Lifelong learning through the Virtual University

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Abstract

Lifelong learning has come to involve a variety of learning
experiences. These include conventional campus teaching,
workplace open learning, modular flexible learning pro-
grammes, correspondence-based distance learning courses,
and most recently Web or multimedia-based courseware. This
paper considers the use of multimedia environments for open,
flexible and distance education, in particular a learning
environment known as the "Virtual University" as part of a
process of lifelong learning. A comparison of different modes
of learning is made. The Virtual University consists of virtual
lectures, virtual seminars, virtual tutorials and virtual exams. It
has a number of advantages over both formal lectures and
conventional open learning materials, such as interactivity,
adaptation, simulation, demonstration and integration. A
questionnaire survey was conducted to assess the effective-
ness of the Virtual University, and the results indicate an
enhancement of the overall learning experience.

Introduction and background

Many authors have begun to consider the use of
multimedia and the Web for teaching and
learning (Schultz and Dahale, 1999; Flori,
1997; Papert, 1997). Studies have already been
conducted which compare conventional
lectures with use of the Web (Riggs *et al.*, 1998;
Regan and Sheppard, 1996; Crismond and
Wilson, 1992). This paper considers the use of
multimedia environments for open, flexible and
distance education as part of a process of
lifelong learning. Following comparisons
between aspects of the different modes of
learning, a particular type of learning
environment known as the Virtual University
will be considered from a learner-centred
perspective.

For the purposes of this paper, a multimedia
environment is taken to be a suite of
complementary interactive computer-based
tools for teaching and learning. These include
live chat rooms, asynchronous bulletin boards,
and conventional interactive multimedia
packages incorporating text, sound, graphics,
and digital video. Some or all of these tools may
be delivered through the Web.

Comparison of conventional and open learning

Lifelong learning has come to involve a variety
of learning experiences or modes (Knapper,
1988; Knapper and Cropley, 2000). These
include formal university campus teaching,
workplace open learning, modular flexible
learning programmes, correspondence-based
distance learning courses, and most recently
Web or multimedia-based courseware (also
known as "virtual learning").

Flexible, open and distance learning
Flexible, open and distance learning are
educational approaches that are designed to be
adaptable to the needs of a variety of learners.
Some authors draw a distinction between
flexible and open learning. Cooper (1996), for
example, takes flexible learning to include
mechanisms such as modularization and
accreditation of prior learning. By contrast,
open learning then relates specifically to the

characteristics of allowing the learner to determine the time, location, and pace of learning. Others such as Rowntree (1991) and Race (1994) regard flexible and open learning as different names for the same approach.

Distance learning is usually understood to involve open learning applied to situations in which there is a geographical separation between the learner and the learning institution. Since it still involves the open learning approach, many authors have come to refer to open and distance learning as a single category (see e.g. Kirkup and Jones, 1996). More recently, the distinction between open and distance learning has become blurred as many universities adopt computer-based learning approaches for both on-campus and distance-learning students. Even the distinction between part-time and full-time modes of study is being eroded (Edwards, 1998).

The development of electronic delivery mechanisms, coupled with the expansion of higher education in particular and lifelong learning in general, has led to an increasing coalescence of these modes.

All of them share a single common feature: they involve an increase in focus on the needs of the individual student and are thus more learner-centred than traditional or formal approaches to education.

For the purposes of this paper the term open learning will be used as a blanket term for educational approaches that make virtue of some or all of the following student-centred characteristics (following Race, 1994; Kirkup and Jones, 1996):

- *Learner determined location for learning.* The learner can choose their own place of study such as work, home or library and does not have to attend the institution providing learning materials.
- *Learner determined time of learning.* The learner can arrange their own learning schedule and does not have to study on days or at specific times determined by the learning institution.
- *Learner determined pace of learning.* The learner can set their own pace of study according to their own needs rather than have it determined by the lecturer, tutor or class.

However there remain significant differences between learning from formal lectures, from open learning texts and from computer-based packages. Direct comparisons between all three approaches are drawn below.

Formal lectures
A great deal of research has already been conducted into the effectiveness of formal lectures. A formal lecture is taken to be an exposition by the lecturer to members of an audience who are expected to listen and take notes. These types of lectures are known to be good at developing knowledge and comprehension but, relatively poor at developing application, analysis, synthesis, and evaluation (Bligh, 1974).

Advantages of open learning materials compared to formal lectures
In contrast with formal lectures, open learning materials try to emphasise application and evaluation.

Conventional open learning materials usually consist of a paper-based study text which may be accompanied by a traditional text book. The materials are written from a learning standpoint rather than as reference works. They usually incorporate self-assessment questions, exercises, or activities and are sometimes supplemented by video tapes, audio tapes or broadcast television. Study is primarily undertaken in the absence of a lecturer or tutor.

This approach to learning offers six key advantages over formal lectures. The first three advantages are the open learning characteristics outlined above: student-determined location, time, and pace of study. As a consequence, study is not dictated by the availability of the lecturer, the availability of accommodation and other students, or the pace of learning preferred by the lecturer or other students.

There are three additional advantages of conventional open learning materials: review, self-assessment and omission. The student can review or revisit material they do not understand. This is difficult in a formal lecture setting as it holds back other learners whilst the lecturer addresses the specific needs of an individual student. Second, the student can also check their understanding at the end of sections through the use of self-assessment questions: a

process which again would otherwise hold up a lecture. Third, they can skip or skim material with which they are already familiar. This allows students to select material to take account of their prior knowledge.

Advantages of formal lectures compared to conventional open learning materials

Despite the flexibility offered by open learning materials, formal lectures offer several advantages:

- *Feedback (interrogation, learner interaction)*. The learner can obtain feedback from the lecturer on aspects that they do not understand or wish to have clarified.
- *Adaptation (lecturer interaction)*. The lecturer can adapt the structure or content of parts of the session on the basis of interaction with the learners.
- *Modelling*. The lecturer can build up a model of the learner's comprehension based on previous interactions with the learner. This can be used to facilitate adaptation.

Multimedia-based teaching provides a mechanism for extending open learning to include some of these features.

Comparison of open and virtual learning environments

Many of the characteristics of open learning can be achieved by means of computer-based teaching and learning. Some studies have shown that the use of multimedia can dramatically enhance student learning (Facciola, 1997; Wallace and Mutooni, 1997). This paper considers a particular kind of environment known as the "Virtual University" which consists of a suite of teaching and learning facilities which are loosely analagous to the features of a formal university.

The main components of the Virtual University are: virtual lectures (multimedia-based teaching), virtual seminars (electronic discussion boards), virtual tutorials (live text chats), and virtual exams (computer-based assessment).

Virtual lectures

The most original component in the Virtual University is the use of virtual lectures. Virtual lectures consist of a specially designed multimedia package which contains all of the core teaching material in the same way that real lectures usually define the core content of a traditional university course. The virtual lecture makes use of text, images, sound, video and interactivity to enrich the learning experience. The design of the interface for the virtual lecture is key to this experience and is discussed in the next section. The virtual lecture can be distributed on CD or made available over the Internet, thus facilitating the three key characteristics of open learning: flexibility in location, time, and pace.

Virtual seminars, tutorials and exams

Virtual seminars serve the function of facilitating learner interaction by allowing the student to ask the tutor questions about the virtual lectures through an electronic discussion board. They also facilitate computer-supported collaborative learning (CSCL) by enabling students to answer one another's questions and develop discussions and even debates. Unlike conventional seminars they are not confined to a particular daytime slot. They allow students and the tutor to discuss a given topic over an extended period of time (usually about two weeks). They do not require the geographical meeting of students to engage in discussion.

Virtual tutorials facilitate increased learner interaction by allowing the student to engage in similar exchanges, but in real-time through a live text-chat. They sacrifice student-determined timing (they must be scheduled) in return for immediate tutor feedback. Like virtual seminars, they do not require students to physically meet up in order to participate.

Virtual exams allow students to gain feedback on their performance through instant computer-based assessment. They benefit from its use as formative assessment as well as in its summative role. Virtual exams also eliminate the overhead in marking since it is fully automated at the time of sitting.

Advantages of virtual lectures over conventional open learning materials

Virtual lectures offer all the advantages of conventional open learning materials: learner-determined place, time and pace; learner review, self-assessment and omission. However they also offer five advantages over conventional open learning materials.

Interactivity and active learning

Textbooks and paper-based open learning materials are non-interactive in the sense that they are unable to provide feedback in response to specific input from the learner. Good open learning materials will usually attempt to anticipate likely responses or errors. But they are unable to give feedback to the particular responses of an individual student. Lack of feedback can discourage the undertaking of activities, as Laurillard (1993, p.111) explains:

> ... there is nothing in the format of the print medium that *requires* them to do it. And many of them choose not to. Only a small proportion of students actually write something down when asked to do so in an activity... (italics in original).

However, virtual lectures are able to provide interactivity through navigational tools and interactive self-assessment questions (ISAQs). These questions provide the learner with a constrained set of options in answer to a question, and provide specific feedback based on their selection. The interactive features of virtual lectures enable the learner to develop an active relationship with the learning material, unlike conventional materials in which the relationship is predominantly passive.

Adaptation

Since virtual lectures are interactive, they can adapt material presented to the learner on the basis of feedback. Whilst they cannot support interrogation by the learner, or build up a model of their understanding, they can use interaction to address problems in the learner's comprehension. Conventional open learning materials do not normally take account of student feedback in determining the path of the learner through the material.

Simulation

The power of multimedia means that physical or abstract systems can be simulated through computer models. For example, it is possible to simulate the behaviour of a nuclear power station, or the painting techniques of an impressionist artist. Whilst these might be illustrated in conventional media through videos or photographs, simulations allow the user to experience aspects of a phenomenon interactively.

Demonstration

In paper media, demonstrations can only be achieved through textual narrative or by supplementing text with video or television. This means that without the use of computer modelling, demonstrations are confined to real world phenomena. The use of multimedia, however, means that it is possible to provide demonstrations of all manner of physical or abstract phenomena that might be difficult or otherwise impossible to experience. The build up of gases in a nuclear explosion, for instance, or the orbitals of electrons in an atom.

Integration

It is possible to incorporate multimedia demonstrations in conventional open learning media through the use of video. Indeed, conventional open learning approaches often combine paper-based material with audio tapes, video tapes, or broadcast television. However, virtual lectures have the advantage that a variety of learning media such as text, diagrams, videos, or audio clips can be integrated into a single environment. This is one of the general pedagogical advantages of multimedia packages identified by Benyon *et al.* (1997).

Virtual University in practice

In order to begin to assess the suitability of the Virtual University for lifelong learning, use of the environment was trialed on a mixture of part-time and full-time undergraduate students following a conventional programme of study at Brunel University, London. Most of the students in the sample were enrolled on a BSc joint degree in business and computing. The lessons from the investigation have implications not just for formal campus-based teaching but for all modes of study including distance, home and workplace learning.

Course structure

In order to incorporate the Virtual University environment, one out of every two formal lectures was replaced with a virtual lecture. The second formal lecture was replaced with a problem class with the lecturer in order to help assess the significance of real seminars compared with virtual seminars. Virtual seminars were held for each of the course topics (eight in total), together with a summative virtual exam. The virtual exams also served to sequence the study of topics over the 13-week period of the course. The virtual tutorials form the subject of a separate trial.

Delivering the virtual environment

The virtual lectures were constructed in Macromedia Authorware: a multimedia development environment particularly suited to developing teaching and training materials. They incorporate text, images, voice-overs, digital videos (talking heads and software demonstrations) and interactive self-assessment questions. They use a specially constructed interface designed to make it easy to navigate large quantities of educational material and with user-interactivity at the fore. This learner-centred design was taken to be an essential determinant in effective teaching and learning. The virtual lectures were delivered over the university intranet for on-campus use, and also on CD for home/workplace use. Whilst they can be delivered over the Net, the low-speed connection of student modems would have meant that some bandwidth intensive features (such as the digital videos) would have had to have been curtailed. CD delivery also meant that home students did not have to amass large telephone bills to access the material (unmetered Internet access was uncommon in the UK at the time of the trials).

The virtual seminars were delivered using a bespoke electronic bulletin board on the Web. This allowed us to control the design of the interface and adapt it to meet the needs and experiences of students. The usability of the interface was taken to be critical to the effectiveness of the system, in common with the virtual lectures.

The virtual tutorials were delivered using an off-the-shelf live chat system (Multichat) which was embedded in a Web page, running without the installation of specialist software. The original design of the chat environment was fixed by the software. A customised version, which employs the same principles of learner-centred design, is currently under development.

Virtual lecture

The construction of the virtual lecture is based on the principles of navigational interface design for multimedia courseware outlined in Evans and Edwards (1999). The design addresses the needs of adult learners in higher education who must navigate a large quantity of structured material. It is intended to give learner flexibility where possible (such as choosing a topic to study), but provide navigational constraint where necessary (such as developing a concept or building an argument).

The interface is divided into three distinct areas: the main display, the navigational menu, and the navigational tools area, as illustrated in Figure 1.

The interface takes teaching material to be hierarchically structured around five to ten topics, each divided into about 5-15 sub-topics. Each sub-topic is then constituted from up to 20 pages which are presented in the main display. The tools for navigating the pages appear in the area below the page. At higher levels the tools are not visible to the user, according to the principle that navigational tools should only appear in context (Fleming, 1998, p. 17). The usability of the virtual lecture

Figure 1 Three areas of the interface
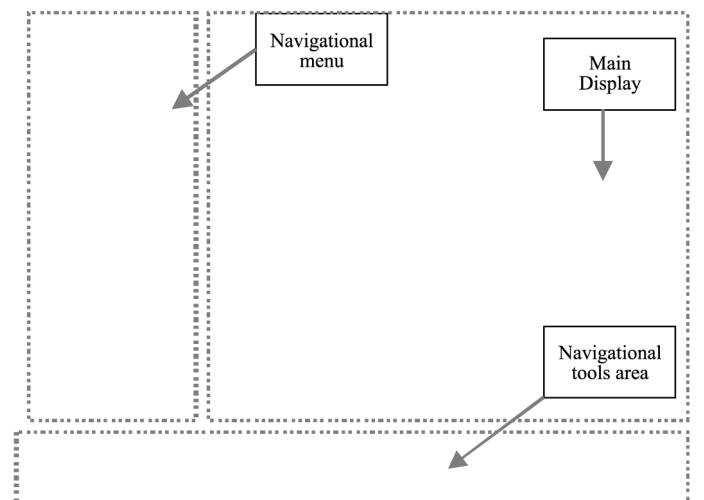
is taken to be a critical factor in realising the potential of multimedia-based open learning. Further details of the navigational tools are given in Evans and Edwards (1999).

Evaluation

The effectiveness of the Virtual University was assessed over a two-year period using questionnaires with four groups of undergraduate students on a joint computing degree course. Selected individual interviews were also conducted but there is insufficient space to discuss these here. The initial trial involved just the virtual lecture and virtual exam. Virtual seminars were introduced with the fourth group.

The primary aim of the study was to assess the impact of multimedia-based teaching from the perspective of open learning. The secondary aim was to consider how well the different components of the Virtual University worked together and to begin an assessment of the implications for lifelong learning students in their different modes of study.

The questionnaire contained three parts. The first part dealt with student's impressions of the virtual lecture in particular, the second part with their views of the (non-virtual) problem class, and the third part addressed the general issues of educational multimedia systems. It consisted of a total of 26 closed questions and five open-ended questions. A four-level Likert scale was used to determine the level of agreements with stated assertions.

There were 13 students in group one, 17 in group two, 25 in group three. Of those in group three, 12 were part-time students in full-time employment. Group four consisted of 42 students, making a total of 97 across all four groups. A summary of the selected findings is set out in the next section.

Results

Virtual lectures, problem classes, and multimedia systems

The results from a selection of ten of the 31 questions are shown in Table I. The table is the collation of results for the groups: the sample size for each of the questions is indicated in the last column (no. of replies).

Virtual seminars

Virtual seminars were introduced only for the fourth group of 42 students. Most respondents (64 percent) thought that the discussion board was a useful way to share knowledge. Despite this, 60 percent claimed they were not helpful in developing their understanding. When asked whether they found it time-consuming or embarrassing to post questions, more than half of them (57 percent and 69 percent respectively) thought it was not. Most respondents (67 percent) thought it would be useful to make use of virtual tutorials in addition to the other facilities.

Full-time v. part-time students

In the sample of 25 in group 3, there were 12 part-time and 13 full-time students. Overall, part-timers share the opinions on most issues with the full-timers. But there were some striking differences between them. For the assertion "It is necessary to have a tutor present whilst working through the virtual lecture", 62 percent of full-time students agreed, but only 33 percent of part-time students agreed. When asked whether they preferred to run the virtual lecture at home, 73 percent of part-time students agreed, whereas only 54 percent of full-time students agreed.

Discussion

The virtual lecture

It is clear from the results that the vast majority of students thought that the virtual lectures enhanced their learning, with more than three-quarters of them claiming they were an improvement on conventional lectures and textbooks, and should be extended across all of their taught courses. One of the key features seems to be the provisions of the interface: 98 percent of the students demanded more interactivity and self-assessment. The general positive reaction would suggest that this reflects the students' enthusiasm for the interactive and adaptive characteristics of the virtual lecture rather than discontent with its deficiencies.

Some of the positive results in the evaluation may be influenced by the fact that the sample population consisted of joint computing

Table I Selected questionnaire results

Question	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)	No. of replies
1. The virtual lecture was a valuable contribution to the module	50	45	5		97
2. The virtual lecture should have more self-assessment questions and interactivity	59	39	1	1	97
3. The user interface of the virtual lecture is clear and easy to use	46	50	4		96
4. The virtual lecture is better than a traditional lecture	30	43	23	4	96
5. The problem-solving seminars were helpful in consolidating my understanding	46	44	7	3	97
6. It is not necessary to have a tutor present when working through the virtual lecture	16	36	34	14	97
7. Please select the statement below which most closely reflects your personal view					
(a) (For this module) I would prefer to be taught solely through traditional lectures					
(b) (For this module) I prefer to be taught solely by virtual lectures	a	b	c		
(c) (For this module) I would prefer to be taught by a mixture of virtual lectures and seminars					
	3	9	88		96
8. I enjoyed using multimedia application and preferred interactive multimedia to traditional textbooks	35	52	11	2	55[a]
9. I would like virtual lectures to be introduced across all my modules at Brunel University	25	53	16	6	96
10. I prefer to run the virtual lecture at home rather than at Brunel University	34	31	27	8	97

Note: [a] Students in group four were not asked this question. Results for the first three groups were overwhelmingly in the agree/strongly agree category so it was omitted in favour of questions about the virtual seminars

students who may be predisposed to embracing information and communication technologies.

Virtual seminars

The virtual seminars (electronic discussion boards) were more of a source of contention. Less than half of the students regularly participated in exchanges, despite the tutor's attempts to make the virtual seminars the primary source of information dissemination. Nearly two-thirds of all students thought they were useful in spite of the fact that most thought they did not contribute to their comprehension. Nearly half the students indicated that they found the discussion board too time-consuming to use, although embarrassment did not seem to mitigate against its use for most students (69 percent). The overall results are likely to have been affected by the fact that the students had the alternative of real seminars in which to raise their problems. The next trial will involve distance learning students in an attempt to gauge this effect.

The need for face-to-face contact

The problem classes provided face-to-face contact with the tutor and were designed to shed light on the students' varying attitudes to tutor presence compared to interactive multimedia. Students were divided, for instance, about whether it was necessary to have the tutor present during virtual lectures. Indeed they appear to value the face-to-face element, with 91 percent rejecting the completely virtual mode of study. However, students in full-time employment seemed to express the contrary

view with only 33 percent having the need for tutor presence during the virtual lectures. They also embraced the flexibility offered by being able to run the virtual lecture at their home or workplace (73 percent).

Conclusion

This paper considered the use of multimedia systems as part of a process of lifelong learning through the Virtual University. The Virtual University appears to offer substantial benefits to lifelong learners over both formal study and conventional open learning. Virtual lectures in particular provide an advanced interactive learning tool with distinct advantages in terms of engagement and flexibility. Students benefited from the interactivity of the environment and its self-assessment facilities. They also welcomed being able to study in their own location, time and at their own pace. The virtual lectures have a number of advantages including interactivity, adaptation, simulation, demonstration and integration. They facilitate active learning rather than the more passive learning associated with conventional open learning materials. The Virtual University aims to be subject neutral. Further trials are needed to compare the reactions of students from less technology-focussed disciplines. The virtual seminars were not fully utilised by students although they believed them to be a useful facility. Further investigation is necessary to establish whether students found the virtual seminars useful for dissemination of information other than teaching material. This might in part explain the students' positive attitude but under-utilisation of the discussion boards. Other trials will involve distance learning students. This allows testing of the hypothesis that the use of virtual seminars is reduced when face-to-face problem classes are also provided. A survey will also be conducted to investigate the use of virtual tutorials. Taken together, this will allow a comprehensive assessment of the benefits of the Virtual University for lifelong learning.

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