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VIDEOCASTS IN ENGINEERING AND DESIGN EDUCATION

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ABSTRACT
The Engineering and Product Design Education conference in Barcelona 2008 highlighted the wide variety of academics, teachers and practitioners using video in their teaching. This paper gives an overview of the current use of videocasts in engineering and design education. Videocasts are the video equivalent of podcasts: online, available and video based. They can be generated and published to demonstrate a variety of information and skills, including traditional lectures, software demonstrations (e.g. CAD, spreadsheets, programming software), animations and hands-on practical demonstrations (e.g. drawing techniques, model making, analytical workings). Videocasts can also be used to assess student work, providing a useful insight into students' understanding and strategy. A critical evaluation of the various videocast types is presented. In particular, practical issues are discussed for publication on generic institutional gateways (e.g. intranet and VLE systems such as Blackboard) and also standalone websites. This paper also serves as a guide to lecturers and teachers who want to use videocasts to complement and extend traditional teaching methods. Guidelines are provided for preparation, presentation and post processing of material. Case studies are discussed to highlight particular strengths and weaknesses in generating the videocasts for various activities in a range of environments. In summary, videocasts are a powerful tool for educators, especially in higher education where student attendance and commitment can be volatile. Used efficiently, they can be perpetuating, save time and present academics with an opportunity to multitask. They can give students a flexible learning environment and support diverse learning styles.

Keywords: videocasts, podcasts, CAD, virtual learning environments.

1 INTRODUCTION

In September 2008, the international conference on Product Design and Engineering Education (see http://www.epde08.org) provided a platform for educators to share good practice in education. One particular theme to arise was the growing use of video in Product Design and Engineering Education. Traditional teaching methods in these fields have been based on delivered material in lecture or demonstration format, with supporting material in the form of written text, handouts, websites, books, articles, etc. Since the implementation of institutional intranets and Virtual Learning Environments (VLEs) such as Blackboard in the past 20 years, this material has been available electronically, albeit statically. Nowadays, with the exponential growth in hardware capabilities, Blackboard and similar VLEs are populated with diverse and dynamic media; blogs, wikis, animations, podcasts and now videocasts (video based podcasts) are all available as learning tools for students. In fact, streaming video is now accessible and available for academics to support their teaching and the student learning in delivery and assessment.

The recent boom in social networking and user-generated video based sites has meant that students are accustomed to and familiar with such high tech innovations. As such, some have expectations that these technologies will be available to complement their learning needs as they progress into higher education. Students are familiar with (some may say addicted to) sites such as YouTube and Facebook which are based on an interactive platform of shared dialogue, images and video. Recording, editing and publishing digital images and video is commonplace. Reusable digital media is also fast becoming the norm with the BBC's iPlayer, Sky's Plus box and Virgin's V+ box all a much slicker, faster and more user friendly version of the old VHS equivalent. The means through which we can access this

media has changed dramatically too. Portable devices such as iPods, Blackberrys and even standard mobile phones are able to play and replay video as well as audio in high quality. It often comes as a shock to new undergraduates when such technology is not embedded in the University curriculum since they are already accustomed to using it to complement their learning. In some cases students are already using blogs, wikis, podcasts and videocasts autonomously to complement and share their learning experiences through "how to" guides and reflective diaries. Often academics struggle to keep up to date with the technology that can surely complement their teaching methods by supporting students, enhancing the learning process and even saving them time. Despite this, the use of learning technologies, video and in particular videocasts in higher education is growing. They provide a means to potentially complement traditional teaching methods and enhancing the teaching and learning process.

2 LEARNING TECHNOLOGIES IN TEACHING

Academics and teachers find their time squeezed by increasing student numbers, administrative duties and expectations for research output. Other pressures such as the need to be in more than one place at a time, the occasional requirement to teach remotely, and the desire to minimise the need for repeated lectures for students who are absent or late also drive staff to seek complementary learning technologies. It is no surprise therefore that academics seek ways to optimise their contact time to improve the quality of teaching.

A wide variety of technologies are now available to support the learning of students that can also help to alleviate the workload for staff. Simply using Blackboard or an intranet as a posting board for lecture notes is now seen as a baseline provision for a course. Blogs can be a help to facilitate the reflective process for students. They provide staff with a real insight into how students think and feel about the material they are learning. Wikis, which are collaborative and editable web tools, are a powerful and flexible means for students to generate high quality reference material with support and guidance from a member of staff. Podcasts allow students to prepare for lectures by revisiting previous classes. They can also help students to organise their work better and provide an opportunity to catch up on classes that are missed. Podcasts are particularly useful in classes where commentary is the key ingredient. This includes field trips to museums, libraries, excavation sites or manufacturing facilities, where students can have access to complementary audio that will enrich the experience. Perhaps the most widely used application of podcasts is the weekly sound bite or the expert lecture on a particular topic. It is common for academics now to upload their lectures to iTunes for all to hear. Such a move to provide lectures as a public service has been a success for the community at large and also for the Universities who gain valuable exposure.

As a result of successful uptake of podcasts and with the considerable hardware and software developments in recent years, it didn't take long for podcasts to progress to videocasts. Covill *et al* recall that students appreciated the use of audio podcasts, but with their knowledge and awareness of online video technology they began to request videocasts too [1]. Video is particularly useful where a physical demonstration of some sort is being given. This is relevant for engineering and product design students in practical tasks where learning by doing is important. Covill *et al* [1] generate videocasts of electrical engineering and product design lectures, including the slideshows, audio and a picture in picture application that uses a webcam to capture whiteboard use for adding notes and deriving equations.

Outside of the lecture theatre, a video can also help in the studio or workshop where it can be difficult for students to gather around the teacher, observe and take notes. Hills [2] developed a film to demonstrate physical model making skills so that students could revisit the demonstration in their own time through the Blackboard VLE. "The most valuable benefit appears to be the availability and ability to replay" [2]. Students also benefitted from detail in the video. In a live demonstration, students at the back of a live class may find it difficult to see clearly what's happening, where the video provides an unobscured view of the demonstration.

Another practical skill to be demonstrated through video is sketching. Eggermont *et al* [3] have developed a DVD called "Basic Sketching" (Available from Pearson Custom Publishing) which introduces sketching techniques combining drawing methods from both engineering and fine art. By publishing the DVD and putting the material on the VLE, the authors aim to widen the participation levels to include all 750 first year students in the School of Engineering. At a less formal level, many people will post drawing videos on YouTube, which can supplement course-based resources.

Seventy level one and two students studying Product Design at the University of Brighton have been given access to a series of videos demonstrating a range of software packages with the aim to develop a repository of Re-usable Learning Objects (RLOs). Demonstrations of various Computer Aided Design (CAD) and other software packages (e.g Adobe Photoshop and Dreamweaver) have been developed and embedded in the VLE as shown in Figures 1 & 2 which show the link to a series of videos and also the video embedded in the browser. The demonstrations include simple introductory tours of the packages, including the layout, typical strategies, various capabilities and sample models from the packages. Demonstrations have also been developed for generic software packages such as MS Office, including "how to" demonstrations focusing on particular tools, such as generating a graph in excel, animating slideshows and using spreadsheets. Overall, students responded well to the videos but indicated that the live demonstration was still their preferred method of delivery since it provides an opportunity for questions and discussion [4]. Unfortunately though, this is not always possible, as one anonymous academic suggested: "If it weren't for videocasts, I wouldn't be able to teach my class and attend this conference".

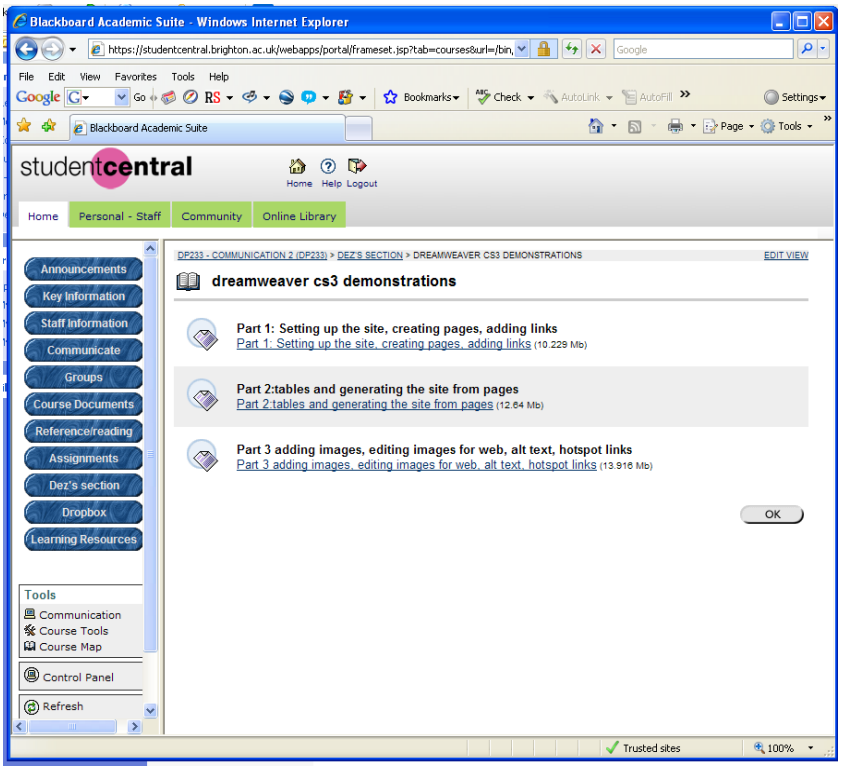

Figure 1. Links to the video split into 3 parts.

3 ALTERNATIVE USES FOR VIDEOCASTS

A novel use of video in product design education has been in the assessment of students' CAD work. The Product Design course at the University of Brighton has introduced an assessment task where students are required to submit a videocast of them generating a CAD model in addition to a portfolio of work [4]. The assessment provides the opportunity for richer feedback, since academics can assess the logic, knowledge and skill of the student as they discuss and develop their work rather than simply looking at the finished product. An important adjunct is the facility for students to then peer assess, to reinforce the learning and develop critical abilities. At a later stage in the course, professional techniques are tested by the use of a professional broadcast studio to record a live "pitch" as a simulation of a shopping channel or "Dragon's Den" scenario [5]. The students needed to demonstrate their ideas and keep control in a high anxiety context.

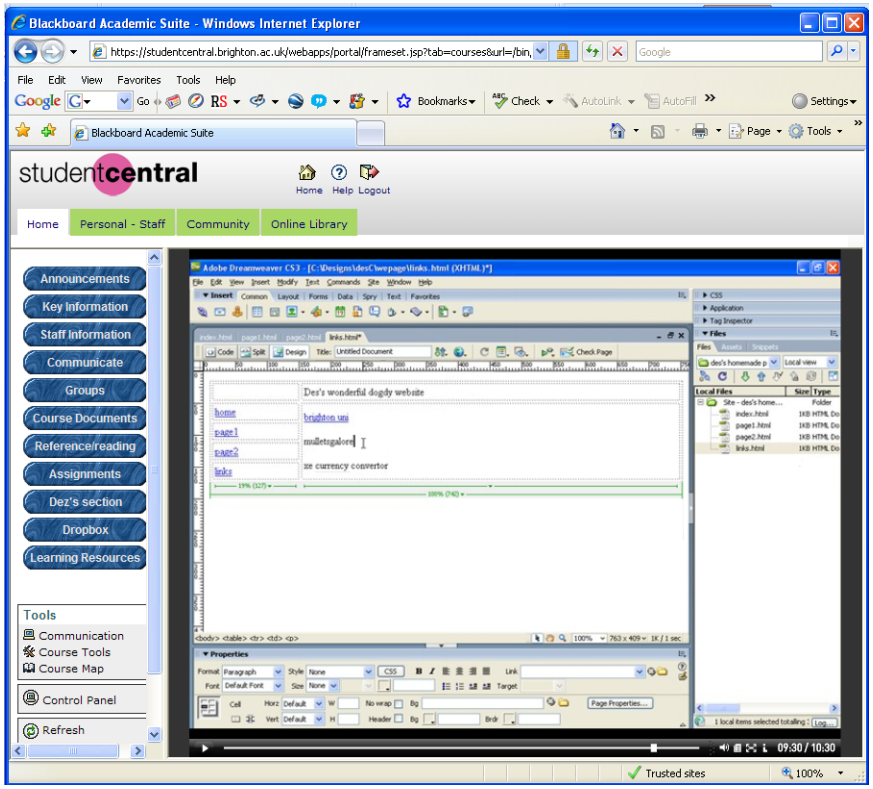

Figure 2. The video embedded in the internet browser.

The growing use of educational and instructional videocasts has also been mirrored by industry. Software companies, such as Solidworks and Simulia, have started using videocasts as a powerful marketing tool to promote the capabilities of their products. The videocasts, which are concise and well presented, also serve as an introduction to the products. In some instances, the demonstrations are tutorials showing novel or advanced tools about which the company wishes to boast. Videocasts are also being used extensively for in-house training of employees in much the same way that Universities are using them to train and educate students.

4 DISCUSSION

One thing that seems to emerge from student feedback is that video is viewed as a complementary source of material, not a replacement [4]. Although students respond well to the video material, allowing more flexible means of learning, they feel that the ability to ask questions and work “live” is the key to their learning. Students also have an interesting response to the videos that are generated by other students. Initially, students are reluctant to spend time watching videos from other students as they feel they aren’t as valuable to observe as those generated by the teacher. After an in-class peer review session however, students are more likely to see the value of learning from their peers as this also acts as a reflective learning process on their own work. This process can stimulate students by opening up different approaches, techniques and skills. It also helps them to realize there may not be a right and wrong answer for their approach to CAD. Some student comments included:

- “you can learn from others and if someone has a skill you find interesting you can learn and ask questions”
- “it's good to see something done from people’s personal perspectives and their different methods”
- “allows you to compare different techniques/ideas with your peers.”

One real limitation for generating videos is the shelf-life of software and in some cases hardware. Software is often upgraded annually, and this can cause real problems for creators of educational or instructional videos. In many cases, the software changes little with only additional features included in the updated version, however many software companies chose to update the interface and usability of the package as frequently as possible. If significant changes arise, reusing video from previous

versions may simply be a waste of time. However, there are ways in which these problems can be avoided, postponed or even turned into helpful tools:

- Generate video material that demonstrates version or even software independent skills, i.e. generic skills, tools and approaches rather than version/software specific details. It can also be possible to discuss how other packages/versions work and how these have developed in the past. This may also be insightful for future changes.
- Software upgrades are not compulsory every year. Although it can be disadvantageous to not upgrade every year (e.g. if significant changes are made to usability or significant new features are added), software can be updated every 2 or 3 years to allow for teaching and training material to last longer.
- Using outdated material can be useful for demonstrating advances in capabilities, usability, speed or even expansion of the software into new technologies. They can also be useful to identify areas of change in the software, where software companies are spending their efforts in order to improve their products. This can be a powerful prompt for a critical discussion on the development of software tools!

The authors have estimated that it takes approximately 13 weeks for the initial investment and subsequent effort to produce and upload videocasts to be break even with the time it would otherwise take to simply deliver the classes and respond to follow up efforts. This is based on a conservative estimate for follow up consultation (5 x 5 minutes) for students who were absent, late or who were unable to digest the material as it was delivered. It's based on 6 hours of training to use the software and hardware to generate, edit, produce and upload the videos each session. Finally, this is based on a two-hour contact period per week. More contact time will reduce the time to break even, while less contact time will lengthen it. Subsequent delivery would of course be more efficient, since no investment into training would be required.

In recent months, a cut-down version of the Camtasia software has become available on the market at a much-reduced price. The new version, Camtasia Relay is a start and stop piece of recording software with no editing capabilities. It is available as a site-wide license whereas the more elaborate Camtasia Studio was only available per seat, making Relay potentially accessible for all academics and teachers to use in their teaching to generate basic videos to complement their traditional teaching methods. There are of course alternatives to Camtasia Studio and Relay. These include: Windows Movie Maker and Adobe Premier for PC users and ScreenFlow and Final Cut Pro for the Mac OS. For video conferencing, presentations and meetings: Adobe Connect, Horizon Wimba, DimDim, Skype are available to name a few.

5 GUIDELINES FOR RECORDING AND PRODUCING VIDEOCASTS

A set of guidelines is presented below which may be helpful for teachers or students attempting to record demonstrations or presentations.

Preparing:

- Preparation and planning: prepare a "cheat sheet" with prompts for specific tools, features, dimensions or discursive points. Preparing a full written text to read from can seem less dynamic. A timed rehearsal is helpful and recording times should be kept within 10 minutes to avoid large production times and file sizes and keep the demonstrations punchy.
- Testing the software: it is recommended to test the software and the microphone prior to recording. Several students made recordings only to discover that the microphone recording volume was too low, necessitating a re-recording.
- Structure: A title slide helps to introduce the material covered in the video. If relevant, an image of the end product of the video also helps the audience to visualise what will be achieved in the session.

Recording, editing, producing:

- Voice, discussion and microphone: It is important to remain calm but to be enthusiastic. A prescriptive sequence of commands is not engaging for an audience. It is recommended to discuss around topics, and when demonstrating software to discuss the merits or pitfalls of a particular tool or approach and to compare with alternatives. Background and breathing noises in the microphone can be distracting and potentially painful for an audience. Lapel microphones are recommended to avoid audio that fades in and out.

- Mouse movements: It can be tempting to race through a demonstration, both in terms of speaking quickly and whizzing around the computer screen with a mouse. To avoid confusion of the audience it is recommended to make slow and purposeful movements with the mouse, avoiding unnecessary movements as these can be misleading and frustrating. A highlighted cursor and highlighted mouse clicks can be helpful to the audience.
- Resolution and frame rate: A resolution of 800 x 600 pixels will provide enough detail to recognise the mouse, toolbars and menus in the window whilst keeping the file size to a minimum and fitting into most screens. A free piece of software called Sizer allows window sizes to be adjusted, which can be helpful if specific window sizes are required. A frame rate between 1-5 frames per second is adequate for static recordings (e.g. PowerPoint presentation), while 15 frames per second is recommended for moving pictures (e.g. in software demonstrations).
- File sizes: File sizes are an important consideration for downloading and streaming videos, even when hosted in a high-speed LAN. Removing zooming and transition effects and using only 16 bit colour schemes can significantly reduce the size of the video without compromising the quality. A suitable alternative to zooming effects is using callouts or captions to draw attention to particular areas of the screen.
- Addressing questions: when recording live demonstrations or presentations and a question is raised by someone in the audience, it is suggested that the presenter repeat the question into the microphone since rarely will questions from the audience be audible in the recording. Questions during a live recording add value and substance to a potentially one-dimensional presentation.
- Finally: Have fun with this. It can be a daunting task for both students and teachers to record material in this way. Do not expect perfect videos, they simply don't exist!

5 CONCLUSIONS

Overall the potential for videocasts is growing ever more rapidly, opening up a new range of teaching resources that can be useful for students, teachers, academics and industry. Although the use of video in education is not a new concept, the idea of it being used on a mass scale to support, rather than replace, traditional teaching and to enable a more flexible and interactive learning environment for students is. It highlights the influence that technology now has on the education students receive and expect to receive for their money. From wide use of YouTube, and even in the professional media, where grainy phone-derived video can be part of a top news story, "quick and dirty" video is now much more acceptable. The real challenge now is for academics to buy into video, investing their time in the technology to improve the learning experience and make it work for everybody without worrying too much about their presentation. This may prove difficult, as the majority of academics are nervous of both the technology and the fact that their expertise may be recorded with less apparent editorial control than allowed by textual documents and formal papers.

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