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Investigating Digital Video Applications in Distance Learning

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ABSTRACT *The paper gives a brief overview of the use of digital video in distance education, the background to The Open University's Digital Video Applications (DiVA) Project, the contexts in which the Digital Video Library system is being used and some evaluation findings. Through DiVA, the university is investigating how it can use its video assets effectively, to support re-use of existing materials in course production. The project team is also evaluating student use of the system. The paper reports on an observation study which revealed several usability issues and stakeholders' opinions about potential uses of the DiVA system. This is followed by findings from an evaluation of student use of the system at a residential school, and its use as part of an online learning activity undertaken by students accessing the system remotely. Evaluation findings to date indicate some quality and workload issues but they also show opportunities that come to light when using the DiVA system.*

Introduction

Digital video offers a raft of benefits in educational contexts. It can be used for recording and analyzing classroom interactions (Pea & Hay, 2002), and to develop students' critical thinking, creativity, language skills and collaborative learning (Becta, 2004). Shearer, Venkatesh & Kieronska (1997) developed a system for the reuse of video clips within an application, enabling users to choose different start and destination points in a video tour of a campus. When digital video is downloaded by learners over the Internet, or viewed 'live' (also known as 'streaming video'), it can become "transformed from a method of delivering information to a focus of student and group activity" (Thornhill *et al.*, 2002, p.5), especially when it is integrated with other web-based resources. Zenios (2002) reports on learners' experiences in higher education based on three case studies and suggests that there is indeed value in streaming video, summarized in terms of ease of access, learner control, integration, bridging theory and practice, and changing perceptions about technology. In another review of case studies of streaming video in support of student learning, Shephard (2003) advocates that the academic community should "record and communicate how streaming video is used in specific cases" (p. 306), and emphasises the need for educational evaluation. She notes that streaming video has been largely confined to 'blended learning' contexts, and has not been used in distance learning other than for administrative functions.

Indeed, as yet there are few evaluated and documented examples of actual use in distance education. Korošec and Debevc (2000) gave an account of how video could be used to stream lectures over the Internet to distance learning students, but they concentrated on technical feasibility. Video lectures are one of the ways in which distance learning students can gain the feeling that they have contact with a human instructor. Several distance learning programs around the world are using videoconferencing for synchronous lectures and for two-way communication, including collaborative learning. For example, at the University of Illinois (2004) distance learning students can share the experience of guest speakers in a different city. At the Singapore-MIT Alliance (2004), videoconferencing allows students located in different countries to experience collaborative class sessions, and they have the option to view the video recording later, asynchronously, on the Web. Other institutions (e.g. University of Colorado at Boulder, 2004) use digital video examples delivered on CD-ROMs or DVDs to distance education students: being able to access video on disk can sometimes be more convenient than having to rely on a live Internet connection.

The Open University (OU) previously explored the use of digital video by collaborating with Carnegie Mellon University on the Informedia-I Digital Video Library Project (Van der Zwan *et al*., 1999; Kukulska-Hulme *et al*., 1999). The Open University contributed 80 hours of content and was one of the four evaluators of the delivered system. It was recommended that a programme of work be undertaken subsequently to "investigate the use of digital video technology in a range of working environments to assess its full potential" (Kukulska-Hulme & van der Zwan, 1999). As a result of this, the DiVA (Digital Video Applications) research project was created. The project is funded by The Open University through its Learning and Teaching Strategy and the Development Strategy Group. Although this project is initially looking at providing access to digitized video resources at Walton Hall (university campus and headquarters), the Open University domain (open.ac.uk) also serves the OU's 13 regional centres in the United Kingdom. Depending on the success of the project, DiVA may well be accessed from these regions, and by OU distance learning students across the globe.

DiVA evaluation project: aims and methods

The DiVA project aims to evaluate the use of digital video within a number of contexts:

- *Production*: to support the re-use of existing video content to produce new teaching materials, for example web pages, CD-ROMs and DVDs. Target users are academic staff and course teams (those who develop courses).
- *Resource-based learning*: to investigate how digital video materials can be used by students, on residential and summer schools or studying at home. What is the impact on teaching and learning - if any?
- *Library processes*: can automatic metadata generation tools speed up the processing of audiovisual materials? What are the cost-benefits, if any, of a system like DiVA? Can it help library staff respond more effectively and efficiently to user enquiries?
- *Users with disabilities*: can the DiVA system improve access to audio-visual material for hearing impaired users and users with dyslexia?

The evaluation is being conducted over a three year period (2002-4) using the following methods:

- Observations: using the Institute of Educational Technology's Data Capture suite, and through observing users in situ
- Questionnaires: circulated to users following use of the system
- Interviews: with selected users
- Process costing of library processes
- Management information data: collected from the DiVA server which logs user behaviour and transactions on the system
- Technical monitoring: the impact of the DiVA system on the OU network is being monitored and assessed.

For the purpose of this paper, we will concentrate on an examination of DiVA as a tool to support teaching and learning. This will include an examination of the production and resource-based learning strands of the evaluation, with a report on initial findings of student use of DiVA.

The DiVA System

A digital video library system has been created, and is being populated with up to 245 hours of selected OU video content. This content comprises full programmes (30 minutes to an hour long), and clips. The clips are taken from the programmes themselves or the "rushes". The DiVA system uses Virage Videologger software to digitize the content, and the Virage Solutions Server *to deliver the content via a web browser interface. The Virage software has been customised to meet the specific needs of The Open University.

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* Recently Virage have been taken over by Autonomy, and the system is now called VS Archive.

The digital video files have been encoded as Windows Media files which are streamed to the users, encoded at 56k (for modem users) and 512K (for LAN/Broadband users). There is no facility to download video clips, as DiVA is intended as a tool for locating, watching, selecting and sharing video resources within the system. DiVA is protected by the Open University's user authentication. In addition, there are three levels of access:

- Staff Interface: this is for OU staff, and includes facilities to create extracts from clips, to email clips to colleagues, share clips and searches via a shared workspace or 'workgroup', and to initiate a Rights Clearance request.
- Student Interface: this is for OU students, and allows access to the search, browse and 'workgroup' functionality of the DiVA system.
- Administrative Interface: this is for "super users" of the system, and includes the ability to edit metadata, generate management information reports, administer users and export the database in XML format.

Metadata to aid resource location has been designed, using the IMS Learning Resource Metadata Specification v.1.2, but with specific extensions that describe the audio-visual qualities of the material, and also OU course specific information. Users can search by keyword, or browse by OU course code or Library of Congress Subject Headings. Once content has been identified, there are functions to support the re-use of data (staff and administrative users only), and to support collaborative working (all users).

The DiVA system has been designed to be a repository of digital objects which can either be used as learning objects in themselves (in the case of complete programmes), or which have the potential to be used as part of a learning object (e.g. a short clip). In their paper examining learning objects from an educator's point of view, Weller *et al.* (2003) conclude that

> Learning objects represent a means of making best use of resources. The development of multi-media for example is costly and requires specialist skills. It is thus sensible to reuse such elements in different courses, thus providing a richer learning experience for the students…. it is their low-level granularity that makes them easily transportable between courses and this can only be achieved through a learning object approach.
>
> (2003: 4)

Created with this kind of activity in mind, the DiVA system functionality aims to support this new way of working. It takes advantage of international Learning Object Repository (LOR) standards to provide flexibility in the use of the assets, and the potential for cross-searching to and from other repositories in the future. A comparison of LORs (Neven & Duval, 2002) highlights a number of features which facilitate the effective re-use of material, most of which are incorporated into DiVA.

Selection criteria to provide guidance as to what content should be added to the system have been developed in liaison with academic units. This will ensure that the material on the DiVA system is representative of current needs in relation to OU audio-visual content and potential re-use as learning objects. In addition, as users agree to participate in the DiVA evaluation, we are ensuring that there is relevant content added to the database. This is done by library staff working with the users to identify what content they are looking for, and then researching using the existing mechanisms of the Library catalogue and viewing videos to add to the DiVA system. This pre-selection is deemed necessary at this project stage, to ensure that there is some content for the user to locate.

Production Use of DiVA

Changes to the educational marketplace and continuing uptake of innovative new technologies have impacted on the way The Open University produces and delivers its courses. Hence the creation of short courses, the need to revise and refresh existing courses more frequently, to deliver courses with an online focus, and to shorten the time spent in developing new courses. A key way to shorten the "time to market" is re-use of existing material.

Locating audio-visual material for re-use has always been a laborious and time consuming task. The Library's Voyager catalogue carries minimal information on video material, mainly contributor, title, date and format. For a selection of programmes staff manually create footage descriptions, which involves viewing a video, and writing down what is seen minute by minute. This information is then added to the video's catalogue record on Voyager. The amount of footage descriptions thus created represents a very small proportion of the total audio-visual stock catalogued. This has had an adverse affect on re-use enquiries. As information is only entered at a general level (e.g. programme title and list of contributors), it is impossible to identify specific content within a programme without viewing the video. The Teaching Materials Officer, who operates the "versioning helpdesk" within the Library, has found that searches of the OPAC (Online Public Access Catalogue) have proved unsuccessful on the whole. She has had to resort to scanning transcripts and viewing programmes, which has proved to be labour intensive.

DiVA aims to make the location of audio-visual material a faster, more cost effective process through the use of the following technologies:

- *Voice-to-text software*:
  The software allows a transcript to be generated automatically from the voice narrative in the video. This transcript is not a continuous text, however; it consists of phrases and words, listed one below the other, that can then be searched by the user. This facility allows users to jump into the video from the point where the words are spoken, potentially saving viewing time.

- *Highlight Reel Tool*:
  This allows the user to create their own sub-clips, or collections of clips, by setting new 'in and out points' (known as 'reels') which determine which part the video is played from the server. Once a reel has been saved, the user is able to:
  - Generate a Rights Request, to clear the selected reel for re-use
  - Save the reel to the Workgroup area, for sharing with colleagues
  - Publish the reel on a Web page, as a linked key-frame or textual link to the clip
  - Export an Edit Decision List which can be used on Avid editing machines to create a copy of the reel in whatever format is required for re-use from the master tapes.

It is anticipated that the additional metadata created on the DiVA system, the fact that it can be accessed via a desktop computer (rather than involving a visit to the Library), and the streamlining of the Rights Request process will result in cost savings in terms of academic staff time. The evaluation will endeavour to establish whether this is the case or not.

Student Use of DiVA

The use of audio-visual material has been a part of the learning package delivered to students since the OU began in 1969. Such material has been delivered to students via the medium of broadcast TV and as videos, providing learning experiences that would otherwise be unobtainable in a distance learning environment. With the current trend in pedagogy away from didactic, instrumental learning towards more constructivist and resource-based approaches, students are being encouraged to go beyond the supplied course materials, and research resources for themselves, often discussing their findings in computer conferences.

DiVA offers the possibility of supporting resource-based learning by providing a repository of digital video that can be searched and accessed directly by the students. Rather than viewing complete programmes, there is the option to view specific clips or jump into key points within the video. The Lifesign project (Lifesign, 2004) has highlighted key differences between streaming video and television: perhaps most importantly, streaming video is available on demand and, being a digital resource, it can be integrated with other electronic learning resources. What impact does this have on pedagogical strategies, and on the learning experience for the students? The student evaluation focuses on the use of DiVA in two different scenarios:

- *Residential School Access*:

DiVA can be used at a residential school to support project work or the completion of a specific task. The benefits of evaluating use of the system at a residential school are that students are available for observational data collection, and there is some control of the technical set-up.

- *Remote Access*:
  How accessible and easy to use is the DiVA system for remote users? Given the distance learning environment of the OU, it is important to be able to understand the technical and user issues from deploying such a system remotely. In addition, we need to find out whether DiVA supports new activities and provides new learning opportunities in the virtual environment.

Students and other users with disabilities may also find improved access to audio-visual material via the DiVA system. The findings of these evaluations will be discussed in detail in the final project report.

Initial Observation Study

The first evaluation of the system was conducted in October-November 2002. The main aims were to investigate the usability of the system and to gather some initial feedback with respect to course production and potential student use. Twelve participants agreed to take part in the evaluation and all relevant stakeholders in course production and presentation were included, i.e. students, course managers, academic chairs of course teams and associate lecturers (tutors). For the purposes of this paper participants' anonymity has been preserved. The observation study was carried out in the Data Capture Suite in the Institute of Educational Technology. This facility can be used to capture video records of human-computer interaction which can be displayed in a four-way matrix, capturing up to four simultaneous 'views' of the user, the computer they are working at and interactions with the application on the screen (Joiner *et al.*, 2001). Participants were interviewed immediately after the observations.

Participants were able to navigate around the DiVA system and to find and use video clips. The ability to search and choose clips of video from across the University course materials was felt to be extremely valuable. Areas where users needed clarification included:

- *Terminology*: e.g. the term *'typo'* in the user interface conveyed the idea of an error to users, rather than a function for looking for similar spellings of search words. '*Clip bin*' as a save area also confused users, as a 'bin' is generally thought to be for rubbish.
- *Level of Description*: More description was felt to be needed to determine whether or not to access a particular clip.
- *What is searched*: it was not always clear to the user what DiVA was searching, e.g. in the case of a 'subject headings' search, users thought they were looking for the term in the transcript, when in fact DiVA was doing a fielded search of the database.
- *Transcript Display*: users were confused by the way the transcript displayed on the Media Player screen – it scrolled off screen as the words were spoken.

The observation study provided us with a practical way to achieve awareness of 'typical' actions. It also gave us the opportunity to find unexpected responses, such as attempts to re-size the Media Player window and to customise the interface to personal preferences in terms of text font and size. Text on the screen can be re-sized by going to View - Text Size options in the browser menu; this also changes the text size in the transcript. Where possible, the user interface has subsequently been amended to take into account user feedback. The main area which was improved was the transcript display, so that the transcript now scrolls onto the screen as the words are spoken. For those areas where we are unable to change the interface, the comments will be used to provide help pages and user instruction. They will also be incorporated into future iterations of the system, when resource allows.

Production use findings from the observation study

Initial responses to the potential of DiVA to support production use were on the whole positive. In particular, the Highlight Reel Tool, whilst requiring training to use, was seen as an advantage. Comments included:

Almost as good as being able to make the video yourself, but less expensive and quicker.

All this lovely back stuff [archived footage] we have will be used.

The Highlight Reel tool was also seen to be empowering for the course team, allowing them to determine what clips they require, rather than relying on audio-visual staff interpreting their requirements. It should be noted that one participant felt that the Highlight Reel did not go far enough, as once clips have been selected they then have to be passed to the audio-visual department:

It's annoying I have to send it to A-V. Can't I just save the clip?

The collaborative features provided by the 'workgroup' facility were described as useful. In particular it could be seen as a way for a course team to identify which clips are most relevant for re-use:

It would be interesting if a lot of people put in the same clip as being useful and that authors find appropriate. It could be a sort of vote.

I suppose if you wanted to find a clip and there were several choices, then it gives you the means for everyone to look at them and make a decision... I can see the use of it.

As such, this initial evaluation has raised hopes that DiVA will prove a useful tool to support re-use, and certainly those who participated in this first round of testing were interested in following it up further.

Learning and teaching findings from the observation study

From a learning perspective, there were comments from both tutors and students on how DiVA could be used to assist with learning activities. Tutors suggested the following possible uses for DiVA:
- Items could be saved to the Workgroup area, with students given a deadline to comment on them.
- It was thought useful to be able to guide students back to material to clarify information.
- Tutors would like to be able to access those clips that were not used in course materials to further explore particular aspects of the course with students.

Students' comments on DiVA were as follows:

- The ability to paste clips into assignments could assist with assessment.
- Some parts of the system are very good and it is relatively easy to save clips, but the biggest problem might be getting people 'au fait' with the system.

Of particular concern was the issue of getting to grips with the technology, particularly when DIVA is yet another tool to be mastered along with other course tools and resources such as online conferencing, CD-ROMs and websites. There were concerns from both tutors and students that this would add to student workload.

Student use at a Residential School

The DiVA system was tested with students at a French Language residential school at Caen University during August 2003. This residential school includes work in small and large groups, social activities, practical work in Caen and the surrounding area, and opportunities to use video and audio equipment and IT. Before the school there is some preparatory work; during and after it students have the chance to demonstrate their skills in speaking and writing French. To assist the students with their research for the oral and written tests which are part of the course, 7.5 hours of content was added to the DiVA system. In the event, there is some evidence from the evaluation that the content was not sufficiently relevant to the task. One problem the evaluator faced was trying to explain the DiVA system to students and staff as simply as possible. The DiVA acronym, as well as the phrase "digital video applications", meant very little to students. Presenting the system as a "digital library of OU television

programmes" seemed more appropriate. Students were asked to volunteer to use the system, and 9 took part in the evaluation. They were observed and filled in questionnaires. DiVA seemed to attract those students who were IT literate and confident in using computers.

The students mostly found the experience of using the DiVA system interesting but had mixed opinions about its usefulness, partly due to not finding the content they wanted. As might be expected, they were mostly very satisfied with the quality of playback of video clips, which were accessed over a broadband connection. The system appeared to work best when students knew exactly what they were looking for. For example, one student knew that there was a programme on another French language course which covered French charities, and she was able to search for a particular charity and find the clip she wanted very quickly. Some people tried very complex and detailed searches, with expectations that the system would behave like the Google search engine, and unfortunately they were disappointed. Students also confused programme descriptions with clip descriptions, and they got confused because the same clip would sometimes appear several times. For example, if they were searching for a word in the transcript they would get the whole programme, then the band within the programme and then a clip which had been made from the band, so in effect they got the same result three times.

The automatically generated transcripts proved very problematic, producing many "false-positives" as search results. However, interestingly, when relevant programmes were found, the transcripts for the programmes seemed to be more useful for the students than the programmes themselves, with students copying down phrases for their oral or written assignments. Students also thought it was useful to be able to use the transcript to jump to specific parts of the clip or programme.

Remote student use

DiVA was also trialled in June 2003 with a group of 26 volunteer students who had recently completed an online Masters course, who were accessing the system remotely. The students were professionally involved in online and distance education and had some experience in evaluating technologies and giving their insights. They were divided into 2 groups, one using the student interface, and one using the staff interface to see if the functionality of the Highlight Reel Tool can be of value to students. They used DiVA as part of an online group activity, being asked to identify clips and discuss them in an online conference, and then paste a link to the clips into a web page.

Students who used the Highlight Reel Tool were able to envisage constructing knowledge, taking a hands-on active role, and being stimulated to add commentary to their reels to aid their reflection. Others liked the idea of combining a repository of learning resources with a shared virtual space in which pre-defined or self-selected groups can work collaboratively, although DiVA's workgroup facilities are quite limited. They were also positive about being able to home in on a section of a clip. They thought it would be useful for students to be able to build up their own library of clips and use them in assignments, and that they could be helpful to students who prefer information in auditory and visual formats rather than text.

On the whole, students found it difficult to complete the set activity in the time allocated, and there were some negative comments which focussed on the following themes:

- *Quality of the video*: the small screen size and buffering caused some concern for users. As was expected, those with high broadband access appear to have had the best viewing experience.
- *Quality of the transcript*: much of the content used in this evaluation had a voice-to-text created transcript, generated automatically by the system. Its poor quality rendered it unusable in the opinion of some students.
- *Terminology*: certain terms in the interface caused confusion, such as the difference between a 'clip' and a 'reel', and the meaning of an 'in-point'.
- *Technical issues*: a number of technical issues were highlighted, which has been useful in terms of ensuring that our instructions are comprehensive, and identifying software bugs.

What was particularly interesting was a debate as to the value of taking clips from a complete programme out of context. One student commented:

> *Is it perhaps the case that advanced and deep learning requires sustained engagement with learning resources and that there is a danger of losing this if we rely on short clips?*

Further work with remote students is in progress; the current cohort of students on the same online Masters course is using the DiVA system as a resource for online learning activities over a period of several months.

Conclusions

Our evaluations so far have identified a number of opportunities and issues. The potential for re-use in course production, and for detailed scrutiny and discussion of video material in teaching and learning is quite apparent. Those involved in course production have stressed how the system can facilitate collaboration and decision-making among course developers. Tutors could see possibilities for guiding students back to material to clarify information, and for accessing clips that were not used in course materials to further explore particular aspects of the course. Students considered it useful to be able to jump to specific parts of a programme, and they made several suggestions for use of the system, such as adding commentaries, building up a library of clips to use in assignments, learning collaboratively and in line with one's preferences.

What is also clear is that users have to become acquainted with unfamiliar concepts and terminology; this was true of the volunteers who participated in our studies, who were arguably more motivated and computer-literate than other students. There were concerns about possible effects on workload when the system is used as part of an array of electronic learning tools and to its full potential, i.e. including the facility for making clips and using the Workgroup area (although the facility for making clips was only made available to the student volunteers during this study, and is normally only a feature of the staff interface). This workload aspect is not much discussed in the literature – whilst integration of video with other systems and resources is seen as an advantage, the possible implications of students having to master these systems, along with their different search facilities and collaboration mechanisms, should be more fully addressed. If DiVA were at some point made available to students as part of their course, a number of mechanisms have already been put in place by the Library for supporting distance learners with their information skills needs (Parker, 2003). These include an online search skills tutorial (http://www.open.ac.uk/safari), a Learner Support helpdesk for each subject area, face-to-face training for tutors, and innovative new technologies such as "Librarians on Call", which uses live web-chat technology to enable students to query a librarian whilst searching a database. In addition, the OU Library is currently testing software which would provide a single search screen to access numerous databases, with a view to lessening the number of interfaces which needed to be mastered.

Some concerns about video quality and the quality of the automatically created transcript were also in evidence, and will have to be investigated further. A forthcoming system upgrade will render it much quicker to import existing – and accurate – transcripts into the system and align them with the video. If this works well, the automatically generated transcript may well be abandoned. Regarding video quality, the findings from the Click and Go Video project (Thornhill *et al*., 2002) do not discount the use of video encoded for use on 56k modems, but the authors warn that institutions must also consider how many students are likely to access the video stream and should ensure that enough bandwidth is available if they advertise the video resources to a wide audience. Internal data collected at the Open University through a survey on access to media technologies indicates that close to a third of students now have access to a broadband Internet connection for study from work or home.

The DiVA project will continue until September 2004, to gain more qualitative data from users, including students with disabilities, and quantitative data from the system management information reports. Future research will also be undertaken on the production use of DiVA. A number of Open University course teams have expressed an interest, and we are currently following up. Whilst the initial user testing has been generally positive, we need to review a number of real applications to assist us in determining the future of this system. For the project team, the key questions are whether DiVA will live up to expectations, and what changes would need to take place in order to roll out the system to OU registered users.

Notes on Contributors

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ANNE JELFS is a Knowledge & Innovation Project Officer in the Institute of Educational Technolgy at the Open University. Her recent work includes joint editorship of the special issue on Blended Learning for the Journal of Educational Media (October 2003) and her research interests focus on qualitative methods and approaches such as phenomenography.

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