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Audio and video podcasts of lectures for campus-based students: production and evaluation of student use

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Podcasting has become a popular medium for accessing and assimilating information and podcasts are increasingly being used to deliver audio recordings of lectures to campus-based students. This paper describes a simple, cost-effective and file size-efficient method for producing video podcasts combining lecture slides and audio without a requirement for any specialist software. The results from a pilot scheme delivering supplementary lecture materials as audio and video podcasts are also presented, including data on download patterns and responses to a survey of students on podcast use. These results reveal students' enthusiasm for podcast recordings of lecture materials and their primary use by students in revision and preparation for assessments. Survey responses also suggest little likely impact on lecture attendance as a consequence of podcasting, but indicate that podcast recordings of lectures may not be effective in facilitating mobile learning.

Introduction

A podcast is a media file that is distributed over the Internet for playback on personal computers (PCs) and portable media players. *Sensu stricto*, podcasting refers to the distribution of media files by syndication feeds, through which new files are automatically downloaded to subscribers, but media files downloaded manually from the Internet are also generally referred to as podcasts. The term 'podcasting' derives from Apple's iPod portable music player and was first proposed by journalist Ben Hammersley on 12 February 2004 to describe listening to audio files on a portable media player (Hammersley, 2004), although the technology for producing and distributing such recordings has been available since 2001 (Ulmer, 2006).

Podcasts have become a popular medium for the dissemination of audio and video content in music, entertainment and news. Between 28 September 2004 and 28 September 2005, the number of webpages found by the Google search engine containing the term 'podcasts'

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increased from 24 hits to more than 100 million (Searls, 2005). Consequently, the New Oxford American Dictionary chose 'podcasting' as its Word of the Year for 2005 (Olanoff, 2006).

Podcasts offer obvious opportunities for distance learning, but several universities are using podcasts to deliver supplementary lecture materials for campus-based students, extending the trend of using e-learning to improve learning performance in this context (Concannon *et al.*, 2005). This use also recognises the differences between 'distance education' and 'e-learning' (Guri-Rosenblit, 2005). Both applications, however, may ultimately have goals of enabling mobile learning ('m-learning'), through which students access course materials at their convenience through portable devices (Landers, 2002).

In the context of educational podcasting for campus-based students, Duke University issued iPods to more than 1600 new undergraduate students in August 2004 to record lectures and receive other course content (Belanger, 2005). In January 2006, Apple launched 'iTunes U', a software package for US universities to manage and deliver podcast materials, which is now being used by institutions including Berkeley, Stanford, Harvard, Penn State and Michigan State University. In the UK, first-year microbiology lectures at the University of Bradford have been delivered only as audio podcasts (Stothart, 2006) and the University of Leicester has also made recordings of lectures available as audio podcasts (Tysome, 2006).

The most common use of podcasting at present in the context of campus-based students involves instructors distributing podcast recordings of lectures for students to review and revise afterwards, given the relative ease of generating such podcast content (Laing *et al.*, 2006). This may be considered an extension of the now-common practice of providing electronic versions of slides used in lectures, either as PowerPoint files or pdf handouts. But do students consider podcasts of lectures to be useful resources? And if so, how and for what educational purposes do they use them? Here I describe (1) a simple, cost-effective and file size-efficient method for producing audio and video podcast content and (2) the results of an experiment using these formats to deliver supplementary lecture materials, including a survey of students' use of these resources.

Methodology

During the first semester of 2006/7, I produced audio and video podcasts of 18 lectures for two first-year undergraduate and two fourth-year undergraduate/Masters-level marine science courses at the University of Southampton (Table 1). The podcasts were made available to students via the Blackboard Academic Suite (http://www.blackboard.com), an online resource management system that enables capture of data on the number of downloads and their pattern in time. At the end of the semester, students were also invited to complete an online survey on podcast use, administered anonymously through Blackboard.

Producing audio and video podcasts

Digital media players with audio recording capability are now available at low cost. A 1-Gb MP3 player can record more than 40 hours of audio at a quality comparable to a dictaphone. Producing audio podcasts of lectures is therefore very simple: the lecturer wears an MP3 player around his/her neck to record the lecture audio. This is usually recorded as a WAV file, which

Table 1. Summary of podcasts produced and downloads during the first semester 2006/7

		Audio podcasts		Video podcasts		
Course	Material	No. of downloads	No. of students downloading	No. of downloads	No. of students downloading	Class size
SOES1003	'Introduction to scientific writing' (1 lecture)	532	119 (68% of class)	256	86 (49% of class)	176
SOES1008	'Earliest signs of life' and 'Origins of life' (2 lectures)	281	125 (51% of class)	182	94 (40% of class)	234
SOES6008	'Reproduction at vents and seeps' (1 lecture)	248	40 (100% of class)	81	33 (83% of class)	40
SOES6018	MSc key skills lectures (14 lectures)	1118	21 (66% of class)	1037	20 (63% of class)	32

can be transferred to a PC and converted to the MP3 format that has become the standard for portable media players. Reducing the bit rate of the audio during the MP3 conversion can reduce file size; while 128 kb per second represents CD-quality for music files, 16 kb per second is adequate for voice recordings. The average file size for an audio podcast of a 45-minute lecture in this experiment was 8.7 Mb; this compares with a typical 4 Mb file size for a 4-minute MP3 music track.

Educational use of video podcasts is much less common than audio podcasting of lectures, despite the learning benefits of video materials (Fill & Ottewill, 2006). One of the barriers to video podcasting of lecture materials is their production. Although software packages (e.g. Microsoft Producer) are available that combine PowerPoint slides, lecture audio and video of the presenter, these may have several disadvantages: (1) they require a video camera to film the presenter, in addition to the microphone recording the lecture audio; (2) their file formats are not generally supported by portable media players; (3) the file sizes are typically very large (intended for distribution of presentations on CD or DVD) and therefore less suitable for dissemination via the Internet.

In most educational contexts, however, video of the presenter is generally less important than video of their lecture slides. If video of the presenter is not required, then it is possible to produce video podcasts combining lecture audio and slides using applications included as standard with the Microsoft Windows operating system. First, each lecture slide, for example in Microsoft PowerPoint, is converted to a JPEG digital image by playing the presentation in full-screen mode and pressing 'Print Screen' twice when each slide is displayed. This copies an image of the screen to the Windows clipboard. This image can then be pasted into a graphics package, such as the Paint application supplied with Microsoft Windows XP, and saved in JPEG format.

The JPEG images of the slides are then imported into Windows MovieMaker, which is also supplied as part of Microsoft Windows XP, along with the MP3 file containing the lecture audio. The slides and lecture audio are then synchronised manually on the movie timeline. This is the most time-intensive step in the process, but overall a lecture can be converted into a video podcast in no more time than it took to deliver the actual lecture.

Choice of file format for the final video file greatly influences file size and is therefore a compromise between video quality and ease of download. Two factors are crucial in determining file size: frame rate and frame resolution. As slides do not change frequently during a lecture, the lowest possible frame rate is usually desirable. The video podcasts used in the experiment here were produced in Windows Media Video format at a resolution of 320 × 160 pixels and a frame rate of 15 frames per second. The Windows Media Video format, which uses a WMV file extension, can be played on any Windows PC. Many video-enabled portable media players are also capable of converting this format to their required formats for playback. The average file size for a video podcast of a 45-minute lecture, typically containing around 40 slides, was 13.7 Mb in this experiment (57% larger than the average size for audio podcasts). The maximum file size produced was 20.3 Mb for a video podcast of one double lecture.

Survey details

Having produced audio and video podcasts of lectures and tracked their download data, I conducted an online survey on student use of podcasts. As an incentive to participate, students were invited to enter their student ID numbers into a draw for a 2 Gb memory stick/MP3 player. These student ID numbers were removed from the survey data to ensure anonymity of responses.

The survey consisted of 35 questions in four sections. The first section collected data about the student (their year of study, access to a PC, ownership of a portable media player, any specific learning needs). The second and third sections examined their download and use of audio and video podcasts, respectively. The final section captured their general comments on the educational use of podcast materials, such as their potential for time-shifting learning activities, m-learning outcomes and likely impact on lecture attendance.

Results

Download data

The Blackboard online resource management system recorded more than 80% of students overall downloading the audio podcasts on the modules where they were available (Table 1). Take-up of video podcasts was slightly lower than audio podcasts, at 61% overall. Take-up of podcast materials was higher among fourth-year undergraduate and MSc students (e.g. SOES6008—100% audio, 83% video; class size 40) compared to first-year students (e.g. SOES1008—51% audio, 40% video; class size 234). Students downloaded podcasts multiple times; in total there were 2179 downloads of audio podcasts and 1556 downloads of video podcasts during the semester. The average number of downloads per lecture per student was comparable between the different courses (e.g. SOES6018: 1118 downloads/14 lectures/21 students = 3.8 downloads per lecture per student; cf. SOES1003: 532 downloads/1 lecture/119 students = 4.5 downloads per lecture per student).

Patterns of downloads in time show clear peaks immediately after the podcasts were made available, followed by sustained low-level download activity throughout the semester and additional peaks immediately before exams or assessments (Figure 1). Download times show an expected diurnal pattern, with download activity peaking in late afternoon (Figure 2A), although

6% of downloads occurred between 11 p.m. and 4 a.m., consistent with studies indicating a lag in the rhythm of body clocks at the end of adolescence (Roenneberg *et al.*, 2004). Data on day of download show a lower level of download activity at weekends (Figure 2B).

Survey results

Eighty-four students out of 283 taking the modules with podcasts completed the online survey, producing a return rate of 30%. Fifty-two respondents were first-year undergraduates and 32 were fourth-year undergraduates or MSc students. Fifty-seven per cent of respondents had downloaded the audio podcasts, while 61% of respondents had downloaded the video podcasts.

All of the respondents had access to a PC at home or in their hall of residence, while 74% also owned portable media players. Only 14% of portable media players owned by respondents had video capability, however. Among these players, MP4 was the most commonly supported video format. Video podcasts intended for mobile platforms should perhaps adopt this format, but clearly mobile video players are not yet common. Given the 100% availability of PCs at home/in student accommodation among respondents, the use of Windows Media Video format for video podcasts was vindicated as most suitable for playback on that platform.

Use of audio podcasts. Most (94%) of the respondents who downloaded the audio podcasts played them mostly on a PC, while 6% had not yet played them at the time of the survey after downloading. Most (87%) of those who played the audio podcasts referred to lecture notes when reviewing them, while a minority (13%) listened to them while doing other things. These included 'on a bus', 'packing before Christmas holidays', 'while on the Internet' and 'whilst relaxing before going to bed'.

Overall, the usefulness of the audio podcasts was rated at an average of 4.4 on a five-point Likert scale (where 1 = 'useless', 2 = 'less useful than traditional printed handouts', 3 = 'no more or less useful than traditional printed handouts', 4 = 'more useful than traditional printed handouts', 5 = 'very useful'; Figure 3A). MSc and fourth-year undergraduates rated the usefulness of the audio podcasts more highly (average score 4.6) than the first-year undergraduates (average score 4.3).

Use of video podcasts. Of the 51 respondents who downloaded video podcasts, all played them on a PC. The usefulness of the video podcasts was rated highly (average 4.7; Figure 3B) when compared to traditional printed handouts as lecture materials.

Of the 33 respondents who did not download the video podcasts, reasons for doing so included: already having the audio podcast (30%), not knowing what a video podcast was (12%), not having a video-capable portable media player (12%), large file size to download (12%), not being interested (6%) and technical problems (6%).

Student feedback on educational use of podcast materials

The most commonly indicated use of podcast materials was 'for revision/preparation for assessments', with 'to enable note-taking at own pace', 'to catch-up on missed lectures' and 'to have

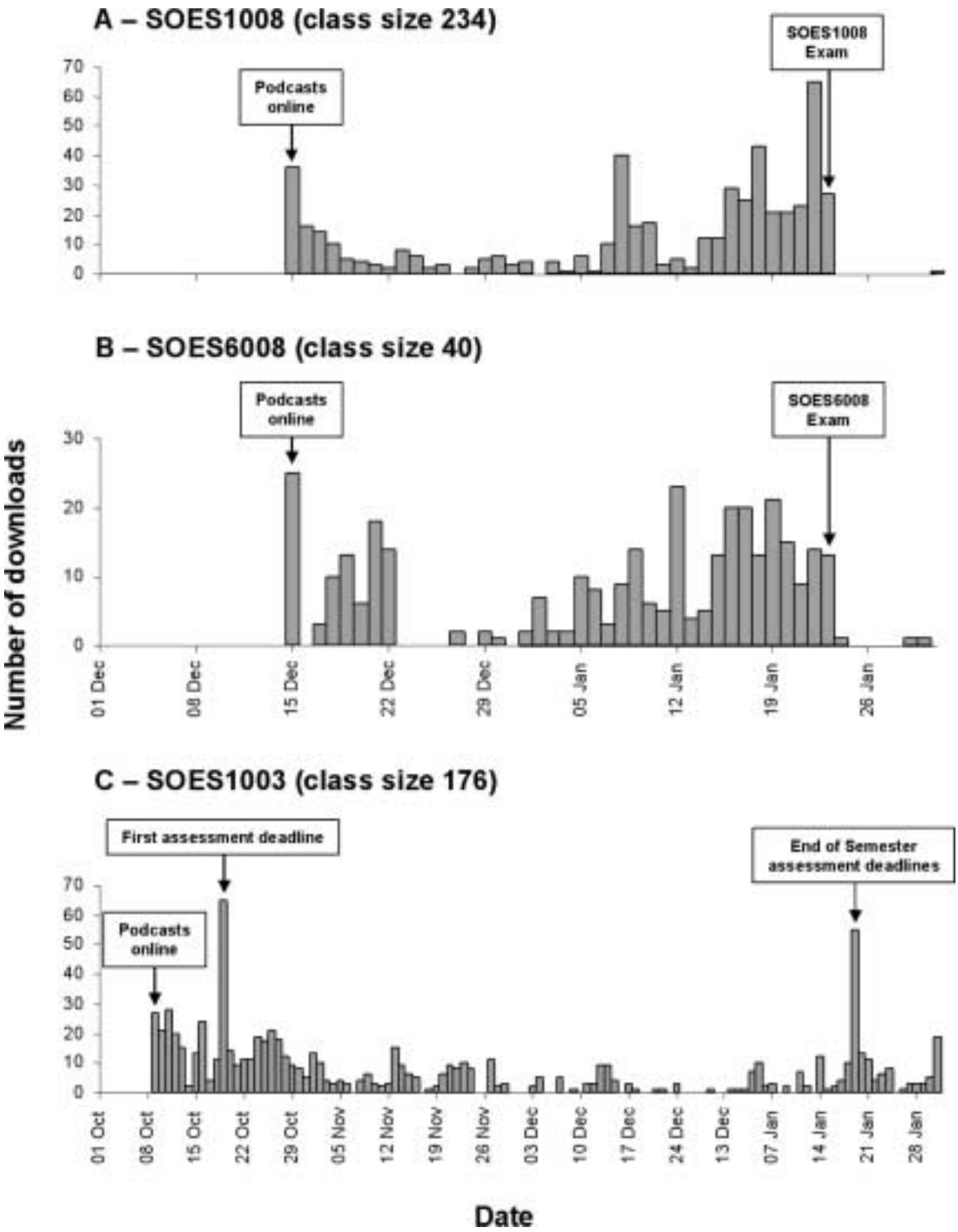

Figure 1. Daily frequency of podcast downloads during the first semester 2006/7

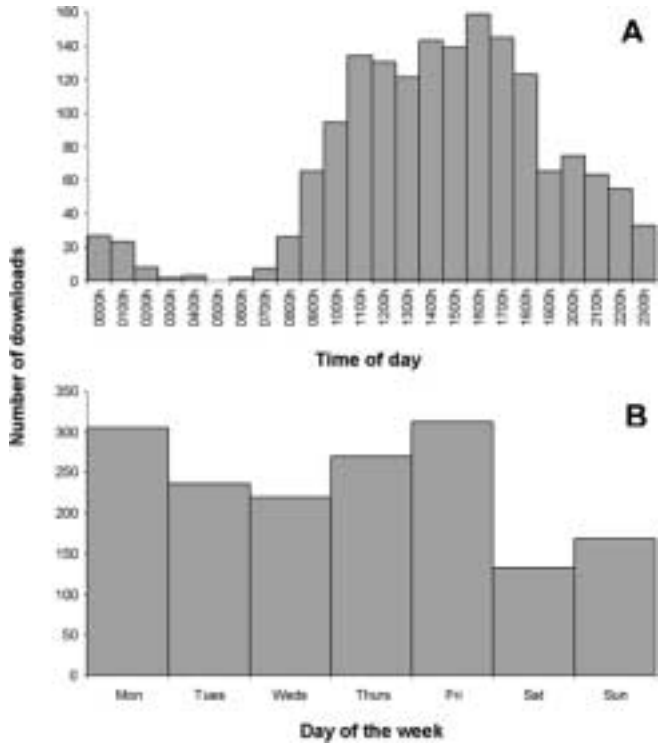

Figure 2. Frequency of podcast downloads (A) at different times of day and (B) on different days of the week

a complete record for own interest' also recorded at lower frequency (Figure 4). The use of the podcast materials for revision/to prepare for assessments is supported by their pattern of downloads during the semester, with peaks occurring immediately before examinations or deadlines for assessments relating to the podcast content (Figure 1).

There was an overall enthusiasm for podcast lecture materials, with 93% of survey respondents indicating that they would like to see more lecture material available in podcast form, including respondents who did not download podcasts during the experiment. In addition to having access to podcast records of lectures, 86% indicated that they would also like podcasting of supplementary 'stand-alone' materials, such as short revision summaries and briefings for assignments.

The majority of students surveyed selected video podcasts as their preferred format for supplementary lecture materials (Figure 5). Of those that stated video podcasts to be their preferred format, 91% chose 'provides a complete record of the lecture' as their reason. Among those who selected audio podcasts as their preferred format, 69% chose 'provides a complete record of the lecture' as their reason, with several commenting that audio alone is sufficient when combined with a handout of lecture slides. Fifteen per cent, however, gave 'smaller file to download' as their reason for preferring audio podcasts. Among those who stated traditional handouts to be their preferred format, 53% selected 'no technology required to review' as their reason and 7% chose 'smaller file to download'.

No data on lecture attendance were recorded during the podcast experiment, but only 12% of survey respondents suggested that having access to podcast records would increase their

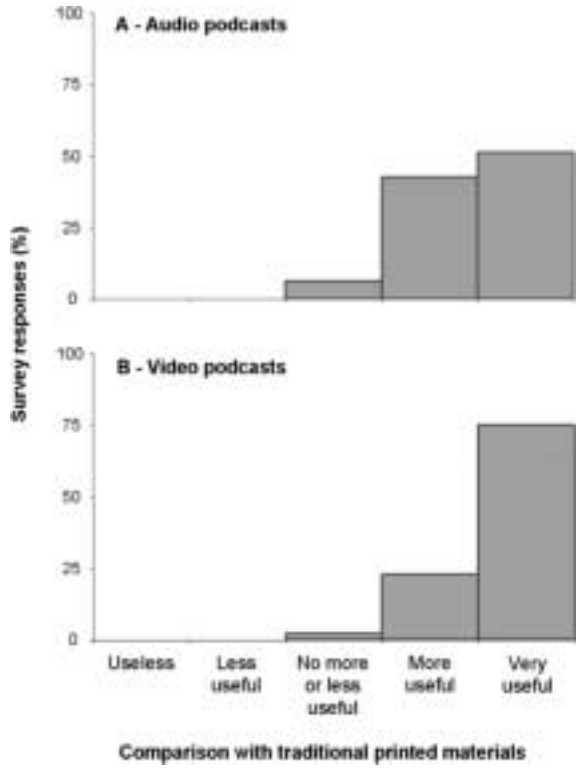

Figure 3. Student ratings of podcast usefulness compared to traditional printed materials on a five-point Likert scale for audio podcasts (n = 47) and video podcasts (n = 48)

likelihood of not attending lectures. The majority (57%) stated that podcasting would not reduce their attendance, while some (31%) indicated that any effect would depend on the lecture course. Students were invited to give their reasons for still attending lectures and the 25 responses received can be categorised as follows: need for routine or structured learning—20%; opportunities for interaction/questions at the lecture—40%; 'live' is simply better than pre-recorded—40%. Specific survey comments provided by students on this aspect are presented in Table 2. When asked whether they would like lectures for some courses to be delivered exclusively as podcasts, 27% responded affirmatively, if this resulted in more time for tutorials and small-group teaching.

At the end of the survey students were invited to offer general feedback on the educational use of podcasts. The responses received are presented in Table 3. Of the two negative comments, one notes that some diagrams on slides were not very clear in the video podcasts. This is a result of using a 320 × 160 image resolution to reduce the video file size. This limitation may therefore need to be considered in slide design in future, although traditional handouts of slides were also provided. The other negative comment ('I do not know what a podcast was or that they were available for download') suggests that greater explanation of this resource may be necessary, despite the podcasts being available in Blackboard alongside other course materials.

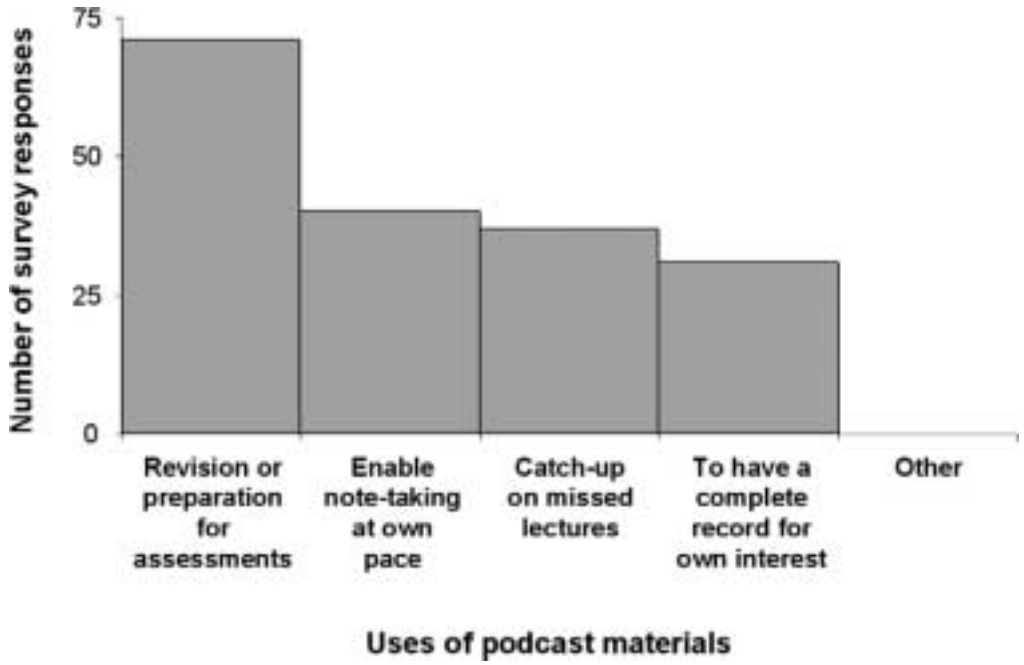

Figure 4. Students' responses describing their uses of podcast materials

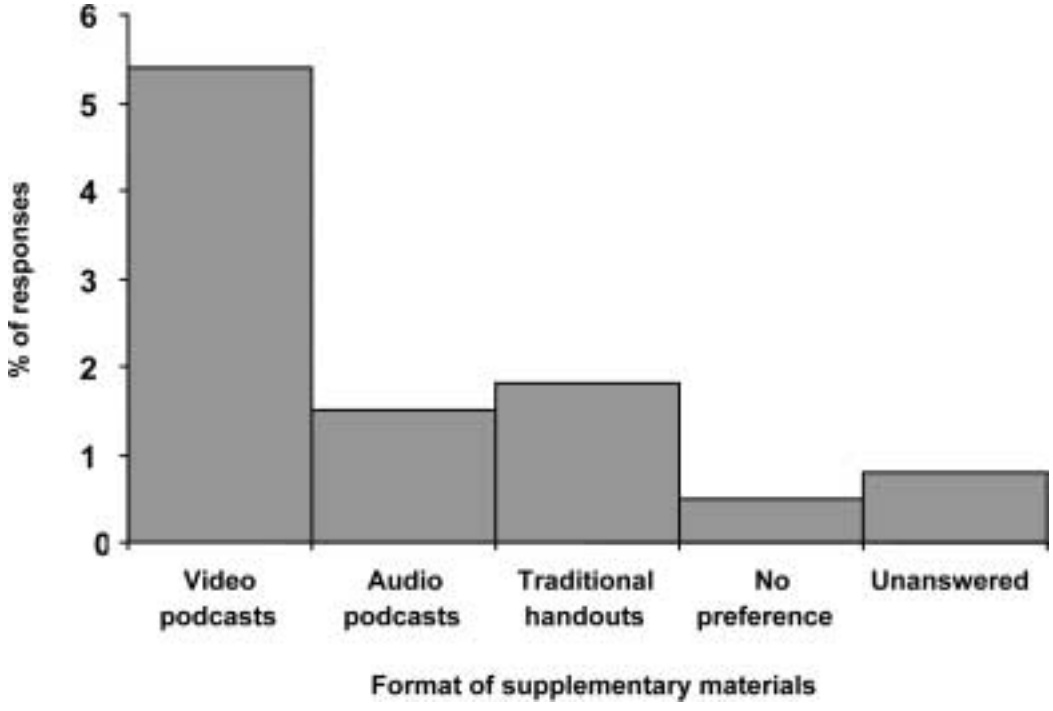

Figure 5. Students' responses indicating their preferred format for supplementary lecture materials (n = 84)

Table 2. Students' comments on attending lectures that are also available as podcasts

Q: Why would you still come to lectures if recordings were routinely available as podcasts?
Need for routine/structured learning:
• As a student you have to work to a routine
• I prefer going to a timetabled lecture, as I'd be more attentive, at home I would probably get lazy/distracted. Then use the podcast as a revision tool
• Because I think teaching from a lecturer actively working in oceanography is more interesting than sitting in your study where there are other distractions. Whilst the audio and video podcasts are great, they are no substitute to direct teaching from experts
• It takes just as much time to listen or watch/use a podcast as attending a lecture and I'm more likely to pay full attention in a lecture theatre
• Coming to the lecture and making notes helps me to better understand the material
Opportunities for interaction/questions at the lecture:
• Opportunity to interact with lecturer and peers
• Can ask questions
• In lectures we have the chance to discuss the subjects with the lecturer
• To ask questions about subjects I might be unclear on
• Because you can ask questions at lectures
• To make sure I understood it and if not ask the lecturer questions
• You can't ask a pre-recorded lecturer questions
• Opportunity to ask for clarification during lectures
• I have the option to ask the lecturer about anything I don't understand
• Because it is better to get the information straight from the horse's mouth as it were
'Live' is simply better than pre-recorded:
• If the lecturer is using lots of images/graphs, it may not always be obvious from the video podcasts what they might be talking about (they may be using a laser pointer to point at different areas to explain something)
• You get more out of being there in person
• Not having podcasts has not stopped me missing lectures in the past. It is better to go to the lecture because sometimes different parts of a slide need to be explained which cannot be portrayed by vidcast
• It is always better to see it first-hand
• I feel the information does come across better face-to-face
• Because I could attend the lectures and actually concentrate on the topic rather than frantically writing notes whilst the lecturer dictates. My understanding of topics that used podcasts is far greater than those without for this reason. If people decide not to come to lectures because of the podcasts then they are clearly not serious about their course. I don't think those who benefit from podcasts should suffer because lecturers feel they should not use them because they are worried about lecture attendance
• As things can be pointed out on slides during lectures and sometimes you concentrate more when the lecturer is talking to you rather than through speakers
• Always good to be in lectures and then use the podcasts to review the lecture and revise
• Best to be taught first then use the podcasts as revision aids
• I like to be there

Addressing the access agenda. Podcasts may be particularly useful to students with specific learning needs such as dyslexia or dyspraxia, who may require more time for note-taking, or those for whom English is not their first language. The survey described here produced limited data to explore these aspects, however. Six survey respondents disclosed specific learning needs registered with the University of Southampton Learning Differences Centre. Five of these

Table 3. Students' general comments on podcasting of lectures

Q: Please share any other comments or feedback on the podcasts
Positive comments
• An excellent revision tool that allows lecture notes to be filled in where there might be gaps
• Excellent idea, so helpful for revision. Would love to see other lecturers using them
• Podcasts are a really, really good idea. It helped to consolidate that lecture
• I used the vidcast to revise and found it extremely useful even though I was at the lecture too
• The only reason I didn't download any yet is because I attended most of the key skills lectures and only skipped ones where I knew the stuff already. I'd like to see this brought in for other courses as it's a great idea and would have been useful to go over explanations of tricky concepts
• So far most of the lectures that have been on podcasts I have not needed to review as the lecturers have been clear and the handouts have been good. In general the idea of having podcasts is good and a very useful resource
• Please please can we have podcasts for all lectures. It is a very important for those who miss lectures due to sickness, because it is impossible to get notes from another student that are comprehensive enough
• I thought this was an excellent idea, I found the podcasts really useful. They mean I can see the lecture more than once in my own time and at my own pace and therefore get a better understanding of the subject. I think podcasts should definitely be used more in future
• Brilliant for catching up
• I missed the lectures on Origins of Life due to illness. I found the video podcasts very useful as it allowed me to hear the lectures and make my own notes on the paper copy rather than relying on notes taken by someone else who was at the lecture
• If all the lectures are made into podcasts, I could study from a ski resort instead and just come back for assessments and boatwork. This would also cost less than to be at Uni, as a few flights/trains a year is much cheaper than living in halls/a house for a year
• Absolutely excellent idea, I missed the actual lecture and found the video podcast to be a great resource to catch up on the work I had missed
• Please introduce more of them, they are very useful for revision purposes
Negative comments
• Text size/resolution was a little low on the vodcast—not all clear, especially diagrams and graphs
• I don't know what a podcast was or that they were available for download

respondents downloaded and used the audio podcasts. Four of these students also downloaded and used the video podcasts. All of these students rated the podcasts as 'more useful than traditional handouts' or 'very useful'. Four out of the five indicated that they used the podcasts 'to enable note-taking at their own pace'.

Five students for whom English was not their first language responded to the survey. Four downloaded and used the video podcasts. Three also downloaded and used the audio podcasts. All of these students rated the podcasts as 'more useful than traditional handouts' or 'very useful'. Only one student in this group, however, indicated that they used the podcasts 'to enable note-taking at their own pace'.

Conclusions

This paper describes a method for producing audio and video podcast content and the results of an experiment in delivering supplementary lecture materials as podcasts. In the experiment,

the majority of students tried the podcasts and reported very positive experiences. There was a near-unanimous call for more materials to be delivered as podcasts, even from students who did not download them on this occasion. Reasons for students not downloading podcasts included the adequacy of other materials that were available, the ability to review traditional printed materials without additional technology and the larger sizes of podcast files. In very few cases, there were indications of possible IT training needs for students to access the podcasts.

All students who tried the podcast materials rated them to be at least as useful as traditional printed handouts. A majority of students indicated video podcasts to be their preferred format for supplementary lecture materials. Students found the podcasts to be most useful to revision or preparation for assessments, as indicated by survey results and patterns of downloads in time. The majority of students surveyed stated that having access to podcasts of lectures would not increase their likelihood of missing lectures, which is a common concern of academics considering whether to provide podcast records of lectures (Blaisdell, 2006). Reasons given by students for still attending lectures included opportunities for interaction and the need for a structured learning environment.

The enthusiasm of students for attending traditional lectures is supported by the minority (27%) of survey responses expressing a desire for some lectures to be available only as podcasts, rather than timetabled lectures. This appears to support the view of Laurillard (2002) that the success of learning technologies depends on embedding them in the existing learning context, even though delivering some lectures exclusively as podcasts could enable time-shifting of learning activities and provide more contact time for tutorials and small-group teaching.

Laing *et al.* (2006) stress the need for practitioners to consider the educational goals that they are trying to meet by using podcasts. The learning outcomes evidenced by the survey of students presented here include facilitating better revision and preparation for assessments, allowing students to engage with concepts during lectures rather than note-taking and providing opportunities for students to assimilate complex information at their own pace.

Very few students indicated that they used the podcasts in an m-learning context, reviewing their content while engaged in other tasks. Only two students out of 83 survey respondents indicated 'can review anytime, anywhere on MP3 player' as a benefit of the podcasts. Only 13% of survey respondents indicated that they reviewed the podcasts while doing something other than referring to lecture notes. Although few students (14%) owned portable media players capable of playing video, the majority (74%) had portable players capable of playing the audio podcasts. This suggests that podcast recordings of lectures, which are currently the most common form of educational podcasting at campus-based universities, may not specifically enable m-learning.

Using podcasts to meet the challenge of translating anytime, anywhere access into exemplary pedagogy, identified by Fallon (2002), requires materials that can be reviewed without reference to lecture notes, such as in a radio show format rather than a recording of lecture audio. Eighty-six per cent of survey respondents expressed a desire for such 'stand-alone' podcast materials, for example to provide briefings for assignments and revision summaries. Some academics might consider producing such materials to be an excessive addition to their workload, but the situation is perhaps analogous to producing PowerPoint slides in advance compared to using a blackboard and chalk. Producing these 'stand-alone' podcast materials should also not involve any more effort than producing printed briefings for assignments, or delivering a briefing 'live' to a class. To design and produce 'stand-alone' podcast materials, however, requires more sophisticated

media skills than most academics possess. This indicates a possible training need in this area if m-learning outcomes are to be realised through the use of podcast media in higher education.

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