



A Hybrid System for Delivering Web Based Distance Learning and Teaching Material

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1 Introduction

Over 150,000 students register with the Open University each year, including 5% non-UK EU students and 10% outside the EU. The University is considered by many to be the world's leading distance learning institution. All students of the University are offered a comprehensive advice, guidance and learning support service, starting from the initial point of enquiry through to completion. A full range of media has traditionally been used to support students, including a strong telephone-based advice and guidance service, student toolkits on study skills, TV programmes, group and individual face-to-face support from course tutors and residential and day schools. Learning and teaching materials have been sent to students in a number of ways including print, broadcast television and radio, videocassettes, audiocassettes, home experiment kits and CD-ROM. The Open University is delivering computer-based learning and teaching materials to over 80,000 students and has over 140,000 users of its on-line services.

The quality and effectiveness of the University's teaching is monitored through the collection, analysis and dissemination of data about the strengths and weaknesses of the materials and services provided, and the quality of the student's experience and learning outcomes.

Web-based advice and guidance, email as an advisory medium and the use of computer-media conferencing for teaching and learner support, are expanding across all services. CD-ROM has grown dramatically in the last few years as the primary distribution media for computer-based learning and teaching materials.

The Open University aims to establish the critical baseline of IT elements for all courses and programmes by 2002; build IT elements into courses to achieve compulsory IT elements for all University degrees by 2005; increase Web focused courses to at least 20 by 2002. Several key environmental factors have influenced these target levels and the way the University is responding to the challenge presented by them. These are:

- the rapid growth of the Internet and prospective student expectation that courses will be available on-line.
- limited bandwidth to the home which prevents effective on-line delivery of data intensive media such as video and high resolution still images.
- the large data storage capacities and versatile functionality of DVD technology.

Software tools are now available which take advantage of the immediacy of the Internet and the versatility of DVD technology. Hybrid developments of this kind are referred to



as "Connected DVD" and web based student learning environments can be developed which use DVD-ROM media to hold up to 9 GB of learning and teaching material. The versatility of DVD technology allows the disc based material to be integrated with web based material or used off-line as a self-contained learning environment. All material which is not computer dependant (audio, video, images) can be viewed with a domestic DVD player from the same DVD disc.

The Open University is well positioned to exploit this technology in its teaching. Over 80,000 students are already using personal computers in their course work and an increasing number have DVD-ROM drives in their home machines. This approach may offer improved media integration and a reduction in the University's learning media production costs.

2 What is DVD?

DVD originally stood for Digital Video Disc and was intended for the distribution of video. It now officially stands for Digital Versatile Disc as its uses now include standalone audio and distribution of software and data. Physically it is the same size as a CD-ROM, but the laser beams used are much finer and the rate of rotation of the disc is faster.

This data can be played by any suitable application, but a key part of the DVD standard is that there is a "standard player" which can either be in the form of a standalone (table-top) player connected to a TV or a software player on a computer. The player interprets the data on the disk in a special way to create a substantially interactive experience. This includes multiple camera angles, multiple language audio tracks, multiple sub-title tracks, still pictures and interactive screens (or video) called menus.

There are emerging standards for extensions to this player which allow display of web pages at key points and also to allow web pages to display DVD video in a convenient manner.

DVD authoring consists of encoding video, audio, text data, creating interactive screens and scripts, and organising the arrangement of all these resources on the disk so as to work appropriately with the standard DVD player. After testing this (including the writing of DVD-R discs) then a tape is created which is sent off together with label graphics etc. for the pressing of a large number of DVD discs. Additional software and files can be included on a DVD and these can include software which incorporates the playing of the encoded DVD files in ways not possible with a DVD player.

The DVD-ROM format can be used as a distribution medium, offering up to 15 times the capacity of the CD-ROM. A move from CD-ROM to DVD-ROM and VHS to DVD distribution, would result in a considerable saving to the University as has a move from floppy disk to CD-ROM. The DVD-ROM format in most common use in Europe is DVD-9 which holds around 9GB of data on two layers of a single-sided disc. DVD-18 production is now underway in the USA and this format holds 18 GB on two layers on both sides of the disc.

Recent projections for DVD household penetration in Europe show a growth from 14% in 2000 to around 80% by 2005. DVD-ROM drives are now rapidly replacing CD-ROM

drives in desktop PCs and an upgrade to a DVD-ROM drive is now an inexpensive option. DVD-ROM drives are compatible with almost all CD formats including CD-ROM and CD Audio.

The Open University is currently working with two systems: the Spruce Maestro DVD authoring system and the Daikin Scenarist DVD authoring system.

3 Applying the Technology

3.1 Applications in Science

S103 Discovering Science is a wide-ranging course that introduces important scientific concepts and develops the skills needed to study science successfully. It introduces the disciplines of biology, chemistry, Earth science and physics and shows the links between them. The course is designed both as a broad foundation for students who intend to study for a science degree, and as a stand-alone course for those who want to discover more about the science of the world around them. As well as full colour books, students receive interactive CD-ROMs, videocassettes, TV programmes, and a practical kit complete with rock specimens and fossil casts. In addition, students are allocated to regional tutors, and they can participate in computer conferences and attend a residential school. All of these activities and materials form an integrated teaching package where each component is used for the purpose to which it is most suited. The course offers such a wide range of media and delivery systems, that it is ideal for piloting the Connected DVD concept with real Open University learning and teaching material. The course in its current presentation format includes:

Books, Study Files and Study Guides

Students receive eleven printed texts which are the main component of the teaching materials and are specifically written by academic authors at the University. Each text is accompanied by a loose-leafy *Study File* containing notes and activities to help the student track their progress through the learning materials. A *Study Guide* card is provided for each text to help students plan and co-ordinate their work.

Interactive Media

Students receive 25 interactive multimedia tutorials on CD-ROM to teach topics which are difficult to present in printed texts. They also receive software to assess and give practice in mathematics skills and self-assessment questions which help identify areas where students require more work to improve their understanding or skills.

TV and Video

There are ten 30 minute television programmes broadcast by the BBC and 5 hours of videocassette material which contains 20 video activities.

Practical Work

There are eight practical activities carried out at home by students.

S216 Environmental Science is planning to send students a number of interactive multi-media applications and all of the course video material on DVD-ROM in its first year of presentation (2002). The course team believes that students will benefit from a reduction in the number of delivery platforms used in the course.

4 Building the DVD-ROM

All of the learning and teaching materials produced for *S103 Discovering Science* have been put in digital format and a pilot DVD-R has been produced which contains all of the S103 software and text material. All University text material is now held in PDF format so text searching functionality is easy to implement with the Adobe Acrobat Reader. All of the video material has been digitised and various compression options are being investigated. The interactive media material has been easy to integrate and access has been provided through a common icon based interface.

The development strategy is to build a DVD-ROM which holds all of the S103 text, application software, much of the video material either broadcast or sent to students on video-cassette and which has links to web based material. All of the material will be accessible from a PC with a DVD-ROM drive and the video material will be playable on a domestic DVD player. Apart from providing S103 students with an invaluable resource, the application will demonstrate the potential of this new technology to higher education. This kind of development will help overcome the concerns of many academics about the Internet and the difficulty of integrating high quality media with a web site.

5 Applications in the Humanities

A number of Arts Faculty projects have been initiated including a pilot project for *A220 Princes and Peoples: France and the British Isles 1620-1714* which looks, for example, at the structure of three contrasting church buildings of the seventeenth century. Other courses which may include DVD based material include *A207 From Enlightenment to Romanticism*, and *A218 History of Medicine*. Both of these courses do not go into their presentation phase until 2004 which gives time to evaluate the use of standalone and computer based DVD players by Arts Faculty students. *A218*, for example, may use CD-ROM during the first half of the course life but may then convert its material to a mixed mode format containing both DVD-Video and DVD-ROM components during the second half of its presentation phase.

6 Technical Issues

6.1 Storage Limitations

The most common DVD-ROM format in mass production today, DVD-9, consists of two data layers on one side of a disc, each layer holding around 4.5 GB. The S103 material requires over 13GB of data storage (text and software: 4.5GB, TV programmes in MPEG-1:

4GB, video programmes: 4.8GB). The amount of data storage required by video material depends on the compression format adopted. Opting for higher data rates during compression results in larger data files but better image quality and the MPEG-1 format (1 Mbits/sec) offers a reasonable data storage/image quality compromise. As there are no direct links from the text material to the broadcast programmes, these will be put on a separate DVD-5 disc which has one data layer.

6.2 Video Encoding

While MPEG encoding has yielded some impressive results, there is a problem in creating a format suitable for domestic DVD players and PC based software players. Most PCs with DVD-ROM drives are shipped with software DVD players and the various DVD authoring products have their own software players. Therefore, rather than relying on a wide range of DVD players on student's machines, we are likely to bundle our own player with the DVD-ROM based material and install it on the student's PC.

6.3 DVD Audio

There is some ambiguity as to the most compatible format for audio and the options include: Dolby (AC3) 5 channel, Dolby Stereo, Dolby Mono, MPEG Audio stereo, MPEG Audio mono, PCM and advanced PCM.

7 Conclusions

The potential of DVD technologies has been ignored by most of the higher education sector, particularly in Europe. Some impressive educational developments based around DVD technologies are currently being undertaken by the Ohana Foundation and these are currently being tested in Hawaii schools (www.ohanalearning.org). As more Open University courses are presented on-line, the bandwidth available to most students in their home will place constraints on the type of learning and teaching material which can be delivered on-line. There is a view in the University that we over produce our courses and that the constraints inherent in on-line delivery may force our course production processes to be more efficient. There is also ample evidence that non-broadcast audio-visual material and other computer-based teaching material which cannot be delivered on-line, does enhance the student's learning process. The hybrid system described in the paper will allow course teams to offer students a richer on-line learning experience until a significant number of University students have access to broadband data networks