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Palmer, Stuart 1998, Current issues and limitations in using the internet for teaching and learning, *Australian educational computing*, vol. 13, no. 1, pp. 12-17.

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Current issues and limitations in using the Internet for teaching and learning

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This paper acknowledges the new educational possibilities provided by the Internet, as well as identifying its current limitations as an educational medium. Issues of concern in using the Internet include equity and access, infrastructure considerations, intellectual property, development methodologies, implications for the delivery and administration of education, and the relationship between the Internet and other new media in education, including audio/video tapes, computer aided learning software, videoconferencing and CD-ROM. While the Internet offers valuable opportunities to enhance all modes of teaching and learning, and it is likely that most of the current limitations of the Internet in this regard will be overcome in time, those developers currently pursuing or investigating the Internet as a teaching resource should be aware of the potential difficulties. This paper draws on the experiences of the author in conventional and distance university teaching, and in using the Internet as an aid to teaching and learning in engineering and technology, but the issues addressed apply generally to those using the Internet in education.

New Educational Possibilities

Despite certain misgivings, that will be identified, in part, below, there is little doubt that, just as computer and communication technologies pervade many aspects of our lives, computers have many roles to play in education. These roles include not only classroom teaching and learning experiences, but also administration, teacher training, the planning and development of educational material and general communications.

When the 'power' of global networked communications is added to

computer applications we have the Internet. The Internet offers a new range of educational technologies to educators that includes: electronic mail, file transfers, the multimedia capability of the world wide web (WWW), low-cost, desktop videoconferencing, on-line, interactive tutorials, real-time group conferencing, remote access to laboratory experiments (Lemckert & Florance, 1996) and 3D interactive modelling.

For example, in engineering and technology education, computer applications can include computer programming, numerical analysis, computer simulation, computer aided design (CAD), computer aided manufacture (CAM), electronic communications, information retrieval and computer aided learning and assessment.

It is important to note that these new educational opportunities do not come without their own limitations, considerations and values. It is always important to remember that teaching technologies are not an end in themselves, only a means to deliver education: "Technologies do not teach; people do" (Ingram, 1996, p.31).

Equity and access

For a student to be able to participate in the new educational possibilities offered by the Internet, they must have access to the required computer hardware and software. On-campus students may have relatively easy access to computer labs and workplace-based students may be able to use the facilities of their employer, but off-campus students may have to purchase their own computer and communications hardware and software. However, simply having the requisite computer resources doesn't automatically grant access to the information super-highway. If one is unfamiliar with computers or the Internet, attempting to navigate this new medium can be frustrating and frightening. Brogan (1997) reports in a survey of 158 post-graduate students, composed of roughly equal numbers of on- and off-campus students, that even though more than 90% of students had access to a computer, 75% of all students stated a need for training in the use of the Internet.

Even when everyone is 'on-line', not everyone may have the same type of connection. On-campus students may have the benefit of high speed, dedicated networking, whereas the only option for an off-campus student may be a dial-up modem line that does not support the data transfer rate required for high quality interactive multimedia programs (Ingram, 1996).

Once a student has access to the required equipment, they may face the additional and on-going cost of service access. Those who require only on-campus use of the Internet in computer labs may pay no direct access costs. Students living close to the education institution may face only the cost of a local call to establish a modem connection to the Internet via their university. Students in remote areas may face more significant costs, perhaps even paying by the hour to a commercial service provider, to establish a reliable and reasonable speed Internet connection.

One approach to dealing with student access to the Internet is to simply make it a requirement for students entering a study program to have the necessary computer hardware and Internet connection. This may remove considerations of Internet access for those within the course, but it does nothing to address issues of equality of access to participation in education, and the barriers to participation created by the adoption of new technology (Milone & Salpeter, 1997). Where only on-campus students are involved, close control can be exercised over both the computing environment and the material presented to students. In this scenario one possibility is to employ a self-contained intranet, where all the material is preset and preloaded by the system administrators, and with no (or limited) connection to the external Internet (Long & Smith, 1996).

Infrastructure issues

Anyone involved in the administration and provision of Internet services will be aware of the large infrastructure costs, both capital and maintenance, necessary to provide the basic networking, computer hardware and software, staff training, and staff and student user support required simply to operate in a networked environment - estimates of the 'total cost of ownership' of a PC operating in a networked environment range from US\$1,500 to US\$9,784 (Francis and Johnston, 1997). On top of this comes the costs of the development of educational

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software applications that run in this environment.

In fact, when it comes to information technology (IT) infrastructure, it is almost pointless to talk about 'capital costs', as to maintain the currency and performance of computer hardware and software, they will need to be upgraded or replaced about every three years. In this environment, capital costs effectively become maintenance costs. The product lifecycle of computer hardware and software ensures that owners of

information technology infrastructure are tied to a treadmill of constant expenditure. One Australian university has recently announced that after an 18 month review of operations, it is to sell its 3000 computer workstations and lease them back in a deal that will include maintenance and upgrades, and will cost \$10 million over three years (Computer Deal, 1997) and (Computer Systems to be Outsourced, 1997).

Additionally, for higher education institutions the nature of the IT infrastructure required has changed dramatically over the last ten years. Where previously an individual school within a university may have maintained modest computer labs running a limited number of basic applications and specialised software, the current demand from virtually all subject areas for students to have access to powerful wordprocessors, spreadsheets, other specialised applications, multimedia and the Internet has seen a trend toward larger, centrally administered and funded computing laboratories providing a common suite of software applications.

The nature of off-campus computing access requirements have also radically changed. Previously, a university may have provided a limited number of dial-up modem lines that supported simple text-based terminal access. Now they must cater for large numbers of off-campus students demanding full access to the Internet and other networked services. Many universities now find themselves offering the same access services to their students that would be available on a fee-for-service basis from commercial Internet service providers (ISPs), but effectively charge nothing for providing these services. Not surprisingly, they find their access services constantly overloaded and a significant financial burden, to the point where several Australian universities are considering

introducing charges for dial-up access (Illing, 1996). Now that it has reached the point where universities are considering charging fees for dial-up access, the question must be asked, "should universities be attempting to compete with commercial service providers by duplicating existing infrastructure?". One answer to this question can be found in the Information Technology Strategic Plan of Deakin University which assumes that by the year 2000, "90 per cent of all external access to Deakin University IT facilities will be via commercial providers" (Information Technology Strategic Plan, 1997, p.5).

Copyright and intellectual property

Historically, educators have enjoyed some freedom with the normal provisions of the Australian Copyright Act in relation to print materials to be used for education. However, these freedoms apply to facsimile copying only, they do not extend to reproduction or transmission via electronic means (Course Development Centre, Deakin University [CDC], 1998). Reproduction in a digitised form requires the permission of the copyright holder. This requirement places restrictions on the use of third party materials when the medium of transmission is the Internet, copyright clearance may take a long time to obtain, or not be granted at all. Under the current copyright legal framework it is not legal to simply take existing print-based course materials that contain items subject to copyright and digitise them for distribution via the Internet.

It should be noted that the Australian Copyright Act is currently under review by the Copyright Law Review Committee (CLRC). The review is a response to concerns that the Act is out of step with technological developments, such as electronic publication and distribution via the Internet, and that it has become unnecessarily complex (CLRC, 1995). In a 1994 report of the Copyright Convergence Group (CCG) (a group formed

in 1993 to propose legislative changes to the Copyright Act) one of the recommendations was that a 'technology neutral', broad based right to authorise transmissions be introduced into the Act (CCG, 1994). Such a development, subject to other changes to the Act, would remove the current restriction that limits the educational use of material subject to copyright to print form reproduction only.

In addition to the concerns about the use of third party material on the Internet, there is also the related issue of protection of the intellectual property embodied in documents that may be

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transmitted over the Internet. This issue is of particular importance to the developers of educational courseware, as a substantial investment may have been made in development of these materials. Traditionally, course materials were printed, affording at least some protection against misappropriation (other than direct photo-reproduction) in that the material would have to be manually re-keyed or otherwise accurately digitised before it could be reproduced. When documents are transmitted using the Internet, particular via the WWW, a complete electronic version of the source file is sent to the remote computer so that it can be reconstructed on the computer screen. This file can be easily captured by the remote computer, providing the reader

with the entire source material for the document already in electronic form.

Development methodologies and issues

The Internet is an all-embracing label for a suite of computer network communication services that includes email, newsgroups, Telnet, file transfer protocol (FTP), Gopher, wide area information server (WAIS) and hypertext transfer protocol (HTTP). These services primarily support the transfer of text-based information and files. The hypertext transfer protocol supports the transfer of multimedia elements including text, graphic images, audio files, and animations, and is the underlying transport mechanism of the WWW. It should be noted that the development of educational materials for use with the Internet is almost exclusively confined to the WWW, this is due to WWW offering support for text, graphics, animation and other multimedia elements, as well as permitting a high level of interactivity. When approaching the development of materials (educational or otherwise) for the Internet, it is important to be aware of the available development methodologies.

It is possible to perform a straightforward and relatively automatic conversion of existing print-based materials, particularly if they already exist in electronic form. Many wordprocessors now have options to save documents in hypertext markup language (HTML) format, the file format required for transmission over the WWW. While this approach offers cost advantages, there may be significant disadvantages, depending on the particular application. If the original material contains items developed by third parties and incorporated in a print-based form under the guidelines of Copyright Act, then copyright clearance will have to be sought for each item if it is to be transmitted electronically via the Internet. Any items in the source

document that aren't in electronic form, such as third party figures and tables or hand drawn diagrams, will have to be digitised or electronically re-drafted for inclusion.

Where the source material is print-based, a direct conversion for display on a computer screen may produce a result that is less than visually appealing. What looks good on paper, may not work well on a computer screen, for example, the average computer screen is not long enough to display an entire page at once, requiring students to continually scroll down while reading. Significant reformatting of the source document may be required to appropriately adapt it to the new medium. The literature related to the readability of computer screens suggests that while the presentation of text on a computer screen does not significantly reduce comprehension, it does impact on reading speed, with the printed page being easier to read than a computer screen, and larger screens being better than smaller screens. Additionally, most readers report a preference for reading the printed page over a computer screen.

Where a document is to be reformatted or authored anew for transmission over the WWW, there exists the opportunity to create or adapt it to take advantage of the additional content elements that are supported by the WWW, such as colour graphics, audio, video, animation, and interaction. Where learning resources are being developed for both print-based and electronic delivery, the requirements and possibilities of both media need to be considered.

What the preceding paragraphs have been inferring is that designing learning resources for the WWW requires an additional set of skills and resources that includes design of screen layout, hypertext markup, development of multimedia elements such as audio and video clips, WWW document editing

software and access to the WWW/Internet. Editorial and instructional design staff who are experienced in the development of print-based materials will require additional training to create materials that use the WWW effectively. Since the advent of wordprocessors and laser printers, just about anyone can create a professional looking printed page but not everyone can present the content in such a way that leads to effective learning. The same can be said for the WWW, with the same wordprocessor, just about anyone can easily create a WWW page, but there are

"with the printed page being easier to read than a computer screen ... most readers report a preference for reading the printed page over a computer screen."

still few people with the knowledge and experience to create WWW learning materials that have a sound basis in educational theory and take full advantage of the new educational possibilities offered by the WWW.

If Internet-based learning resources are to be developed without the use of dedicated editorial or instructional design staff, then the task must fall to specialist consultants or project officers, or to general academic staff. If the task is to be delegated to academic staff, then they too will require individual training and development if meaningful, effective and consistent results are to be obtained. To simply expect that academic staff with a wide variation in computer and Internet literacy and perhaps limited knowledge of

instructional design principles will magically produce quality Internet courseware, without appropriate training, is unrealistic.

Apart from human resources, effective and efficient development of WWW-based learning materials requires specialised and dedicated computer hardware and software. While it is possible to create WWW pages using a standard wordprocessor, there exist specialised WWW authoring programs that provide an integrated development environment encompassing text, graphics, colour, sound and animations, as well as document control and management functions. To develop full multimedia applications requires the addition of specialised hardware to a standard computer, including optical scanning capability, audio and video recording and playback, CD-ROM, large amounts of memory, mass storage, and a network connection to the Internet.

Implications for the delivery and administration of education

Once a university, or even an individual has decided to employ Internet-based teaching technologies, there are other issues and problems that are likely to arise. Some of those considered above include, will student access to the Internet be compulsory/essential?; are the necessary hardware, software and network resources in place?; if not, will they be provided centrally by the university, or must the faculty/school provide them? Similar questions need to be answered regarding staff training and development; who will fund the capital and on-going system costs?; and what development methodology will be used to create the learning materials? A fundamental consideration in answering most of these questions relates to the nature of the development exercise, is it intended as a 'one off', special project to create an item,

or items of specific courseware, or is it intended as an on going and 'normal' part of the courseware development and delivery process?

The development of WWW-based learning materials is similar in nature to conventional software development. This suggests that the difficulties experienced in accurately estimating software development costs (Kusters, van Genuchten & Heemstra, 1990) are likely to apply to WWW courseware development as well.

While many of the same difficulties arise when using the WWW for teaching both on- and off-campus students, at least the on-campus computing environment is normally under the control of the teaching institution. The nature and variability of the off-campus computing environment, which is normally under the control of individual students, leads to many problems, some of which are described below. Given that one of the primary justifications for pursuing developments in this medium is ability of the Internet to bring education to students, via the communications network, regardless of their location, then the organisation of effective off-campus computing is crucial.

First of all, off-campus students have to get connected to the university's network, which normally means a dial-up modem link. Communications software and details of the procedure for connecting to the university's network must be provided to students. Normally, there will also be some bulletin board or other user interface to the network that the student must use to access specific subject-related and general resources, documentation for using this system must also be provided. Some of this documentation is likely to be produced centrally for universal distribution, and the rest will be produced by faculties/schools to deal with course-specific details. All of which must be coordinated and delivered to off-campus students.

Anyone who has been involved with off-campus computing will be aware of the wide variety of problems experienced by students attempting a modem dial-up connection. Such

problems are typically caused by incorrect configuration of the student's modem and/or communications software, or because the student simply does not have the knowledge of computing necessary to understand the directions given in the documentation provided, but, may be caused by problems as difficult to diagnose as corrupted files on the floppy disks used to distribute connection software to students.

Problems of this nature can provide difficulties for a computer 'expert' on the spot, so it is not surprising that they can be extremely difficult to diagnose by 'remote control' when a student calls the university computer centre and says, "I can't get it to work". Where the system is comprised of centrally supported computing infrastructure, special resources developed by the faculty/school and the remote student's equipment, attempting to pin down the location and nature of a problem can be virtually impossible. If the student cannot access expert assistance locally, it is not uncommon for such problems to remain unresolved, with the student simply never getting 'on-line'.

Once initial courseware materials are developed and students are connected to the network, the issue of administration of on-line teaching must be considered. Authors of WWW learning materials normally include contact information, in keeping with the nature of the medium this is often in the form of an email address. If the number of students accessing the material is large, the author may find themselves inundated with questions, request and comments sent via email. While some of these electronic requests will replace enquiries that would have traditionally been made by the telephone, fax or post, the ease with which students can create and send an email message is likely to lead to a net increase in their demand on academic staff time. Where electronic communication is designed to be an integral component of the course, such as a discussion group, bulletin board or email list, the new administrative load can involve supervision, housekeeping, responding to

direct enquiries or general questions from the group, moderation of discussions and production of summaries or digests of discussions. Even where there is no planned electronic discussion, and the materials are simply placed on the WWW for students to access and read, there is still a need to keep this information up to date and evolving if the desire is for students to visit the information regularly. A static WWW site is soon recognised as such, and students lose the motivation to regularly check back to see 'what's new'.

There exist a number of integrated applications that provide a framework for the development and management of on-line (particularly WWW-based) teaching and learning resources. These applications include Learning Space from Lotus, Virtual-U from Virtual Learning Environments Inc, WebCT from WebCT Educational Technologies and Top Class from WBT Systems. The typical features provided by these systems include operation via the WWW, email, file exchange, newsgroups, self-assessment, testing and progress tracking tools for students, course planning and management, instructional design tools, grading and results analysis, and security tools. The benefits of these systems are their integrated development and management environment and their abstraction of the user from the underlying WWW and database technologies.

Relationship with other new media

'Multimedia' and 'new media' are somewhat overused terms in education, but the various technologies that fall under these headings can be valuable teaching tools (Satran, 1994). By definition, 'multimedia' refers to a communications system that combines more than one media, this then includes audio and video tapes, interactive computer programs, computer aided learning (CAL) packages and videoconferencing. The WWW is generally included as one of the new media, so a comparison of the WWW with some other of the new media is valuable.

Where the aim is to provide learning resources to off-campus students

without the requirement that the students have access to a computer or the Internet, then print-based materials supported by audio and/or video tapes are likely to be the preferred option. Compared to the WWW, print materials have limited interactivity and cannot be updated without forwarding revised materials to the student.

Virtually all of the functionality that can be provided by a dedicated CAL package or a computer simulation program (such as animations and interactivity) can now be provided by the WWW, thanks to recent developments in the WWW programming language Java. If students do not have access to the Internet, then dedicated computer programs have the advantage that they can be distributed on a floppy disk or CD-ROM. The advantage that the WWW has here is that WWW applications are independent of the computer platform that the students uses, whereas dedicated CAL/simulation programs must be developed for each possible platform the student may use.

Currently, if videoconferencing is to be employed, the best results are still obtained by using a dedicated videoconferencing system that is based on special image compression hardware and high speed digital communications channels, such as ISDN. However, recent developments in WWW-based videoconferencing, using only a Pentium computer, standard telephone line, video compression card and low-cost camera are impressive to say the least (Adams, 1996), and will bring videoconferencing for education applications into the realm of individual students.

If an application requires large amounts of digital information to be accessed, searched or transferred in a short time, then CD-ROM technology is currently probably the best solution. All of the same functionality can be delivered with the WWW, but data transfer rates across the Internet are (currently) no match for having a CD-ROM installed locally in your computer. Additionally, a local CD-ROM does not suffer from availability problems caused by network

REFERENCES

- Computer deal. (1997, 4 March). Geelong News, pp. 4.
- Computer systems to be outsourced. (1997, 7 march). Network: Deakin University Newsletter, pp. 1.
- Information technology strategic plan. (1997, 21 march). Network: Deakin University Newsletter, pp. 5.
- Adams, E. J. (1996). See You, See Me. *World Trade*, 9, 36-37.
- Brogan, M. (1997). Off-campus and Off-line? Access to the Internet of postgraduate TESOL students at Deakin University. In T. Evans, V. Jakupc & D. Thompson (Eds.), *Research In Distance Education 4* (pp.115-127). Geelong: Deakin University Press.
- Copyright Convergence Group. (1994). *Highways To Change - Copyright in the New Communications Environment - Report of the Copyright Convergence Group August 1994* : Retrieved 12 December, 1997 from the World Wide Web: <http://www.agps.gov.au/customer/agd/clrc/ccg/homepage.html>.
- Copyright Law Review Committee. (1995). *Simplification Reference - Terms of Reference* : Retrieved 12 December, 1997 from the World Wide Web: <http://www.agps.gov.au/customer/agd/clrc/homepage.html>.
- Course Development Centre Deakin University. (1998). *Deakin University, Publishing Manual*. Geelong, Australia: Deakin University.
- Francis, B. & Johnston, S. (1997, 3 March). How much will it cost? *Informationweek*, 620, 44-49.
- Hyams, P. (1996). Internet Disc Takes Prize at Online. *Information World Review*, 4.
- Illing, D. (1996, 23 July). Dial-in fee mooted. *Australian Higher Education Supplement*.
- Ingram, A. L. (1996). Teaching with technology. *Association Management*, 48(6), 31-38.
- Kusters, R. J., van Genuchten, M. M., & Heemstra, F. J. (1990). Are software cost estimation models accurate? *Information and Software Technology*, 32(3), 187-190.
- Lemckert, C. J., & Florance, J. R. (1996). Fluid Laboratories the Off-campus Way - the FLOW Project. In I. Morrison & Z. Pudlowski (Eds.), *Proceedings of the 8th Annual Convention and Conference of the Australasian Association for Engineering Education* (pp. 230-234). Sydney, Australia: UNESCO Supported International Centre for Engineering Education.
- Long, R., & Smith, G. (1996). The Educational Power of the Intranet - A Case Study. *Australian Educational Computing*, 11(2), 24-27.
- Milone, M. N., & Salpeter, J. (1996). Technology and equity issues. *Technology and Learning*, 16(4), 38-47.
- Pardhu, V. (1996). Comdex Vendors to Display Hybrid Software Applications. *Info World*, 18, 10.
- Satran, A. (1994). New Media Educational Products: The "digitizing straw into gold" fallacy. *Educational Technology*, 34(7), 23-25.

failures or modem drop-outs, and does not slow down to a snail's pace because large numbers of users are trying to access it at the same time. The downside of the CD-ROM is that the large amounts of data on the disk are as permanent as a book, and revisions require the issue of another CD-ROM, whereas a WWW site can be updated frequently and quickly. New, hybrid applications are combining the best characteristics of both CD-ROM and WWW technology - large amounts of static data can be placed on a CD-ROM, along with automatic links to WWW sites that contain software updates and/or the latest supplementary information (Pardhu, 1996) and (Hyams, 1996).

Conclusion

This paper presents a series of issues and limitations for consideration regarding the use of the WWW in teaching and learning applications. There is no doubt that time, and with it developments in technology, custom and the nature of education will overcome many of the current limitations and render irrelevant many of the current issues associated with using the Internet in teaching and learning. The passage of time will, no doubt also bring new problems and new issues to be considered. For those currently working in this area, the limitations and issues identified herein are important and must be considered.