teachers, the integration of all four pillars won't occur to allow both students and their teachers to realise technology's potential to deliver improvements to education.

An Australian Perspective - Information Technology and Australian Teachers

National sample studies in areas such as literacy and numeracy are quite common in Australia, however in 1997 the Department of Employment, Education and Youth Affairs (DEETYA) commissioned the first national sample study on the computer skills of Australian school students. This national sample study on computer use by Australian school students, titled *Real Time: Computers, change and schooling - National Sample study of the Information Technology Skills of Australian School Students* (DEETYA, 1999), was undertaken under the auspices of the Annual National Report on Schooling in Australia Task

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Force of the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) and funded by the Commonwealth Department of Employment, Education, Training and Youth Affairs. The largest Australian study of its kind, the national sample study was formulated on the assumption that schools within Australia were committed to improving teaching and learning through the appropriate use of information technology. A representative sample of 400 schools from all Australian States and Territories and including the three major schooling sectors (government, Catholic and Independent schools) were surveyed to provide information for the Annual National Report on Goal 6d of the Common and Agreed Goals for Schooling. Goal 6d refers to the development of students' skills in information processing and computing.

As well as obtaining information from students and principals, the study surveys were completed and returned by 1258 teachers, consisting of 382 primary school teachers and 546 secondary school teachers. An analysis relating to key findings from the teacher responses is undertaken in this paper to identify issues and implications for the preservice and inservice professional development of Australian teachers in their use of IT. We also present a comparison of the increasing numbers of computers in schools in the United States with Australian State Education Department initiatives, and a review of research evidence on the IT professional development of teachers including the following areas:

- Teachers' basic and advanced computing skills,

- How teachers use computers in the classroom,
- Teachers use of computers outside school,
- Teachers' reported perceptions about the challenges facing educators, and
- Teachers' experiences and preferences for professional development.

Increasing Student Access to Computers in United States and Australian Schools

In the 1990-91 school year, the average U.S. school had only one computer for every 20 students (Anderson, 1992). By the 1996-1997 school year, the figure had improved so there was one computer for every 9 students which represented an increase of over 50%. To take advantage of the best available learning resources, students and teachers increasingly need access to multimedia computers. In the 1995-1996 school year, the average ratio of students to multimedia capable computers was 24 to 1.4. By 1996 - 1997, the average ratio was 16:1.5 (United States Department of Education, 1997). The United States of America Presidential Commission on Information Technology (1997) has recommended that American schools strive to reach a student to multimedia computer ratio of 5:1.6. In 1995, reports suggest that nearly 60% of school computer purchases were used to replace old and outdated computers, resulting in only a marginal increase in the number of machines available to students.

As shown in the summary below in Table 1, all of the Australian states have targets for improving the ratio of computers to students (modified from Trinidad, 1998, pp. 29-31). Together with schools in Australia obtaining IT infrastructure and increased numbers of computers, State education systems have also highlighted the importance of the professional development and training of teachers (Trinidad, 1998).

Table 1: National Overview of State Education Department Initiatives

State	The Target Ratio of Computers to Students	A Summary of Professional Development and Training for Teachers

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Queensland	Systemic Targets for 2001 · a ratio of 1 computer for every 7.5 students · improved student learning achievements through the use of learning technology · computers in every classroom for use across all eight key learning areas and all year levels (P-12) and by students with special needs · school network that gives every classroom access to the Internet · quality curriculum software and courseware systems available to all students and teachers	· The major systemic goal is to develop and maintain the information technology competencies of staff and the application of these competencies to effective learning and teaching in all key learning areas in P-12. · Minimum systemic learning technology competencies for teachers have been established with a percentage of the workforce to meet the targets each year up to 2001, when it is expected that 100% of staff will have the competencies. A school-based model is being applied where funds are provided directly to each school and the school community decides the approach for professional development to be provided. · The learning technology competencies for teachers have four dimensions: · IT skills · Curriculum applications, including classroom planning and management · School planning · Student-centred learning · The accreditation process for achievement of the competencies will ensure that teachers meet all four dimensions
New South Wales	By June 1998, a ratio of 1:14 computers to students on a state wide basis. This is based upon a base allocation with schools using additional funds to provide equipment beyond this level. The government announced in June 1998 that an additional 22000 computer entitlements would be provided to government schools.	· A program of training and support for teachers has been developed. The aim of the program is to enable teachers to integrate technology into their current teaching and learning practices. · There are two main aspects to this program: a thirty hour technology course for teachers K-12 known as Technology in Learning (TILT) and one and a half days of training for one Internet contact person in each school. TILT is a flexible program designed to develop the technology skills of teachers and promote the application of technology in teaching and learning.
Tasmania	Provision from central initiative of new computers on a basis of	· Senior secondary colleges and other schools have been funded to be the initial course providers. An Educational Computing

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	1 computer per 5 students. This provision is in addition to the existing computers in schools.	Professional Development (ECPD) has been established to coordinate PD statewide. · A series of PD modules has been constructed which address both functional and educational aspects of using It in schools-organised into focus areas: eg. computer literacy with a personal and professional focus. · A Graduate Certificate in Education (Education Computing) under the ANTA framework is currently under development.
Victoria	A ratio of 1:5 by 2000	· A priority is the professional development of teachers to enable them to confidently and capably use IT. The Government has committed $56 million over four years for this purpose. · Schools have received a Learning Technologies Teacher Capabilities resource package, and a range of programs and resources are available. · Allocation of notebook computers requires a commitment by teachers of at least 40 hours professional development in the use of learning technologies.
South Australia	A ratio of 1:5 by 2001	· Schools are provided funds with local providers delivering the training. Certain outcomes are required to be achieved with audits done to measure progress. The training focuses on Microsoft Office software, CD ROM's and use of the Internet.
Western Australia	A ratio of 1:5 by 2002 in Secondary Schools and a ratio of 1:10 in Primary Schools. This is based upon full government funding for the acquisition of computers to meet these ratios.	· Each school has had a trainer trained to provide PD in their school on the use of the Internet. · Schools have funding to fund professional development to support the implementation of school priorities. · The new Learning Technologies project provides funding to schools which may be used to provide professional development. · In their planning for integrating learning technologies into the curriculum, and accessing the government funding, schools are required

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		to demonstrate how they will be providing professional development opportunities for their staff. · The Department is exploring establishing a directory of quality assured providers. · Annual audits of teacher competencies will commence in 1999.

Research Evidence on the IT Professional Development of Teachers

As shown in Table 1 above, while schools are obtaining increased levels of IT infrastructure and increasing the number of computers, State education systems in Australia and the United States have also highlighted the importance of the professional development of teachers. Given the substantial expenditure by United States and Australian governments, education systems, schools and their communities on IT, questions are now being asked relating to the extent to which teachers have undertaken professional development enabling them to effectively integrate IT in their classrooms and the extent to which student learning outcomes have been improved or otherwise influenced. For example, when interviewed, Sivin-Kachala (1999), co-author of the *metastudy Report on the Effectiveness of Technology in Schools*(1996) which provided evidence of technology's positive impact on schools, indicated the need for "more large-scale studies... In general there's not a lot of follow-up". There is evidence that simply providing students with computers might have little effect (Finger, 1995) and the level of teachers' knowledge and skill is becoming more widely identified as a major factor in promoting the effective use of IT in schools (Means, 1997). The implication is that "a major implementation pitfall is failure to provide teachers with adequate professional development in technology" (Means, 1997). Similarly, Sivin-Kachala (1996) indicates that there are two findings borne out by the research - that technology use in schools is more effective if teachers have more training as well as the amount of time students spend on computers.

Evidence in the literature suggests that few schools provide effective professional development programs for their staff. For example, training programs often are not well conceived (Pelgrum and Plomp, 1991), and short-term training has been reported to be counterproductive (Wiburg, 1997). More recently in the United States, Spoon (1999), Chief Executive Officer of the Washington Post Company and CEO Forum co-chair, in referring to the findings of a new report in the United States (copies of the report are available at the CEO Forum's website: www.ceoforum.org) stated that "more than half of our nation's schools still have too little equipment, are not connected to the Internet, and have too few teachers who are integrating technology in their classroom". The CEO forum urged school districts to allocate more funding for teaching teachers how best to integrate technology in the classroom. Similarly, Crane (1999), President of Jostens Learning Company and CEO Forum co-chair, argues that investing in technology without adequate funding for effective teacher training is "like building the space shuttle and sending the crew to space with no training".

> "Teachers are being asked to learn new methods of teaching, while at the same time are facing even greater challenges of rapidly increasing technological changes and greater diversity in the classroom...[given such

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> challenges] relatively few teachers (20%) report feeling well prepared to integrate educational technology into classroom instruction." (U.S. Department of Education, January 1999)

Thus, teacher training and professional development in both pre-service and in-service needs to keep pace with the rapid changes in technology. In Australia, one State Education Department, (Education Queensland) has developed the Minimum Standards Project (Education Queensland, 1999) for teachers in the use of learning technology. While the project provides ideas for models of professional development and training programs, it also emphasises that "it is not sufficient for teachers to attend professional development and training courses to achieve the learning technology standards. It is necessary for teachers to apply the skills and strategies to the classroom and school settings to achieve the minimum standards" (Education Queensland, 1999, p.3). The responsibility for assessing the standards for the assessment and credentialling process lies with the principal and his/her delegate. According to Boston (1999, pp. 10 - 11), tension exists between 'minimum' and 'optimal' standards for teachers. Boston is critical about approaches to minimum levels of competence for teachers and warns that

> "There is a danger in Australia that if we focus solely on minimum standards, we will simply institutionalise mediocrity by accepting the lowest common denominator as the norm. This would reinforce a deficit view of teaching and further contribute to lowering the public status of teachers" (Boston, 1999, p. 11).

In suggesting a resolution to that tension, Boston suggests that we develop both 'minimum' and 'optimal' standards for teachers. The specific implication for IT competencies emerging here is addressed later in this paper by examining the extent to which teachers have indicated they have acquired basic computing skills and advanced computing skills.

To design pre-service and inservice teacher education programs to meet various imperatives discussed above, we completed a scan of research on models of effective professional practice involving IT, and the results of this search are summarized as key findings in Table 2.

Table 2: Summary of Research Findings of Conditions for Enhancing Teachers' IT Skills

Models of Effective IT Professional Development	Literature Source
Teachers need knowledge of curriculum issues for successful classroom implementation.	Oliver, 1994
Teachers are better able to integrate the use of technology in the curriculum in a supportive school environment.	Becker, 1994
Teachers are better able to ‘integrate the use of technology in the curriculum when they have received a sustained and broad ranging staff development program in the use of IT.	Becker, 1994
Teachers need specific instruction on how to integrate technology into their instruction.	Schoefield,1995

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Teachers have effective professional development when a framework is used having characteristics used in some ACOT schools; viz. • Small group collaboration between teachers, • Takes place in working classrooms and schools, • Builds upon teachers' existing knowledge about curriculum and practice, • Provides opportunities for experimentation and reflection on new experiences	Yocam and Wilmore, 1995
Teachers need time to design a plan for using IT software in the classroom and time to restructure curriculum around technology.	Bosner and Daugherty, 1994; Poole, 1997
Teachers need knowledge of what is available to them through technology.	Wiburg, 1997
Student learning is enhanced when teachers use curriculum approaches. which feature "situated" information management projects that provide a service to the community.	Wolfson and Willinsky, 1998

These findings suggest that, in order to develop effective IT classroom skills, teachers need to be taught both computer skills and skills in designing and implementing curriculum using technology. Elsewhere, the International Society for Technology in Education (ISTE), commissioned by the Milken Exchange on Technology Education, to surveys schools, colleges, and departments of education in the United States about how well they were preparing new teachers to use information technology in their work, found, in general, that "teacher training programs do not provide teachers with the kinds of experiences to prepare them to use technology effectively in their classrooms" (Lemke, 1999). Lemke argues that the findings of the report should be

> "a wake-up call for higher education institutions and policy makers across the country. Today's students live in a global, knowledge-based age, and they deserve teachers whose practice embraces the best that technology can bring to learning." (Lemke, 1999, p.i)

Teachers' Basic and Advanced Computing Skills

A list of thirteen basic and a list of thirteen advanced computing skills were developed for the national survey of Australian teachers to try to determine future teacher training needs (DEETYA 1999). The basic skills included using a mouse, turn the computer on, using a keyboard, shutting down and turning off, exiting/quitting a program, saving a document, printing a document, starting a program, opening a saved document, deleting files, getting data from CD-Rom, creating a new document, and moving files. As displayed in Table 3 below, teachers were found to have very high levels of basic computing skills. Ninety-seven per cent of teachers surveyed reported that they had more than half of the thirteen core skills basic to the operation of computers and 76% of teachers indicated that they had them all. However, as shown in Table 4, outcomes for responses to the advanced computer skills were lower than for basic skills. Teachers were also asked where they first acquired their IT

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skills and findings are shown in Tables 3 and 4. The results of this survey show that, at a basic computing skill level, teachers have a similar skill profile to that of students. The proportion of teachers who claim to learn skills at home rather than at school is lower than the student responses to the same question. Less than 15% of the teachers learnt basic computing skills in their pre-service education course.

Table 3: Teachers' Basic Computer Skills and Where They First Acquired Them

Operation	Percentage of Teachers	Learnt at home	Learnt at school	Learnt at Pre-service	Other
Turn on computer	99	33	43	13	9
Start program	96	32	41	14	9
Delete files	89	35	35	12	7
Move files	82	32	32	11	7
Shut down	98	36	41	12	9
Open saved document	96	35	39	13	9
Save document	97	35	39	14	9
Create new document	90	32	35	14	9
Print document	96	34	40	14	8
Use mouse	99	35	45	12	9
Exit program	97	34	40	13	9
Use keyboard	98	34	37	14	13
Get data from floppy/CD-ROM	93	32	41	12	8

In Table 4, the results reveal that almost half the teachers do not know how to use virus detection software and only a quarter of the teachers know how to make a web-site. Overall,

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consistent with the findings for the acquisition of basic computing skills, pre-service education is considerably less important as a source of advanced skills acquisition. Pre-service education programs were rated as important by teachers in the development of the skills to create inter-active multimedia, for searching the web and creating websites. That is, the skills most likely to be acquired during pre-service education are those that teacher educators seem to have identified as necessary for research, curriculum support and presentational applications. We would argue that acquiring these basic and advanced computing skills should be achieved by all teachers to achieve an optimal computer skill competency level.

Table 4: Teachers' Advanced Computer Skills and Where They First Acquired Them

Operation	% Teachers	Learnt at home	Learnt at school	Learnt at Pre-service	Other
Play games	80	50	19	4	7
Copy games from www	41	25	11	2	3
Creative writing	85	40	30	8	7
Use of virus software	52	24	22	2	3
Create music/ sound	26	12	8	3	3
Draw using mouse	77	33	30	8	6
Send email	65	22	27	9	7
Use spreadsheet	75	25	31	11	8
Create multi-media	37	12	15	6	4
Search WWW	71	21	32	12	6
Make a web site	24	7	9	4	4
Use www	76	22	34	13	7
Create program	45	9	15	11	10

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There was not found to be any significant variation of either teachers' basic or advanced computer skills between the States and Territories. However, patterns relating to where teachers first acquired skills were evident. For example, there was a tendency for skills such as playing games to be learned at home and for skills using the World Wide Web to be learned at school. Pre-service education was not considered an important source for the acquisition of either basic or advanced skills. This might be partly explained given the relatively recent inclusion of computer education programs in pre-service education. Given the importance of basic and advanced computer skills, pre-service education programs need to align with the development of those skills for student teachers. Moreover, teachers' possession of skills appeared to be related to teachers' age as younger teachers had more skills than older teachers. Eighty-two per cent of 20 to 30 year old teachers had all the basic skills compared with 64% of over 50 year old teachers.

Overall, nearly all of the teachers in the sample study possessed the basic range of skills required, but indications that a considerable proportion of teachers, ranging from twenty-five per cent to fifty per cent, lacked *some* of the required skills remains a source of concern. There are also equity concerns implicit in the distribution of skills reported in the sample. It is more likely that those who lack basic skills in the use of information technology will be over fifty, female and primary school teachers. By implication, the students of these teachers may be disadvantaged, and this may mean that professional development will have to be tailored to the needs of these groups of teachers. Similarly, teachers in Catholic schools, and to a lesser extent government schools are falling behind in basic skills, in comparison with those teachers who work in Independent schools.

Despite such concerns, the data nevertheless provides strong indications of changing teaching practices associated with the use of information technology. Across the range of age and teaching experience, many teachers have begun to use information technology with their classes in recent years. Thirty per cent of the sample nominated the period 1995-1998 as the period in which they started using computers with their classes, while an additional sixty-one per cent nominated 1994 or earlier.

There are implications for teacher education programs in tertiary institutions to prepare beginning teachers to use technology effectively by ensuring that they have acquired the basic and advanced computing skills prior to being appointed as teachers. Coherent strategic plans for teacher preparation programs and professional development programs for current teachers need to be developed to prepare teachers to effectively integrate learning technology in schools. The evidence provided provides directions for determining the IT skills which enable teachers to use IT effectively across the curriculum and for establishing benchmarks for measuring minimum and optimal standards for IT skills for teachers.

How Teachers Use Computers in the Classroom

Four domains of educational IT activity were examined; viz.

- Creative uses - which included any use across the curriculum of writing stories, poems, script writing, creating pictures, graphics, slide shows or animation, making music or sound.
- Informational uses - which included research activities; e.g. obtaining information from a CD-Rom or using the Internet/World Wide Web, and mathematics, science, social science applications; e.g. creating graphs or diagrams, and using spreadsheets or databases.
- Communication uses - which included sending and receiving email, taking part in email discussion, Internet Relay Chat, video conferencing and communicating with other schools,

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- Educational programs and games - which included skill building applications such as learning programs.

As displayed in Figure 1 and shown through the information presented in Table 5, which provides an overview of teachers' main uses of IT in each of the four domains and the kinds of activities their students are engaged in, teachers reported that IT was most frequently used in their classrooms for information purposes, creative purposes, and educational programs and games. Very little use was made of IT for communicating with others. The disproportionate nature of the ways in which teachers use each of the IT domains is shown in Figure 1.

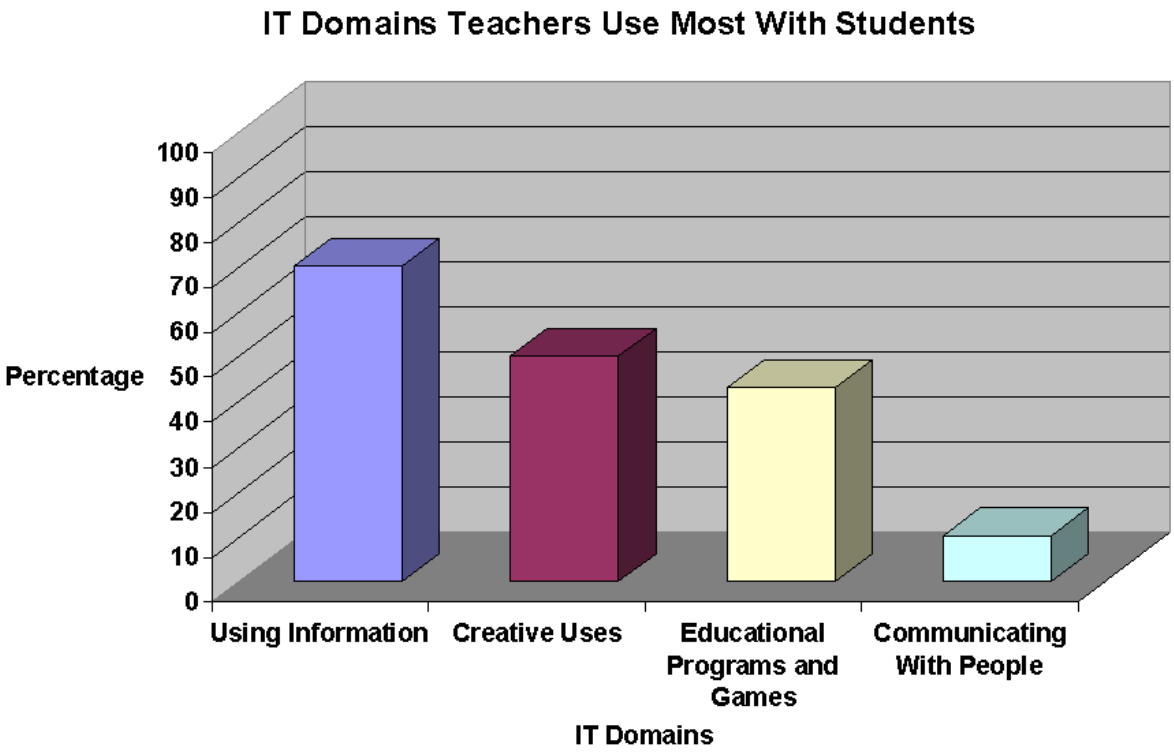

Figure 1: Teachers' Use of the IT domains

Table 5: IT Domains Teachers Use Most With Students and Activities Undertaken Within Each Domain

Domains and activities within each domain	Percentage of all teachers
Using Information	**70**
• Get information from CD-Rom	70

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• Get information from Internet/Web	57
• Use computerised library catalogue	53
• Create graphs or diagrams	43
• Use spreadsheets and databases	37
Creative Uses	**50**
• Creative writing	51
• Create their own pictures	41
• Make music or sound	9
Educational Programs and Games	**43**
• Use an educational program or game to help them learn	61
• Record their level or score when using programs and games	27
Communicating With People	**10**
• Send and receive personal email	15
• Communicate with schools in other countries	7
• Take part in an Internet Relay Chat	2
• Take part in a desktop video conference	1

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Teachers' Use of Computers Outside School

Eighty-five per cent of the teachers surveyed reported use of computers outside school, and of this group, 94% indicated that they used a computer at home. Use at home is extremely high for teachers in Victoria (98%), in Independent schools (97%), and large country towns (97%). Another trend identified showed that teachers' use of computers at home increases with age as 85% of 20 to 30 year old teachers used computers at home compared with 97% of 41 to 50 year old teachers. The study suggests that this might reflect higher levels of resources in the homes of older teachers and that is consistent with earlier studies which identify relationships between household income and computers in homes (Australian Bureau of Statistics, 1996). However, the finding here provides interesting implications for improving the computer skills of older teachers given that they might have high levels of access to computers in their homes. In addition, the study reported that 61% of teachers were frequent users on the computer at home and 96% of teachers use the computer at home for teaching related work, with 55% indicating that they used the computer at home for more than 2 hours per week on teaching related tasks. Eighty-five per cent of teachers who use computers outside school do so at least once or twice a week. Ninety-six per cent of teachers who use a computer outside school use it for teaching related work. Only ten per cent reported that they did not enjoy using computers at home. Overall, Australian teachers emerge as a group who are comfortable with the use of computers outside school. However, it would be misleading to extrapolate from this data anything conclusive about the effectiveness of computers for teaching and learning in the teachers' schools. Data reported elsewhere in this paper suggests that while teachers possess good basic computer skills, there is considerable variation in their knowledge of advanced computer skills.

Teachers' Reported Perceptions About the Challenges Facing Educators

Eighty-one per cent of teachers agreed with the statement that "information technology will inevitably change how we understand the nature of schools and schooling", 90% agreed that "information technology is a worthwhile addition to the quality of teaching and learning", and 86% agreed that "information technology has applications in all subjects". Despite the very strong support for the use of IT in schools arising from the study, and the realisation that the nature of teaching and learning must inevitably change as a consequence, teachers were able to identify several barriers to the effective implementation of information technology.

Eighty-one per cent believed that the costs of hardware are a barrier, while seventy-one per cent believed that software costs could be a limiting factor. Most teachers did not agree with the statement that "the availability of maintenance and technical support is adequate to support teaching and learning", although technical support availability was seen as unsatisfactory by 55% of teachers, while 49% were dissatisfied with maintenance. Teachers in Independent schools, in large schools, or schools in a higher-income area were less likely to be concerned with problems associated with maintenance and technical support.

Teachers' responses demonstrated a very positive attitude towards information technology, however, Principals were less positive than teachers. Both the teachers and the principals identified concerns about resources, support, and the adequacy of training and professional development. Barriers to the effective implementation of information technology are summarised below in Table 6.

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Table 6: Barriers to the Effective Implementation of Information Technology in Schools

Barrier to Effective Implementation	Supporting Evidence from the Survey
Costs of providing adequate hardware and software	81% of teachers agreed that the costs of hardware are a barrier 77% of teachers agreed that the costs of software are a barrier
Availability of hardware and software for teachers	The responses by teachers were lower than by principals for the same items; viz. Teachers Principals Access to computers - • Teaching and learning 82% 97% • Administrative purposes 80% 95% • Personal use at work 82% 93% • Personal use at home 42% 64% Teachers are more to indicate that they have access to hardware/software resources for teaching and learning if they are from primary schools (87%), Independent schools (89%), and provincial cities (88%).
Availability of information technology support services in the school	Only 11% of teachers definitely agreed that there was adequate maintenance support, and only 9% definitely agreed that there was adequate maintenance support. The larger and better resourced a school is, the more likely it is to have technical support and maintenance services available.

Significantly, teachers who had access to resources for teaching and learning were found to be more likely to have all the basic computing skills (79% of teachers with access compared to 69% of teachers without access) and all of the advanced computing skills (12% compared to 7% of those without access).

Teachers' Experiences and Preferences for Professional Development.

Teachers' belief in the importance of professional development is implied by the 88% of teachers agreeing with the statement that "it is essential for all teachers to be technologically literate". However, this suggestion is in sharp contrast to levels of satisfaction with the availability of professional development. Forty-seven per cent could not agree that availability of training was adequate. In addition, 55% of teachers believed that they were unable to keep abreast of new programs and applications, while 46% believed that they were not adequately informed about how to incorporate IT into the curriculum. While there

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have been commendable policy initiatives in Australian States and Territories to address deficiencies in professional development in IT, there is clearly a need for a considerable commitment to funding professional development if computers are to be used effectively for teaching and learning in Australian schools. Ninety per cent of teachers agreed that professional development was available to them. Arguably, it is not the availability of professional development which is in question, but the duration, type and location. Indeed, over three quarters of the teachers had received professional development related to IT in the previous two years, but for 63% of teachers, this amounted to ten hours or less. Most teachers (73%) had participated in professional development after teaching hours in school days. It is interesting that, in contrast, the preferred type of IT professional development was reflected in 35% of teachers in support of school-based training, while the remainder of preferences were distributed among an additional ten professional development options. There is considerable evidence from the literature that teachers do not strongly support brief professional development sessions run after the end of their teaching (see, for example, Russell and Bradley 1997; Bradley and Russell, 1997) although for reasons of cost and administrative ease, such an approach is common.

Teachers were reported to place a very strong importance on IT and both teachers and principals agreed that it is essential for all teachers to be technologically literate. However, in contrast to that, most teachers did not agree that the availability of training was adequate to meet their needs as teachers. Only 5% of teachers definitely agreed that they were able to keep abreast of new programs and educational applications, and only 6% definitely agreed that they were sufficiently informed about incorporating information technology into the curriculum. Teachers from Independent schools, large schools, and high income areas were considerably more in agreement with both statements, while teachers in large country towns and small country towns were more likely to disagree than urban teachers that they were sufficiently informed about incorporating IT into the curriculum.

When compared with principals' responses, teachers were found to perceive that there was less flexibility in terms of where professional development is available. For example, only 48% of teachers indicated that professional development was available in both school based and external mode, compared with 85% of principals indicating that professional development was available in both school based and external mode. This might be explained, in part, by principals' greater access to information at a school and system level. Teachers in Independent schools (57%) and schools in capital cities (53%) were found to be more likely to consider that professional development is available both at school and externally. Teachers were found to be more significantly more likely to indicate that no professional development is available to them if they were from NSW (13%) and Queensland (12%), small schools (12%) and small country towns (16%).

Despite the rhetoric from education systems throughout Australia about the importance of professional development of teachers, an examination of recent professional development reported by teachers found that professional development had not occurred evenly across the States and territories (see Figure 2 below).

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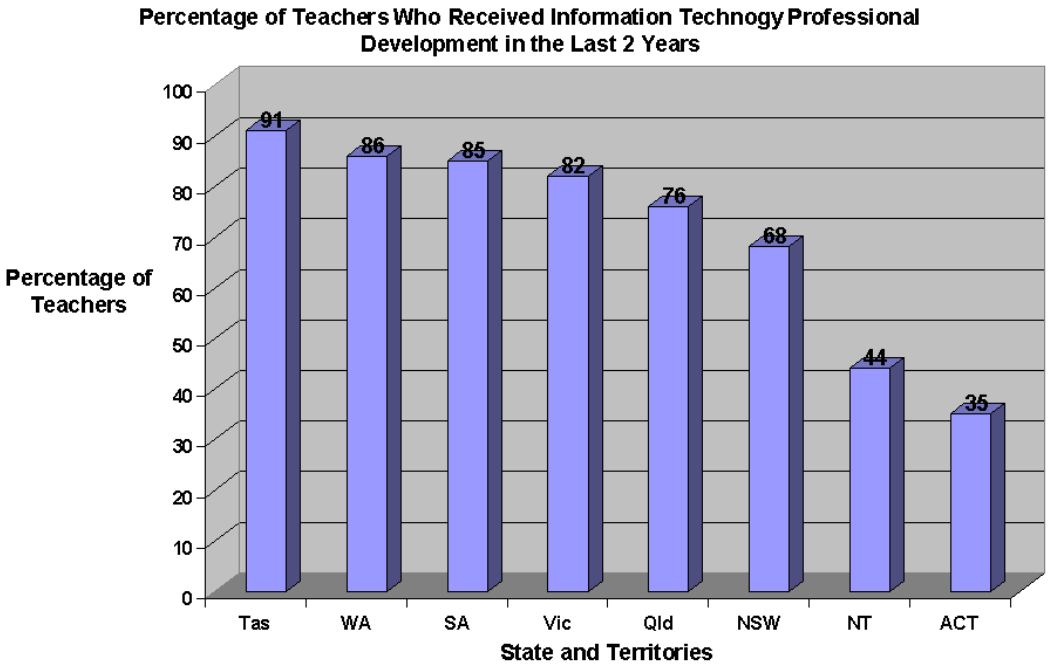

Figure 2: Teachers' Professional Development Received During the Last Two Years

In addition, as shown in Figure 3, the majority of teachers across all Australian States and Territories indicated that they would like further IT professional development. Disturbingly, as

displayed in Figure 4, teachers also indicated that there were low levels of support provided for IT professional development.

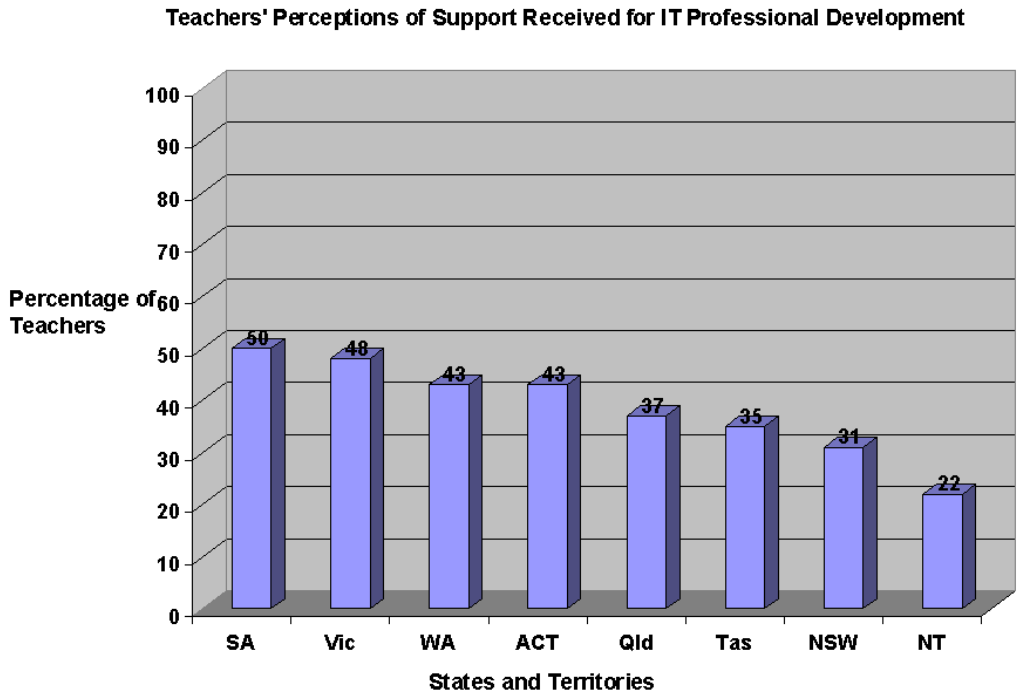

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Figure 3: Teachers' Indications That They Would Like Further Professional Development in Information Technology

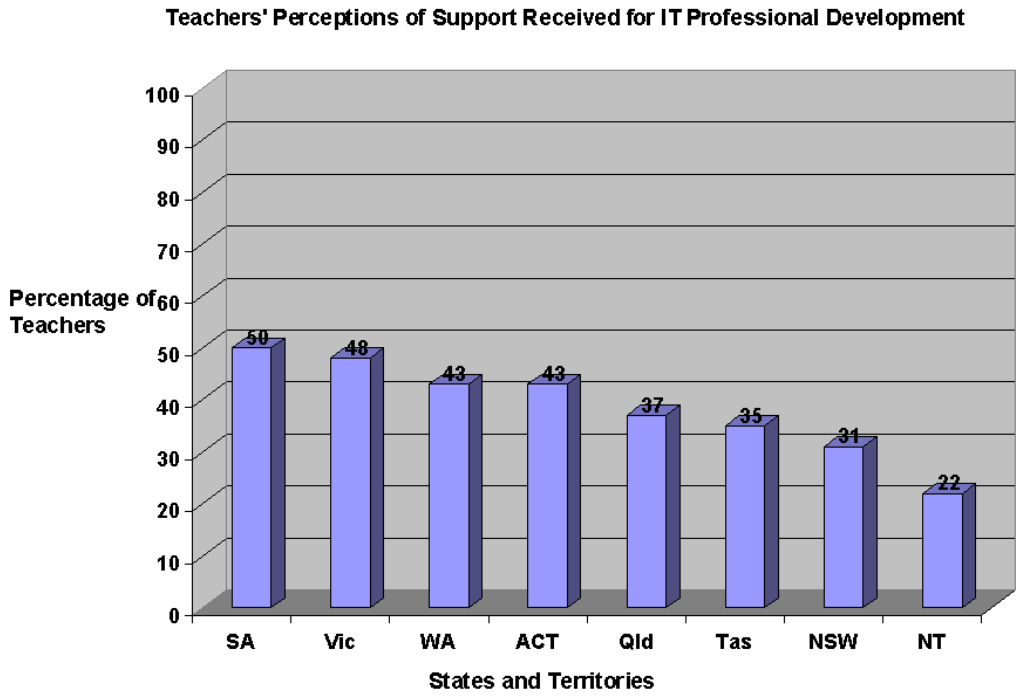

Figure 4: Teachers' Perceptions of Support Received for IT Professional Development

Suggestions for Models of IT Professional Development for Teachers and Student Teachers

As well as providing teachers with opportunities for IT professional development to overcome the concerns identified by teachers, more research is required into identifying effective models for the design and delivery of that professional development. As well as the basic and advanced computing skills (see Tables 3 and 4), teachers also require professional development in the pedagogical skills necessary to integrate the use of technology into the curriculum using the teaching desiderata listed in Table 2; viz.

- Teachers need knowledge of curriculum issues for successful classroom implementation,
- Teachers are better able to integrate the use of technology in the curriculum in a supportive school environment,
- Teachers are better able to integrate the use of technology in the curriculum when they have received a sustained and broad ranging staff development program in the use of IT,
- Teachers need specific instruction on how to integrate technology into their instruction,

- Teachers have effective professional development when a framework is used having characteristics used in some ACOT schools; viz.

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  - Small group collaboration between teachers,
  - Takes place in working classrooms and schools,
  - Builds upon teachers' existing knowledge about curriculum and practice,
  - Provides opportunities for experimentation and reflection on new experiences,
- Teachers need time to design a plan for using IT software in the classroom and time to

restructure curriculum around technology,

- Teachers need knowledge of what is available to them through technology, and
- Student learning is enhanced when teachers use curriculum approaches. which feature "situated" information management projects that provide a service to the community.

Two Canadian researchers, Wolfson and Willinsky (1998) have developed an approach to teaching and learning using technology based on the ideas of the Russian psychologist Vygotsky. As part of a theory on developing interactive learning approaches, Vygotsky has suggested that for effective learning to take place there was a need for collaborative construction of understanding (Vygotsky as cited in Billett, 1994). As part of this approach, Vygotsky (1994) envisaged development from lower to higher orders of cognition being achieved by students who could be placed in problem solving situations where they were under adult guidance or in collaboration with more capable peers. Incorporating some of Vygotsky's work in their research, Wolfson and Willinsky distinguish between real-world problem solving and abstract, in-school learning. They champion teaching and learning practices which have students involved in long term projects of use to the school and local community, under the guidance of an adult or with informed peers. The purpose of this approach is to actively engage the learner in the positive experience of acquiring a wide range of skills in what some writers would describe as authentic contexts (See http://www.knowarch.com/edex). We see value in this orientation to teaching and learning for the integration of computers as a tool across the curriculum for both teacher education students as well as the children in the classroom. The ideas of Wolfson and Willinsky (1998) and the research findings presented in Table 2 were used to prepare a framework for the design of structured assignments for teacher education students at Griffith University on the Gold Coast. Students were required to create computer based learning activities and projects for school students they would be teaching during scheduled teaching practical experiences. At the School of Education and Professional Studies on the Gold Coast campus, the student teachers work in small groups (3-4) with a teacher/lecturer who has high level skills in the application of computer integration in the curriculum skills. Sample curriculum activities are designed for later classroom use and critiqued by other groups in the class. Revised activities are then adapted for actual classroom use and critiqued by the class teacher, the lecturer and the school students. Final versions of curriculum materials produced are then loaded onto a web site so that other teacher education students can review the material produced. This provides an example with considerable promise in which the teacher education institution can develop in student teachers optimal computer skills to integrate technology more effectively into curriculum applications.

For student teachers, the national sample study (DEETYA, 1999, p. 293) indicated that teacher education institutions will need to

- provide sufficient time for student teachers using computers for instructional purposes to develop confidence in using hardware and software,

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- provide student teachers with computer education activities such as analysing material downloaded from the Internet, creating home pages for schools and facilitating communication between students,
- require student teachers to demonstrate facility in word processing, using spreadsheets, use of the Internet, sending and receiving attachments, and establishing desktop videoconference links with other schools,
- encourage student teachers to model positive reinforcement strategies and constructivist approaches to learning and teaching,
- Require student teachers to complete some class presentations using computer presentation applications,
- Require student teachers to prepare student assessment portfolios using computers.

Conclusion

By providing information relating to IT and Australian teachers, this paper has focused attention on the significance of the study *Real Time: Computers, change and schooling - National Sample Study of the Information Technology Skills of Australian School Students* for establishing baseline information through detailed data on students' computer skills on a national basis and assisting in the identification of issues that require policy development for the equitable integration of IT in Australian schools. The paper, in assuming the important role to be played by Australian teachers, highlighted the issues and implications for the professional development of teachers. We urge that standards for teachers need to go beyond the 'minimum' or basic computing skills to aim for the acquisition of 'optimal' standards in using IT through teachers acquiring and incorporating basic and advanced computing skills in their curriculum planning and delivery. For that to be achieved, suggestions were made for effective professional development, drawn from a review of the recent literature on IT professional development for teachers.

Furthermore, we have argued that future teachers need to graduate from their pre-service tertiary education with both computer skills and curriculum design abilities which will enable them to integrate the use of the computer as a tool across the various subject areas of the school syllabus. In order for this to happen, education students will need to be given time to develop these skills and abilities, and carefully structured learning situations to enable them to have practice in using IT in curriculum design for the classroom. As schools face the rapid changes in technology, come under increasing demands to justify expensive IT budgets, and examine the ways that IT improves or otherwise influences student outcomes, Australian teachers will need to ensure that they are sufficiently well-trained to meet the IT challenges.

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