Computer and communications technologies are having an enormous impact upon the ways in which educational materials are created, stored, acquired, and delivered to potential end-users (Barker, 1998; Brooks, 1997; Khan, 1997; Forsyth, 1998; Hart, 1996; Collis, 1995). In the past, and to a large extent, even today, much emphasis has been placed on the central role of ‘the teacher’ as a primary source of knowledge and deliverer of information. Today, particularly in tertiary education (and beyond), this model is changing. Nowadays, much greater emphasis is being given to the need to provide suitable infrastructures that will foster and facilitate self-managed learning on the part of students. As we have discussed in detail elsewhere (Barker, van Schaik, & Hudson, 1998), we feel that the adoption of this strategy within academic institutions is a good preparation for the effective use of the lifelong learning opportunities that are likely to arise long after full-time conventional university/college education has ceased.

The changes that are now occurring within many academic institutions with respect to the reorganisation of teaching and learning methodologies are being brought about by four important ‘change agents.’ First, the availability of technology which makes the storage and sharing of information easier than was ever the case previously. Second, easy access to interactive computer-based technologies which facilitate the retrieval of information that has been stored in electronic form. Third, the widespread availability of global communication networks to facilitate information sharing. Fourth, the ease with which electronic information can be assimilated using modern techniques for information presentation and display; and fifth, the ease with which people can now communicate with each other using electronic means (such as ‘email’). Obviously, the rapid developments that are taking place in computer and communications technologies now means that many new, and possibly more effective, approaches to instruction can be devised. Collis (1995) has reviewed some of the many different possibilities that now exist.

Bearing in mind what has been said above, the remainder of this paper discusses some of the ways in which computer and communications technologies might be used to provide new approaches to teaching and learning activities within a university framework. Some possible ways in which these might then be used for the support of lifelong learning are then briefly discussed. Finally, our own methodology for the realisation of electronic course delivery (ECD) and a virtual university paradigm. The possibilities that exist are illustrated by means of a case study involving some recent work that we have been undertaking with respect to applying ECD techniques within a conventional university framework.

NEW TECHNIQUES FOR THE SUPPORT OF TEACHING AND LEARNING

There have been two recent major and important technological developments which have acted as powerful change agents with respect to the impact of technology on teaching and learning. First, the advent of low-cost, portable, multimedia personal microcomputer systems. Second, the development of affordable global and local network technologies for the support of communication and
information dissemination. Taken together, these two developments now provide many new mechanisms for the support of teaching and learning which have, hitherto, been unparalleled in terms of their potential future impact. This section of the paper briefly describes two of these mechanisms: electronic course delivery (ECD), and the use of virtual reality (VR) techniques to create virtual university/college environments.

Electronic Course Delivery
ECD is a holistic approach to teaching and learning in which all the basic resources for course provision (such as lectures, practical exercises and assessment tools) exist in digital format – either on a computer network or within a standalone computer system. Such an approach to course provision can be used both to improve students’ access to teaching and learning resources and to enhance the quality of their learning experiences.

The easiest way to implement ECD within an organisational context is through the use of an in-house intranet facility – that is, a private network that is protected by a firewall (Hopkins, 1997). Local workstations that are attached to the intranet can then access ECD materials using a browser (such as Netscape if they are based on HTML) – otherwise, a helper application or a ‘plugin’ will also need to be used. Global network access to the ECD resources from remote arbitrary locations can be achieved by mounting them on suitable Internet servers. This is easily done by directly transferring the resources from an intranet server to the Internet servers using a file transfer program like FTP.

Another way of providing access to ECD materials is through the use of CD-ROM publication. The publication of educational resources on a CD-ROM platter means that ECD can be implemented on a standalone computer – for example, in a home environment. Unfortunately, the use of CD-ROM as a publication medium can introduce problems with respect to the easy updating of materials – this can be expensive compared with the use of a computer network since new CD platters have to be pressed. Furthermore, if a CD-ROM is being used to distribute ECD materials and a network connection is not available on the host computer, certain facilities that are dependent on such a link may not be able to be provided, such as the automatic reporting of a student’s progress.

Virtual Universities
A ‘virtual university’ is one that exists only within the confines of a cyberspace environment that is provided by a suitably configured host computer system. Such an environment might be provided through the medium of a CD-ROM (Stanger, 1997) or a computer network facility such as an intranet or the Internet (Freeman et al, 1998).

An interesting example of the use of the World Wide Web for the realisation of virtuality is provided by the ‘World Lecture Hall’ that has been developed by the University of Texas (1997). This system was designed to implement a ‘lectures on demand’ paradigm. Its users can ‘request a course’ or ‘add a course’ to the system. The range of currently available courses is very impressive – ranging from accounting through pharmacy to zoology. Other examples of virtual university implementations have been described by Swigger et al (1997), Whittington and Sclater (1998), Baker and Gloster (1993), Foster (1995) and Hutchison (1997).

In our early research into virtual university (VU) systems we proposed that access should be provided for its global community of users by means of a suitably configured, high speed information superhighway (Barker & Tan, 1997). In our initial ‘blueprint’ for a VU structure we proposed the use of four basic building blocks: (a) a virtual library; (b) one or more virtual laboratories; (c) online lectures that are delivered through a virtual lecture theatre, and (d) facilities to support teleteaching. At the time of our original research, because we were (primarily) only interested in mechanisms for resource provision, we did not include any explicit facilities for managing the various administrative processes that go hand in hand with teaching and learning activities.

The importance of the administration mechanisms associated with a VU system is reflected in the current implementation of the Clyde Virtual University (Sclater et al, 1997; Whittington & Sclater, 1998). Like our own system, the Clyde Virtual University (CVU) emphasises the role of ‘The Lecture Theatre’, and ‘The Library.’ However, in addition, the CVU system also includes an ‘Assessment Hall’, an ‘Administration Office’ and a ‘Virtual Cafe.’

As we shall discuss in the following section, virtual university/college systems and ECD (from conventional academic institutions) are now starting to provide a number of important and valuable mechanisms for the support of new types of learning. These can be used to make an educational provision for many different types of learning situation which are either inappropriately or inadequately serviced by conventional courses of instruction.

EDUCATIONAL PROVISION FOR LIFELONG LEARNING
For a variety of reasons, teaching and learning activities are of fundamental and vital importance to all of us. Unfortunately, in the past, there were many who thought that these activities ceased when individuals left school, college or university. Fortunately, this ‘ill-informed’ opinion is rapidly disappearing as the notion of ‘lifelong learning’ gains more impetus with more support from individuals, organisations (both academic and nonacademic), and governments (Ball & Bradshaw, 1991). Bearing this in mind, there is now growing concern about how nations and organisations should cater for the increasing demand for access to post-compulsory teaching and learning activities (IBM, 1990; ENB, 1997). This access may be needed in order to meet changing job demands, to facilitate personal fulfilment or simply to provide pleasure, entertainment, and/or enjoyment.

The need for lifelong learning arises as a consequence of the ‘change agents’ to which we are all exposed. According to Beacham (1997), change agents are naturalistic and/or...
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sociotechnical forces that influence us through both the local and global environments in which we exist. Typical examples of change agents include: (a) technological developments; (b) the availability/scarcity of resources; (c) changing job demands; (d) changing roles; and (e) the financial freedom/stringency imposed by waxing/waning government budgets. Lifelong learning can thus be interpreted in terms of the dynamic adaptation of individuals, groups and organisations as a consequence of the compelling effects of dominant change agents.

There are various views about lifelong learning and the functions that it should perform. According to the English National Board for Nursing, Midwifery and Health Visiting (ENB, 1997), lifelong learning is an active process that focuses on ‘independence and self-direction.’ The core characteristic of a lifelong learner is ‘to continue the search for information and learning opportunities …’ (ENB, 1997). Of course, as well as being an activity from which individuals can benefit, it is one which will be of substantial value to society and organisations. Indeed, according to Moser (1991), “the creation of a learning society is everyone’s business and it is in everyone’s interests.” The importance of developing lifelong learning and the creation of a learning society has recently been emphasised in various consultation papers produced by the UK Government (1997, 1998). These provide a number of guidelines and recommendations as to how the UK should move towards the realisation of such a society through the use of ‘national learning grid’ and the creation of a ‘University for Industry’ (UfI). In the short term this university is to provide students with access to academic courses using a ‘brokerage’ mechanism. However, in the longer term the UfI could provide access to courses directly through the use of the ECD and virtual university paradigms that were described in the previous section of this paper.

Our own view is that lifelong learning involves continuously changing mental models and their adaptation to meet the needs of dynamically changing societies and environments (Barker, van Schaik, & Hudson, 1998). In terms of change agents, our view is that these agents will impose different demands on individuals who will subsequently need to acquire new knowledge and new skills in order to handle the new situations in which they find themselves (IBM, 1990). In keeping with these requirements, an individual’s mental models and skills will need to evolve in an appropriate way.

As a means of realising the above requirement, new organisational infrastructures are needed, which can accommodate more flexible and more responsive approaches to teaching and learning in an electronic era. These will include: (a) giving greater emphasis to autonomous, self-managed learning (both by individuals and by groups); and (b) providing greater flexibility with respect to where learning takes place - for example, in a person’s home or at their place of work. Naturally, when learning takes place in these types of environments, learners will have control over when to learn without the inconvenience of (additional) travel to remote study centers. Of course, one of the main advantages of using autonomous and cooperative learning techniques in the workplace is that they can incorporate many of the useful training facilities that are embedded within electronic performance support systems (IBM, 1990; Barker, 1995; Beacham, 1997; Hudson, 1998).

Bearing in mind what has been said above, the remainder of this paper discusses some fundamental issues relating to knowledge transfer by electronic means using ECD. We then discuss how this technique might be used in order to meet the requirements of lifelong learners through the provision of on-the-job training, open access learning and the design of performance support systems (Barker, 1995; Beacham, 1997; Hudson, 1998).

CASE STUDY – AN ELECTRONIC OASIS

Naturally, an important question that we now have to ask is whether or not conventional approaches to providing educational opportunities are able to meet the new demands placed upon them by lifelong learners. In many cases the answer to this question will most certainly be “no.” There are many reasons for this, such as rigid timetables, the use of inappropriate teaching/learning styles, lack of staff and inflexible delivery, and/or access strategies. In view of this, it is imperative that we seek out new approaches to educational provision in order to meet the needs of lifelong learners. We are of the opinion that these needs can be fulfilled through distance learning techniques that involve the utilisation of ECD, which includes the successful use of the Information Superhighway for the realisation of virtual university systems (Barker, 1997a; 1997b; 1997c; Tan, 1998). Within such environments, tutors and students can create and share learning resources and interact through an electronic communication and data sharing network.

Because of the importance of the techniques described above, the remainder of this section discusses the principle of ‘education on demand’ and how this might be realised through an ECD/virtual university facility which is based on the use of an ‘Electronic Open Access Student Information Service’ (OASIS) (Barker et al, 1995). The way in which such a facility could meet the needs of lifelong learners is then briefly discussed.

Education on Demand

Recent developments in digital information and communication technologies now make it possible to store and retrieve massive amounts of learning material using computer systems. In principle, the stored resources can be accessed anywhere in the world. This makes it possible to realise autonomous learning through the principle of ‘education on demand.’ In order to achieve this, the electronic resources are usually stored on ‘servers’ which can be accessed directly by learners as and when they need to obtain learning materials. Of course, the mere availability of electronic materials alone is not a sufficient condition for ECD and/or successful learning. In order to satisfy the latter requirement, a suitable organisational structure and appropriate pedagogic support is necessary – in the form of a virtual college or university system and the interactive tutorial assistance that can be provided through such a facility (Barker, 1997d; Freeman et al, 1998).
Creating an Electronic OASIS

This case study describes and discusses some recent work we have been undertaking with respect to the development and use of an in-house intranet facility for the realisation of ECD. The resources that have been developed have been mounted on our servers in order to promote student-managed, autonomous learning activities (both individualised and group-based) relating to the study of human-computer interaction within a modular degree course. Although the work that has been undertaken relates to a specific subject domain, the principles involved are perfectly general and can be applied to virtually any teaching and learning situation.

The tasks involved in building our Electronic OASIS started some years ago when a decision was made to explore the use of a computer system in order to store and disseminate teaching resources to campus-based students. The first implementation of our OASIS system therefore took the form of a document management facility for handling paper-based resources, such as (a) lecture notes, (b) project specifications, (c) reading lists, (d) photocopies of overhead transparencies, and so on (Barker et al, 1995). Naturally, the use of paper-based documents within the OASIS imposed certain access restrictions with respect to when and how students could obtain copies of sought-after documents (usually, by collecting them from a service desk during ‘normal’ working hours).

As the Electronic OASIS system developed and evolved, more and more materials were being stored in an electronic format. Consequently, a decision was then made to store all resources in electronic form and make them available to students through a collection of networked interactive workstations that were attached to a central server. This meant that electronic documents could now be made available on demand, twenty-four hours a day. At the time this decision was made, we also decided that we should try to make these resources available, with equal ease, to both campus-based students (using intranet servers) and distant students (using Internet servers). This was not a difficult problem to solve since it simply involved placing duplicate copies of documents on a server to which public access was granted. Although there is currently no access control imposed on this document collection, we may need to review this situation in the future. Using the current system, online documents can be browsed through interactively or downloaded to local or remote workstations where they can subsequently be printed (in whole or in part) if this is deemed necessary.

The original intent of the Electronic OASIS was to provide a mechanism for students to access ancillary teaching/learning support materials. However, in the more recent work that we have been doing we have extended the system to meet the requirements of ECD (as defined earlier in this paper). That is, all teaching, learning and assessment materials are available electronically and they are designed in such a way that they can be used both by campus-based students and distance learners with equal ease. Of course, one of the important advantages that the ECD approach offers is flexibility, both with respect to how materials are delivered (for example, through lectures and/or self-study resources) and with respect to where study takes place (on-campus or off-campus).

Lifelong Learners and Electronic Course Delivery

The work that we have been undertaking with respect to the realisation of an infrastructure to facilitate ECD also provides us with some ‘stepping stones’ by which we are slowly moving towards the establishment of a virtual university system for the support of on-the-job training and lifelong learning. The need for such a facility is growing at a rapid pace as more and more people in our locality are seeking out new educational opportunities either for job enhancement or for skill and knowledge updating purposes.

Increasingly, we are finding that our conventional approaches to teaching and learning (as used with full-time, campus-based students) are not suitable for part-time students that are based in industrial or commercial settings. For such students, learning in the locality of the workplace is an important requirement. Indeed, because of this, more and more organisations are now taking over responsibility for their in-house training and the provision of lifelong learning opportunities. Invariably, the motivation for this stems from the realisation that a well-educated, highly trained and competent workforce is an important organisational asset.

Although the primary responsibility for the provision of lifelong learning opportunities now resides with individual employers, the realisation of appropriate educational provision is often fulfilled in partnership with an academic organisation. As an example of this, our involvement in this area (with various nonacademic organisations) has been mainly in the role of providing access to university teaching and learning resources relating to particular subject areas. In order to do this we have used ECD facilities in conjunction with a ‘virtual classroom’ paradigm that forms part of our prototype virtual university system (Beacham, 1997; Tan, 1998). Within this classroom, students who reside at different geographical locations and operate within different time frames can obtain course materials as and when they need them. They can also work individually or collaboratively on projects that are designed to develop new skills and knowledge that are relevant to their individual interests.

In the long term, we see ECD and the realisation of a virtual campus facility important imperatives. Undoubtedly, these techniques will enable us to ensure the more successful delivery of on-the-job and in-the-home education to lifelong learners. Our future work in this area will therefore extend our subject specific implementations of ECD in a way that enables more general approaches to be developed.

CONCLUSION

Increasingly, intranets are now being more widely used within organisations for the delivery of teaching and learning resources (Hopkins, 1997). Associated with this use is the technique of ECD. ECD offers a holistic approach to the creation, storage, maintenance, and delivery of courses using digital electronic storage media – such as optical disk
and computer network facilities. Undoubtedly, from the perspective of flexibility, ECD has a lot to offer since it can provide easier and wider access to teaching and learning resources from both within and without an organisation. It can also be used to monitor progress and provide feedback on each individual student’s progress. Of course, the initial implementation of an ECD facility is usually very labour and equipment intensive. However, once resources have been developed, ECD can offer a very flexible, motivating and cost-effective approach to teaching and learning. Naturally, when using this approach, designers need to be guided by students’ attitudes, opinions, abilities, and preferences with respect to how materials should be accessed and used. Furthermore, if ECD is to be successful, institutions need to provide an appropriate culture and infrastructure to facilitate its use. This may involve creating virtual classrooms, or indeed, a virtual campus facility. In the future, ECD is likely to offer many useful solutions to the problems associated with the provision of lifelong learning opportunities for learners who are based in a workplace environment or who prefer to study from their homes.

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