



## **ICT mediated study and teachers: Do they have access to the infrastructure?**

Lindsay Burnip  
Flinders University

Course delivery mediated by information and communication technology (ICT) is increasingly seen as a desirable and cost effective means of providing study opportunities to large numbers of teachers. However, it is unclear to what extent teachers have access to the ICT infrastructure that is required for participation in such study. This paper reports on a survey of teachers' access to ICT infrastructure and offers some insights into the nature and adequacy of that access. A sample of 203 trained teachers was surveyed regarding their access to hardware, software, and the Internet both at work and outside work. Data regarding access to technical support were collected also. Access to adequate levels of ICT infrastructure was not universal among teachers in this sample and access levels varied with teacher characteristics such as age and school type. Teachers in Government schools had slightly poorer levels of access, both at home and at school, when compared with teachers in independent schools. The most problematic area of access overall was in technical support which, when coupled with the reportedly low and variable levels of ICT skills among teachers, would represent a major impediment to successful and satisfactory participation in ICT mediated study for many teachers. These findings have important implications for developers of ICT mediated courses for teachers and for those who seek to encourage teachers' participation in such study.

### **Introduction**

Teachers require access to information and communication technology (ICT) infrastructure for a number of reasons. These include their need to live as citizens in a world undergoing rapid and major transformations as a result of increased use of ICT, their need to embed ICT use in their teaching and administrative duties and, increasingly, their need to use ICT in their professional studies. Much has been written about the need for ICT use across our school systems and the infrastructure required to allow this to happen has been investigated and reported in close detail. However, teachers' use of ICT in continuing study has received much less attention and is an area in need of further investigation and discussion. This paper

reports on a survey of teachers' access to ICT infrastructure and offers some insights into the nature and adequacy of that access.

### **ICT access for teaching**

In Australia, as elsewhere in the developed world (e.g. Kearns, 2002; Kay, 2006), the importance of ICT use in schooling is widely accepted and the various independent and government school systems have developed policies and programs intended to promote ICT use in school administration, as well as in teaching and learning (Downes, Fluck, Gibbons, Leonard, Matthews, Oliver, Vickers & Williams, 2001; McCabe, 2000). The development of ICT infrastructure has been a major component of those programs and large expenditures of funds have occurred over a number of years in all states and territories of Australia (Kearns, 2002).

However, despite the large investments in ICT infrastructure across school systems, there is reason to question whether all teachers have ready access to that infrastructure, and whether the access that they do have is adequate for their teaching and administrative needs (Kay, 2006; Zhao & Frank, 2003). Lankshear and Snyder (2000), for example, stated that not only is variability of ICT infrastructure among schools common but that similar variability exists within schools. That is, some parts of the same school can have very different levels of infrastructure. Hernandez-Ramos (2005) drew a distinction between access and availability, suggesting that, even where ICT infrastructure is located within schools, this may not be freely available for use by some individuals and groups of teachers. This discrepancy between access and availability may occur because some teachers are unaware that computers are, in fact, available to them for various purposes, or because some teachers perceive other impediments to their use of those computers. These impediments may relate to power relationships within schools, inconvenient location of computers, or restrictions on access times. Morton referred to discrepancies between access and availability in 1999, suggesting that this is not a new problem.

### **ICT access for continuing study**

In addition to the longstanding needs of teachers for continuing studies in various curriculum areas (McRae, Ainsworth, Groves, Rowland & Zbar, 2001), the pressures on teachers and school systems to adopt ICT into their core activities has increased their need for ongoing study opportunities (Hawkes, 2000; Kearns, 2002). Professional development for teachers is widely recognised as one of the highest priorities for the school sector (Dede & Honan, 2005; Meiers & Ingvarson, 2005) and educational writers are increasingly advocating ICT mediated course delivery as a means of serving large, geographically dispersed populations of already busy

teachers (e.g., Nichol & Watson, 2003; Vance & McKinnon, 2002). Professional development for teachers has long been offered in a variety of ways, with university accredited, postgraduate studies being an important component (Harvey, 2005; Meiers & Ingvarson, 2005) ICT mediated postgraduate courses are widely believed to offer benefits far beyond that of greater convenience of time and location (Carswell, Thomas, Richards, Price & Petre, 2000; Haddad, 2002; Postle, 2002). Also, universities in general are seeking to increase their income and are keen to attract fee paying postgraduate students from a variety of sources (Ryan & Stedman, 2002). It seems likely, therefore, that increasingly teachers will be offered study opportunities delivered wholly or partially through various forms of ICT.

It is not possible to be definitive about the nature of the ICT infrastructure that would be required for ICT mediated study, as practices vary so greatly and the field is evolving so rapidly (AUTC, 2002; Oblinger, 2000). In reviewing the literature dealing with these practices, variously described, some insights into the actual technologies employed do emerge. Unsurprisingly in such a rapidly evolving field, the technologies referred to in the literature reflect the age of the reported research. For example, various early studies reported on the use of file access and transfer systems such as telnet, FTP (e.g., Osman, Noi, Sai, & Chall, 1998), and listserv (Hawkes, 2000). Some of these older technologies are still employed but are largely hidden from the end user and require no special skills or understandings. When clicking on a hyperlink in a web page, the modern end user does not need to know what protocol is being used to transfer the target file to their computer screen. The web based course delivery systems that are now widespread in Australian universities, such as *WebCT* and *Blackboard* (Bell, Nicholson, O'Brien & Tran, 2002), are designed to require little ICT skill or understanding beyond the ability to use a computer, an Internet connection, and to move files from one location to another.

The bulk of the practices reported on in the literature involve technologies that can be considered as comprising two main functions:

- the transmission of information (for administrative, as well as teaching and learning purposes), and
- communication between the various participants in the study process.

Both information transmission and communication are relevant to the administration of ICT mediated study as much as to the study itself. Most, perhaps all, universities in Australia and other developed countries use ICT extensively in their administration (Lawnham, 2000; Selwyn, 2003) and these administration systems are increasingly being integrated with course delivery systems (Collis & Moonen, 2001).

In the ICT mediated courses identified in the literature, the most common modes of information transmission involved the use of CDs and DVDs, files sent as email attachments, information displayed on web sites, and Internet (usually web) accessed library and data base information (Naidu, 2002). In some more specialised cases, 'traditional' video conferencing was employed, for example, in language teaching (Steed & Trevitt, 2001). However, with video conferencing facilities that require dedicated equipment and skilled technical support staff, it is doubtful that this will be an affordable technology for many (Hardin & Ziebarth, 2000). The highly interactive multimedia technologies envisaged in Taylor's (2001) fifth generation, ICT mediated distance education are probably still largely in the future. Although various forms of online multimedia are used now for educational purposes, for example, simulations, interactive graphics, and video clips, the widespread use of these must wait on the availability of the necessary bandwidth (Naidu, 2002). That is, these technologies involve file sizes that cannot realistically be delivered to people without high speed, broadband Internet connections. Although the takeup of broadband services is increasing rapidly in Australia (ABS, 2005) the bandwidth available to most home users is well below that which is regarded as 'true broadband' in other developed countries (*Sydney Morning Herald*, 2006). Limitations in Internet connectivity are similarly seen as a major impediment to effective ICT use in Australian schools (ICT in Schools Taskforce, 2005). Until true broadband connectivity is available and affordable to students in their homes and schools the use of fifth generation technologies will remain limited.

If web based technologies have become the standard for ICT mediated courses in universities as suggested by the Australian Universities Teaching Committee (2002), then the level of ICT infrastructure required for this form of study would, in most cases, be relatively modest and similar to that required for everyday purposes such as Internet banking and online shopping. However, it is unclear whether all teachers have access to even that modest level of ICT infrastructure. It is possible that some teachers can use the ICT infrastructure in their schools to carry out components of the continuing studies, however, this may be limited by time constraints and demands on that ICT infrastructure for other purposes.

The literature provides only limited insight into teachers' access to ICT infrastructure for study purposes, either at home or at their place of work. One source of information on access at work is the large scale study by Meredyth and colleagues (1999) which collected data from 1,258 teachers and 222 principals across a range of states and school types. They asked a question about "access to computer hardware and/or software for ... personal use at work", (p. 172) which could encompass personal study

purposes. Although most respondents (82%) said that their school did provide this access, participation in the survey was voluntary so it is possible that these results represented a 'best case' picture of teachers' skills in this area. In any event, considerable variation among groups of teachers was evident, with 90 percent of teachers in Victoria agreeing that their school provided them with access to hardware and software for personal use at work, while in Tasmania the figure was a much lower, 57 percent. School level was also a factor with 86 percent of primary school teachers agreeing with the proposition, in comparison with only 80 percent for secondary school teachers. Although this study (Meredyth, Russell, Blackwood, Thomas & Wise, 1999) is now quite old, it is questionable whether much has changed. The use of ICT in school education is still characterised more by "islands of excellence" than by the sort of wholesale transformations that have occurred in other areas of society (Schrum, 2005) and it is widely accepted that teachers' ICT access and skill levels remain problematic (e.g. Kay, 2006; Zhao & Frank, 2003). A recent study found that this situation existed even among schools in 'Silicon Valley' (Hernandez-Ramos, 2005).

The situation regarding teachers' access at home is even less clear. The study cited above (Meredyth et al., 1999) also asked a question about teachers' access to computers at home. Most teachers reported that they did have such access (85%) but, again, the pattern of responses revealed considerable variability among states and school types, and with the age and sex of the teachers. Although this study is now quite dated, no more recent source of information appears to be available nor was any direct reference found in the literature to teachers' access to the Internet, to software, or to other technologies that may be used in ICT mediated study.

The Australian Bureau of Statistics (ABS) provides some data on the Australian population as a whole. In 2002, the most recent census year and the year in which the data for the research reported in this paper were collected, the ABS (2003a) found that 61 percent of Australian households had a computer. Computer ownership increased from 60 percent of household in 2000 to 65 percent in 2003 (DCITA, 2004), so, unless this rate of increase has grown in recent years, it appears likely that a significant proportion of Australian households would still be without a computer.

The ABS (2003b) also provides some insights into Internet access at home across the Australian population. In 2002, this stood at 46 percent nationally and, by 2003, at 55 percent (DCITA, 2004). Again, this is a modest rate of increase and indicates the likelihood that a significant proportion of Australian households would still be without Internet access today.

The 2002 census data showed that both computer ownership and Internet access increased with household income to a high of 90 percent and 81 percent respectively for household incomes over \$99,999. It is not possible to know the household income of the typical teacher in 2002, but one might assume that it would be somewhere in the middle of the population range. If this is so, it is likely that household computer ownership among teachers was between 76 and 83 percent. Internet access has been found to be steady at approximately 10 percent below the figure for computer ownership (DCITA, 2004) suggesting access among teachers' households of around 66 to 73 percent. These calculations involve a great many assumptions but do suggest that a sizable minority of teachers may be in households that do not own a computer and are not connected to the Internet.

Of course, the ABS data present an either or choice - a computer or no computer - and provides no insight into the quality of the computer or its suitability for ICT mediated study.

The availability of technical support is an important aspect of ICT infrastructure. This is closely related to ICT skill levels as users with a high level of skill will, in general, be more able to carry out their own troubleshooting and more able to draw technical support from readily available sources such as manuals and online help resources. The evidence on teachers' ICT skills suggests that high skill levels are far from universal and that many would require technical support in order to carry out ICT use at even modest levels of complexity (e.g., DET, 2000; Lankshear & Snyder, 2000; Zhao & Frank, 2003). Little is known about the availability of technical support to teachers for the purposes of their own studies. However, it has been suggested that technical supports for ICT use in schools is inadequate (Angus, Olney, Ainley, Caldwell, Burke, Selleck & Spinks, 2004; Bullock, 2004) and highly variable among schools (Lankshear & Snyder, 2000; Phelps, Graham & Kerr, 2004).

In summary, we have an incomplete understanding of the adequacy of teachers' access to the ICT infrastructure that they would require in order to undertake ICT mediated continuing study. Although it appears likely that the majority of teachers would have the access required, it appears equally likely that a minority do not. A better understanding of this minority is required in order to assist us in developing and delivering satisfactory and successful ICT mediated courses. It may be necessary, for example, to identify those students requiring assistance and to direct resources to support them in their studies. Also, as web technologies are becoming a standard means of course delivery in universities (AUTC, 2002; Bell et al., 2002), it is important that we obtain a better understanding of the minority of teachers who have inadequate access to ICT infrastructure, to ensure that they do not avoid studying out of a perception of inadequacy

or fear of the technology involved. To address these needs, a study was undertaken to ascertain the levels and variations in teachers' access to various aspects of ICT infrastructure, specifically: hardware, software, Internet access, and technical support.

## Methodology

The data reported in this paper were obtained as part of a larger investigation into the willingness of teachers to undertake ICT mediated study. A questionnaire was developed containing sets of items intended to assess teachers' willingness to undertake such study and to reflect the technical and cultural factors hypothesised to influence teachers in that decision. Access to ICT infrastructure was a technical factor hypothesised as a necessary, but probably not sufficient, precondition for teachers to be willing to undertake ICT mediated study. A sample of teachers was drawn from the postgraduate student population at Flinders University, South Australia, and in 2002 anonymous questionnaires were sent by post to the 615 potential respondents identified from university records. A total of 203 useable questionnaires was received giving a return rate of 33 per cent.

The age, sex, and school type (government or independent) characteristics of the sample obtained were compared with data from other sources (ABS, 2003c; LifeLong Learning Associates, 1999; Meredyth et al., 1999) describing Australian teachers at, or close to, the period of data collection. No significant discrepancies between the sampled and reported groups of teachers were found for these characteristics.

Almost 90 per cent of surveyed teachers were trained in Australia or in other countries with similar teaching systems (e.g., New Zealand and UK).

However, it is not suggested that this sample is wholly representative of the wider population of teachers in Australia. All respondents were, or had recently been, enrolled in postgraduate studies in teaching related areas. Although the majority of Australian teachers engage in professional development activities, it is likely that only a proportion undertake formal postgraduate studies. The extent to which the sampled teachers differ from the general population of Australian teachers is unknown and this imposes constraints upon the application of the findings of this study to groups of teachers who have not undertaken postgraduate studies at a university.

The majority (69%) of teachers in the sample identified South Australia as their most recent teaching location. A further 18 percent were, or had recently been, teaching in other states of Australia so this is predominantly a South Australian sample.

In the questionnaire, a standard Likert style response format was used. For example:

Teachers are under paid and over worked.

1	2	3	4	5	6	7
strongly agree	agree	mildly agree	neither agree nor disagree	mildly disagree	disagree	strongly disagree

Factor analysis of the questionnaire data was undertaken using *SPSS for Windows* version 11.0.0 [SPSS, 2001]. and produced a 6-factor solution that accorded closely with the hypotheses underlying the design of the questionnaire. Reliability testing was also conducted to identify the relative contribution of the items within each factor scale. Both the factor analysis process, and the reliability testing of the resultant scales, led to a reduction of items from the original 69 to produce a final 43 item, 6-factor solution which accounted for 59.9 percent of total variance. Table 1 shows the factors identified and their relative contributions to the total explained variance.

Table 1: A 6-factor solution for 43 questionnaire items relating to technical and cultural aspects of teachers' ICT use

Factors	Variance
Factor 1: ICT skills and knowledge	28.8%
Factor 2: Positivity toward ICT use in everyday life	8.6%
Factor 3: Access to ICT infrastructure and support at home	8.0%
Factor 4: Willingness to undertake ICT-mediated study	5.8%
Factor 5: Access to ICT infrastructure and support at school	4.4%
Factor 6: ICT use in teaching	4.3%

The data reported in this paper are drawn from the scales for factors 3 and 5, access to ICT infrastructure at home and at school. Data on other factor scales will be reported in subsequent papers as will the results of path analysis undertaken to compare various models which sought to explain the relationships among the factors and their relationship to the outcome variable, willingness to undertake ICT mediated study.

## Results and discussion

A supplementary question, not included in the factor analysis, was asked in order to identify points of ICT access other than work or home. This revealed that very few teachers accessed ICT anywhere else. Four percent of respondents said that they accessed computers or the Internet from an Internet café and eight percent at the University. The very limited use of facilities at the University was surprising and only partly explained by the



fact that some of these teachers were studying in distance mode. The majority were on campus students, but only studying part time, and perhaps spent little time there other than to attend classes.

**Access at home**

Table 2 shows the actual questions that comprised the access at home factor. Other questions were asked but were dropped during factor analysis.

Table 2: Items comprising Factor 3: Access at home

My access to computers outside of work is adequate for my needs
My access to other ICT (e.g., scanners, printers, CD burners, digital cameras) outside of work is adequate for my needs
My access to software outside of work is adequate for my needs
I have adequate access to the Internet from outside of work
My access to computers outside of work is adequate for my needs
I have adequate technical support ... outside of work

For simplicity of presentation, the access ratings of 1, 2 and 3 have been aggregated to produce a single measure of adequacy of access. Figure 1 presents responses to the questions in Table 1.

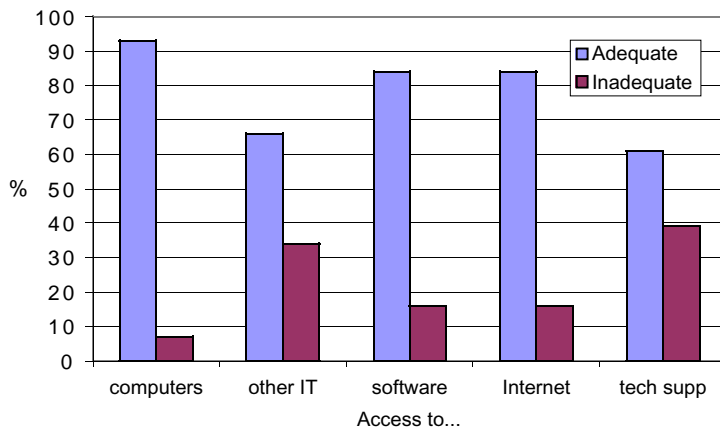


Figure 1: Teachers with adequate access at home

The availability of computers was clearly adequate for the needs of the majority (93%) of this group. They were similarly well served with software (84%) and Internet access (84%). Access to other ICT, such as scanners and digital cameras, was not quite as good but still satisfactory to the majority (66%). Access to technical support at home was the weakest

area reported by this group and, although a majority (61%) reported support as adequate, the 39 per cent who did not are a concern in terms of ICT use at home.

### Access at work

Table 3 presents the 5 items comprising the Access at Work factor and the responses are shown in Figure 2.

Table 3: Items comprising Factor 5: Access at work

My access to computers at work is adequate for my needs
My access to other ICT (e.g., scanners, printers, CD burners, digital cameras) at work is adequate for my needs.
My access to software at work is adequate for my need
I have adequate access to the Internet from work
I have adequate technical support for my use of ICT at work

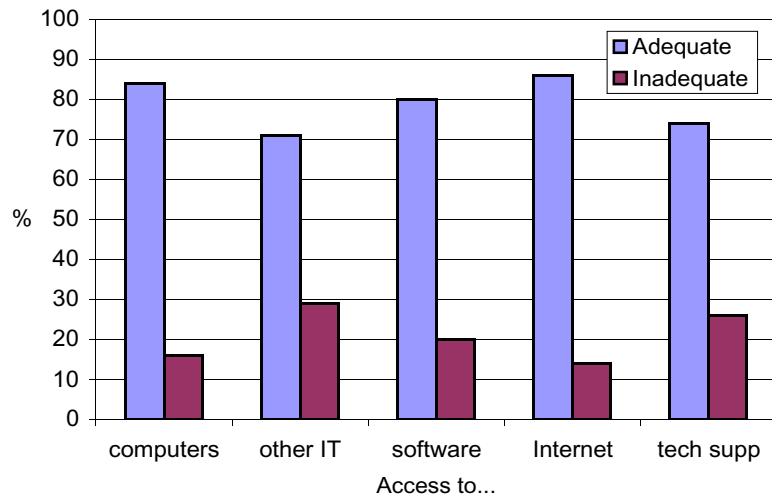


Figure 2: Teachers with adequate access at work

In view of the large investment in ICT infrastructure in schools in the recent past, one might reasonably expect to find very few teachers reporting inadequate access to basic infrastructure. That was not the case in this study. If these findings are truly reflective of teachers' access to ICT across the school system, then the finding that 16 per cent lacked adequate access to computers, 20 per cent to software, and 29 per cent to other ICT, would represent a serious impediment to the stated goals of educational systems in Australia and to the hopes of using these technologies as an effective channel for conducting continuing education.

### Comparative access

Figure 3 compares access at home and at work. These teachers had significantly better access to computers and software at home than at work, but the reverse was the case for other ICT. Access to the Internet did not differ significantly between home and work but the availability of technical support was clearly poorer at home than at work. The literature suggests that teachers are acquiring much of their ICT competency and experience outside of school (e.g., Nichol & Watson, 2003) – most of these teachers had the basic ICT infrastructure at home to do this, but in the absence of adequate technical support one might question the quality of some of their ICT learning experiences.

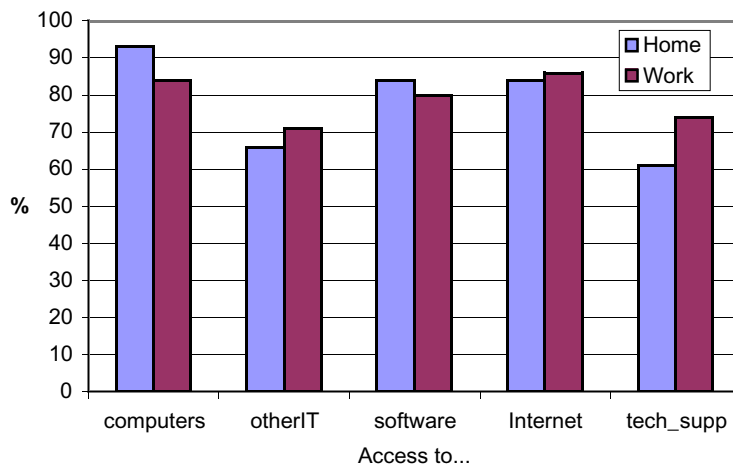


Figure 3: Comparison of access: Home and work  
[All relationships other than Internet access are significant at .05 or better]

With the exception of Internet access, which was relatively high in both instances, all other access measures were closely correlated perhaps suggesting that whatever influenced access in one place also influenced access in the other.

### Some patterns of ICT access

When these data are considered in relation to respondent characteristics, some interesting patterns appear. Not all patterns are reported here, only those that are considered to be meaningful and likely to be of interest.

## Age

It has been suggested that older teachers are more resistant to the adoption of ICT use in their work (DET, 2000). Given the age profile of teachers in Australia, it is clear that most would have trained before the arrival of the 'ICT revolution' and would not have grown up with these technologies as have their younger colleagues. One might expect, then, that older teachers would report significantly lesser levels of ICT access and ICT use. However, as Figure 4 shows, in this study age was not significantly related to any of the access at home items and levels were high across all age groups. This was not simply a matter of access without use. For comparison, access is shown alongside positive responses to the statement: 'Computer use is already a regular part of my everyday life.'

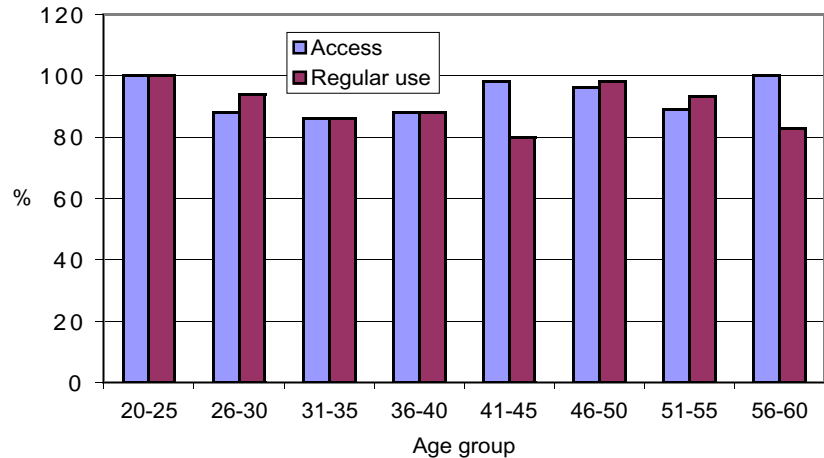


Figure 4: Access to computers at home (and regular use)

All age groups reported high levels of access and regular use of computers in their daily lives. Similarly, age was largely unrelated to access at work. The one exception being access to the Internet which showed the lowest level of access in the youngest age group. Figure 5 shows the levels of access to computers at work across the various age groups. For comparison, access at work is shown alongside positive responses to the questionnaire item: 'ICT use is a frequent part of my own teaching'. Age was not significantly related to either.

Although not directly relevant to this study, the low rates of ICT use in teaching in the younger age groups is worrying but is consistent with reports in the recent literature (Haddad & Jurich, 2002; Schrum, 2005).

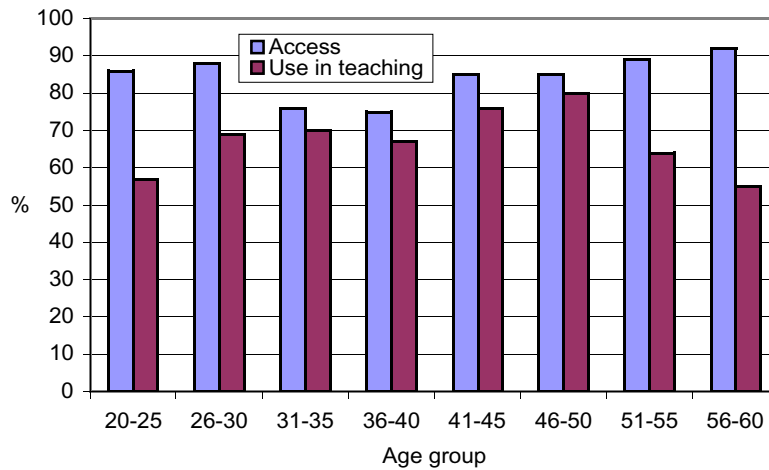


Figure 5: Access to computers at work (and use in teaching)

**Government and independent schools**

In Figure 6, access at home is shown by school type. Although reported access was high for teachers from both schools sectors, access to computers outside of work was higher among teachers in independent schools. No ready explanation of this difference is suggested by the data. It is possible that this was related to income, and that this sample of government school teachers contained a higher proportion of teachers on lower household income levels than those from independent schools. However, no significant differences were found in comparisons of age, sex, or years of experience, all factors that might affect income.

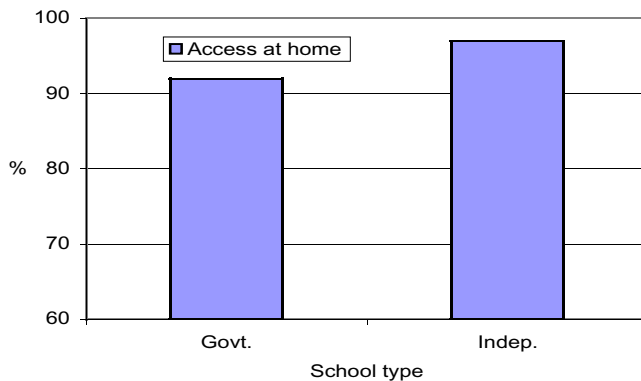


Figure 6: Access to computers at home

A similar difference was found in the case of access to computers at work. For comparison, this is shown in Figure 7 alongside positive responses to the statement: 'ICT use is a frequent part of my own teaching'. It is unclear why teachers in government schools should report less access to computers than their colleagues in independent, while both report near equal rates of use in teaching. Perhaps, teachers in independent schools have greater access to computers at school for other purposes, such as administration. This study offers no insights into this matter.

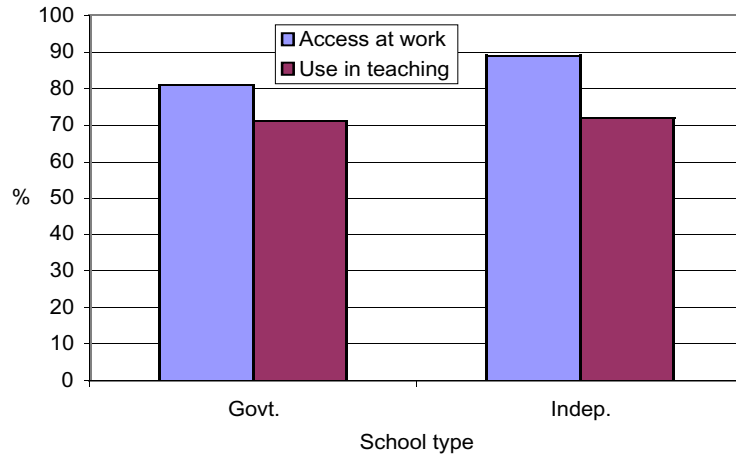


Figure 7: Access to computers at work

### Technical support

The availability of technical support can be crucial in determining the successful adoption of new technologies by teachers (Rogers, 2002). If, as the literature suggests, much of the learning of new ICT skills by teachers occurs at home, then the limited availability of technical support outside of work is a concern. No significant difference was found between the availability of support and any of the respondent characteristics. However, as Figure 8 shows, the pattern of support availability across the age groups is interesting. Other than the youngest group, which contained only seven respondents, the levels of technical support at home were inadequate for between one third and a half of respondents in each age group. Subsequent research will look at the nature and source of the technical support that was available. The slight increase post-40 suggests that older children might be one source of technical support, a possibility supported by anecdotal comments obtained in the course of this study.

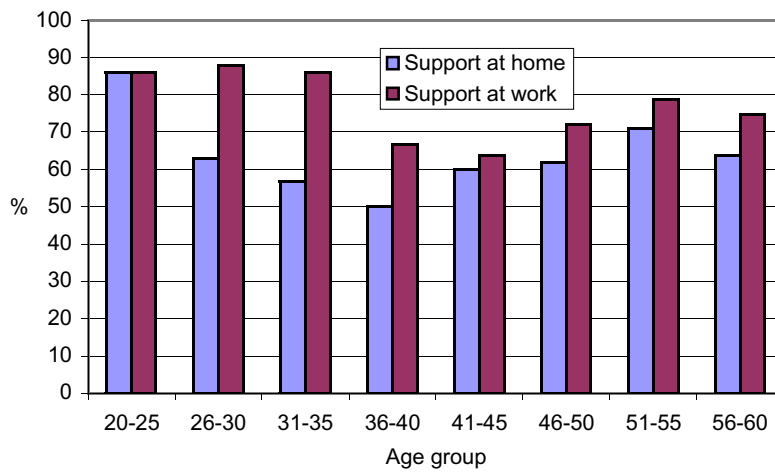


Figure 8: Availability of technical support at home and work

## Conclusions

Although the majority of the teachers in this sample reported adequate access to hardware, software, and the Internet at home and at work, significant proportions did not. For example, 16 percent of teachers did not have adequate access to the Internet from home and 34 percent lacked adequate access to other ICT infrastructure such as printers, scanners and digital cameras. Access to technical support was the most problematic area, especially at home where the majority of ICT use occurred and where 39 percent of teachers did not have the technical support they required. Even at work, slightly over a quarter (26%) of teachers lacked adequate technical support. For significant numbers of these teachers, these limitations in access would constitute a serious impediment to the use of ICT in continuing study and, one might assume, in their teaching and administration also.

As has been reported elsewhere, teachers' access to ICT infrastructure is highly variable within and among schools (Lankshear & Snyder, 2000). In this study, age was not a significant factor influencing levels of access, but school type was, with slightly higher access in independent schools.

ICT mediated course delivery is increasingly seen as a desirable and cost effective means of reaching large numbers of teachers (Nichol & Watson, 2003; Postle, 2002; Vance & McKinnon, 2002) but this requires that the target audience has access to the necessary ICT infrastructure. The findings of this study suggest that adequate access is far from universal among

teachers and that technical support is the area of greatest need. When coupled with the reported low and highly variable levels of ICT skill among teachers (e.g., Lankshear & Snyder, 2000; Phelps, Graham & Kerr, 2004), the limited access to technical support is of major concern.

If teachers are not as well served with ICT infrastructure as many in universities and the school systems assume, the provision of successful and satisfactory continuing study opportunities for teachers will be compromised. Continuing study is seen as vital in maintaining and improving the quality of school education and any impediment to this ongoing process should be regarded as a serious matter. It may be necessary for school systems, or some other concerned agency such as a state government, to look at means by which levels of ICT infrastructure among school teachers might be improved. In the absence of such outside assistance, course developers would be well advised to give careful consideration to the ICT capabilities of their intended student market and design for limited and variable levels of access and support. It may also be advisable to develop strategies to identify those teachers who do not have the necessary ICT infrastructure and to provide targeted assistance to help overcome their limitations.

## References

- Angus, M., Olney, H., Ainley, J., Caldwell, B., Burke, G., Selleck, R. & Spinks, J. (2004). *The sufficiency of resources for Australian primary schools*. Canberra, ACT: Commonwealth Department of Education, Science and Training. [viewed 15 Oct 2004] [http://www.detya.gov.au/schools/publications/2004/resource\\_sufficiency/resource\\_sufficiency\\_report.pdf](http://www.detya.gov.au/schools/publications/2004/resource_sufficiency/resource_sufficiency_report.pdf)
- Australian Bureau of Statistics (2003a). *Households with access to a computer*. Information and communications technology indicators. <http://www.abs.gov.au/Ausstats> [viewed 5 May 2003]
- Australian Bureau of Statistics (2003b). *Households with access to the internet*. Information and communications technology indicators. <http://www.abs.gov.au/Ausstats> [viewed 5 May 2003]
- Australian Bureau of Statistics (2003c). *Schools Australia 2002* (4221.0)1. <http://www.abs.gov.au/ausstats/> [viewed 5 May 2003]
- Australian Universities Teaching Committee (AUTC) (2002). *The centrality of learning*. Higher Education Review Submission 10. [viewed 22 July 2006] <http://www.backingaustraliasfuture.gov.au/submissions/crossroads/pdf/10.pdf>
- Bell, M., Bush, D., Nicholson, P., O'Brien, D. & Tran, T. (2002). *Universities online: A survey of online education and services in Australia*. Canberra, ACT: Commonwealth Department of Education, Science and Training, Higher Education Group, Occasional Paper Series 02-A. [http://www.dest.gov.au/sectors/higher\\_education/publications\\_resources/summaries\\_brochures/universities\\_online.htm](http://www.dest.gov.au/sectors/higher_education/publications_resources/summaries_brochures/universities_online.htm)



- Bullock, D. (2004). Moving from theory to practice: An examination of the factors that preservice teachers encounter as they attempt to gain experience teaching with technology during field placement experiences. *Journal of Technology and Teacher Education*, 12(2) 211-237.
- Carswell, L., Thomas, P., Richards, M., Price, B. & Petre, M. (2000). Distance education via the Internet: The student experience. *British Journal of Educational Technology*, 31(1), 32 -40.
- Collis, B. & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations*. London: Kogan Page.
- Corbett, B.A., & Willms, J.D (2002). Canadian students' access to and use of information and communication technology. Paper presented at 2002 Pan-Canadian Education Research Agenda Symposium "Information Technology and Learning" 30 April - 2 May, Montreal, Quebec. [viewed 27 May 2003, verified 2 Aug 2006] [http://www.cmec.ca/stats/pcera/RSEvents02/BCorbett\\_OEN.pdf](http://www.cmec.ca/stats/pcera/RSEvents02/BCorbett_OEN.pdf)
- Dede, C. & Honan, J.P. (2005). Scaling up success: A synthesis of themes and insights. In C. Dede, J.P. Honan & L.C. Peters (Eds), *Scaling up success: Lessons from technology-based educational improvement* (pp. 227 -239). San Francisco: Jossey-Bass.
- DET (Department of Education and Training, NSW) (2000). *Issues of relevance canvassed in submissions to the New South Wales Review of Teacher Education*. Department of Education and Training, NSW. [viewed 11 May 2000, verified 2 Aug 2006] <http://www.det.nsw.edu.au/teachrev/submiss/infotech.htm>
- Downes, T., Fluck, A., Gibbons, P., Leonard, R., Matthews, C., Oliver, R., Vickers, M. & Williams, M. (2001). *Making better connections: Models of teacher professional development for the integration of information and communication technology into classroom practice*. Report to the Commonwealth Department of Education, Science and Training. Canberra, ACT: Commonwealth of Australia. [verified 2 Aug 2006] [http://www.dest.gov.au/sectors/school\\_education/publications\\_resources/profiles/making\\_better\\_connections.htm](http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/making_better_connections.htm)
- Haddad, W.D. (2002). Technology and teacher education: Making the connection. *TechKnowLogia*, 4(4), 5-6. [viewed 28 Nov 2002, verified 2 Aug 2006] [http://www.techknowlogia.org/TKL\\_active\\_pages2/CurrentArticles/main.asp?IssueNumber=18&FileType=HTML&ArticleID=434](http://www.techknowlogia.org/TKL_active_pages2/CurrentArticles/main.asp?IssueNumber=18&FileType=HTML&ArticleID=434)
- Haddad, W.D. & Jurich, S. (2002). ICT for education: Prerequisites and constraints. In W.D. Haddad & A. Draxler (Eds), *Technologies for Education: Potential, parameters and prospects* (pp. 42-56). Paris: United Nations Educational, Scientific and Cultural Organization and Washington, DC: Academy for Educational Development. [viewed 16 January 2002] <http://www.aed.org/publications/TechnologiesForEducation/TechEdBook.pdf>
- Hardin, J. & Ziebarth, J. (2000). *Digital technology and its impact*. National Centre for Supercomputing Applications, University of Illinois at Urbana-Champaign. <http://www.ed.gov/Technology/Futures/hardin.html> [viewed 23 Feb 2000, verified 2 Aug 2006]

- Harvey, P. (2005). Motivating factors influencing teachers' engagement in postgraduate study: The results of a study of five schools. *Proceedings Australian Association for Research in Education Conference 2005*. [viewed 13 July 2006] <http://www.aare.edu.au/05pap/har05249.pdf>
- Hawkes, M. (2000). Structuring computer-mediated communication for collaborative teacher development. *Journal of Research and Development in Education*, 33(4), 268-277.
- Hernandez-Ramos, P. (2005). If not here, where? Understanding teachers' use of technology in Silicon Valley Schools. *Journal of Research on Technology in Education*, 38(1), 39-64.
- ICT in Schools Taskforce (2005). *Bandwidth - Connectivity*. Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA). [viewed 27 July 2006] <http://icttaskforce.edna.edu.au/icttaskforce/Jahia/home/pid/19>
- Kay, R. H. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education*, 38(4), 383-408.
- Kearns, P. (2002). *Towards the connected learning society: An international overview in policy for information and communication technology in education*. Commissioned Report, Department of Education, Science, and Training, Government of Australia. [viewed 21 July 2006] [http://www.dest.gov.au/sectors/higher\\_education/publications\\_resources/profiles/towards\\_the\\_connected\\_learning\\_society.htm](http://www.dest.gov.au/sectors/higher_education/publications_resources/profiles/towards_the_connected_learning_society.htm)
- Lankshear, C. & Snyder, I. (2000). *Teachers and technoliteracy: Managing literacy, technology and learning in schools*. St Leonards, NSW: Allen & Unwin.
- Lawnham, P. (2000). Steadily down cyber road. *The Australian*, Higher Education Section. Wednesday 12 July, p. 47.
- McCabe, B. (2000). Canberra needs clearer IT focus. *The Australian IT*, Tuesday 8 August, p. 2..
- McRae, D., Ainsworth, G., Groves, R., Rowland, M. & Zbar, V. (2001). *PD 2000 Australia: A National Mapping of School Teacher Professional Development*. National Curriculum Services, Commonwealth Department of Education, Training and Youth Affairs. [viewed 5 Nov 2003, verified 2 Aug 2006] [http://www.dest.gov.au/sectors/school\\_education/publications\\_resources/profiles/pd\\_2000\\_australia\\_school\\_teacher\\_development.htm](http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/pd_2000_australia_school_teacher_development.htm)
- Meiers, M. & Ingvarson, L. (2005). *Investigating the links between teacher professional development and student learning outcomes*. Department of Education, Science, and Training. Canberra, ACT: Commonwealth of Australia. [viewed 22 July 2006] [http://www.dest.gov.au/sectors/school\\_education/publications\\_resources/profiles/teacher\\_prof\\_development\\_student\\_learning\\_outcomes.htm](http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/teacher_prof_development_student_learning_outcomes.htm)
- Meredyth, D., Russell, N., Blackwood, L., Thomas, J. & Wise, P. (1999). *Real time: Computers, change and schooling. National sample study of the information technology skills of Australian school students*. Canberra, ACT: Commonwealth Department of Education, Training and Youth Affairs. [viewed 15 Feb 2000, verified 2 Aug 2006] [http://www.dest.gov.au/sectors/school\\_education/publications\\_resources/profiles/archives/real\\_time\\_computers\\_change\\_schooling.htm](http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/archives/real_time_computers_change_schooling.htm)

- Morton, A.D. (1999). *Teachers' intentions to use information technologies: A study of Western Sydney Secondary Teachers*. Unpublished MEd (Hons) thesis, University of Western Sydney. [viewed 23 Sep 2000, verified 2 Aug 2006] <http://library.uws.edu.au/adt-NUWS/public/adt-NUWS20030812.091933/>
- Naidu, S. (2002). Designing and evaluating instruction for e-learning. In P.L. Rogers (Ed), *Designing instruction for technology-enhanced learning* (pp. 134-159). Hershey, PA: IRM Press.
- Nichol, J. & Watson, K. (2003). Editorial: Rhetoric and reality - the present and future of ICT in education. *British Journal of Educational Technology*, 34(2), 131-136.
- Oblinger, D. (2000). *A conceptual framework for decision making about distributed learning*. National Learning Infrastructure Initiative, Annual Meeting Notes, January 19-22, New Orleans, Louisiana. [viewed 12 Apr 2000, verified 2 Aug 2006] <http://www.educause.edu/Elements/Attachments/nlii/nlii001notes.pdf>
- Osman, Z., Noi, T., Sai, C. & Chall, D. K. (1998). Developing IT skills through information skills (IS) programmes. Paper delivered at the IT In The Next Millennium Conference, University of Malaya, June 1998. [viewed 20 Oct 1998, not found 2 Aug 2006] <http://www.sbh.lib.edu.my/latest/conference/develop.htm>
- Phelps, R., Graham, A. & Kerr, B. (2004). Teachers and ICT: Exploring a metacognitive approach to professional development. *Australasian Journal of Educational Technology*, 20(1), 49-68. <http://www.ascilite.org.au/ajet/ajet20/phelps.html>
- Postle, G. (2002). Emergence of Fourth Generation Technologies. *E-Journal of Instructional Science and Technology*, 5(1). [viewed 4 April 2003, verified 2 Aug 2006] [http://www.usq.edu.au/electpub/e-jist/docs/html2002/pdf/g\\_pos.pdf](http://www.usq.edu.au/electpub/e-jist/docs/html2002/pdf/g_pos.pdf)
- Rogers, P.L. (2002). Teacher-designers: How teachers use instructional design in real classrooms. In P.L. Rogers (Ed), *Designing instruction for technology-enhanced learning*, (pp. 1-17). Hershey, PA: IRM Press.
- Ryan, Y. & Stedman, L. (2002). *The business of borderless education: 2001 update*. Canberra, ACT: Evaluations and Investigations Group, Commonwealth Department of Education, Science, and Training. [verified 2 Aug 2006] [http://www.dest.gov.au/sectors/higher\\_education/publications\\_resources/profiles/business\\_of\\_borderless\\_education.htm](http://www.dest.gov.au/sectors/higher_education/publications_resources/profiles/business_of_borderless_education.htm)
- Selwyn, N. (2003). Why students do (and do not) make use of ICT in university. Paper presented to the 'Finding Common Ground: IT Education, Dearing and Democracy in the Information Society' Conference, University of Leeds, 9 July. [http://www.ics.ltsn.ac.uk/pub/Finding\\_common\\_Ground/selwyn\\_conference\\_paper.pdf](http://www.ics.ltsn.ac.uk/pub/Finding_common_Ground/selwyn_conference_paper.pdf) [viewed 21 July 2006]

- Steed, A.F. & Trevitt, C. (2001). Video-conferencing and online multimedia in Hindi language learning. In R. Phillips (Ed), *Learning-centred evaluation of computer-facilitated learning projects in higher education* (pp. 217-226). Canberra, ACT: Commonwealth of Australia, Australian Universities Teaching Committee. <http://www.tlc.murdoch.edu.au/archive/cutsd99/finalpdfreports/Ch18Steed.pdf> and <http://www.tlc.murdoch.edu.au/archive/cutsd99/Appendices/Ch18Appendice.pdf>
- Taylor, J.C. (2001). *Fifth Generation Distance Education*. Canberra: Commonwealth Department of Education, Training and Youth Affairs, Higher Education Series, Report No. 40. [viewed 17 Oct 2001, verified 2 Aug 2006] [http://www.dest.gov.au/sectors/higher\\_education/publications\\_resources/profiles/fifth\\_generation\\_distance\\_education.htm](http://www.dest.gov.au/sectors/higher_education/publications_resources/profiles/fifth_generation_distance_education.htm)
- Vance, V. & McKinnon, D. H. (2002). Teacher professional development online: Fertile ground or fetid swamp? In S. McNamara & E. Stacey (Eds), *Untangling the Web: Establishing Learning Links*. Proceedings ASET Conference 2002. Melbourne, 7-10 July. <http://www.ascilite.org.au/aset-archives/confs/2002/vance.html> [viewed 4 July 2004, verified 1 Aug 2006]
- Zhao, Y. & Frank, K.A. (2003). Factors affecting technology use in schools: An ecological perspective. *American Educational Research Journal*, 40(4), 807-840.

Lindsay Burnip Flexible Delivery Unit Faculty of Education, Humanities, Law, and Theology Flinders University Bedford Park SA 5042 Email: <a href="mailto:Lindsay.Burnip@flinders.edu.au">Lindsay.Burnip@flinders.edu.au</a>
---