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Application of Podcasting in Online Engineering Education*

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Applications of mobile technologies for engineering education can be found in the literature, but, many of the reported applications are aimed at the online (wirelessly), on-campus, synchronous and proximal use of mobile technologies. Mobile technologies in engineering education can encompass more than the proximal teaching and learning environment—they can be offline, asynchronous and at a distance from the classroom. This paper reports on the initial application of 'podcasting' in a wholly online engineering study unit. It presents the rationale for, technical development details of, and, limited evaluation of this initial podcasting trial.

Keywords: Podcasting; asynchronous delivery; distance education

ROLE OF MOBILE TECHNOLOGIES

USE OF 'POCKET PC' PDAs for students to wireless access educational material and then follow along manually with examples being presented in the classroom has been reported by Perry and Jacob [1]. Further, as part of a wider educational multimedia development, Burleson, Thampuran and Ramaswamy report on the development of online course materials for delivery to handheld devices (PDAs and tablet computers), and, a system for delivery of multimedia content to students via phones, pagers, PDAs, laptop computers, etc. [2]. Avanzato reports on an application where second-year students in an engineering course were provided with a Palm PDA for collaborative learning activities in the classroom and laboratory [3]. Alford and Hill report on an application where all students were required to purchase a PDA for use in their studies [4]. Deneen reports that the College of Science and Engineering at University of Minnesota Duluth requires all commencing students to have a PDA device [5]. Not surprisingly, many of the initially reported applications of mobile computing in engineering education are from courses in electrical, electronic and computer engineering.

In the wider education literature there are also other examples of mobile technology. Sharples describes the use of a pen tablet computer with camera, phone, wireless LAN and software for use by primary school children [6]. In Japan, where the rate of student ownership of video-capable mobile phones is high, Thornton and Houser describe two applications; English vocabulary lessons delivered to students' mobile phones by text-based mobile e-mail; and the use by students of mobile phones to access video animations explaining English idioms [7]. McKeown reports on the application of tablet PCs combined with wireless networking in an introductory Visual Basic programming course [8].

It is noted that, while mobile technologies have the potential to support education, their uncontrolled use in the classroom (mobile phones, gaming devices, etc.) can also be disruptive to learning [6]. Even 'sanctioned' mobile devices can cause problems in class where students get 'lost' in the new technology, or, find the ability to surf the web, check their e-mail or chat wirelessly online more tempting than the formal classroom activities [8]. While there may be an immediate reaction to attempt to ban certain types of mobile devices, educators need to take a wider view and see student ownership and use of these devices as an educational opportunity [9]. Many students now come to education with multiple literacies beyond text, and, rather than ignoring these new literacies, educators should acknowledge them and investigate the opportunities they present for enhanced student learning, albeit, premised on a more learner-centred pedagogy than was perhaps the case in the past.

Many of the reported applications of mobile technology in education are aimed at the online(-wireless), on-campus, synchronous and proximal use of mobile technologies (laptop computers, tablet computers and personal digital assistants (PDAs)) in the classroom and/or laboratory. However, there is a growing number of engineering students who spend limited time in these learning environments and might benefit from other approaches to the application of mobile technology in engineering education.

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ENGINEERING STUDY BEYOND THE CLASSROOM

Full-time, on-campus students may be the most immediately prominent group in undergraduate engineering education; however, when the full spectrum of engineering education is considered, there is another important group of engineering students (off-campus students) [10] who, while being likely to spend a significant amount of time online [11], spend little or no time in the classroom (due to work and/or family and/or geography) [12], but, like their conventional on-campus counterparts, could benefit from the application of mobile technology in their continuing engineering studies [13, 14].

In addition, the distinction between on-campus and off-campus students is no longer as clear cut as it once was. There are many on-campus/full-time students who spend limited time on-campus. In many countries, a decline in state support of higher education has been paralleled by an increase in student term-term employment [15–17]. The reported average hours per week of term-time student employment varies, but, is significant. In Australia, recent surveys have shown that 70 per cent of undergraduate students work, and, that the average hours per week of paid employment is about 14.5 [18, 19]. Similar results are reported in other countries [20, 21]. For these students, study is but one element of their life that has to be juggled with paid work, relationships, leisure and other activities.

As lifelong learning (and postgraduate study while employed) becomes the norm in all professions, as the costs of education rise requiring more 'full-time' students to seek term-time employment, as society becomes more 'mobile' [22], and, as the 'net generation' (who are less accepting of traditional educational norms of 'classroom' and 'class participation') become the main undergraduate student body [23], there will be an increasing need to look beyond the classroom and use technology to open up informal learning arenas [24] and facilitate student learning around and within their other activities [25]. As computers (and related communications technologies) move from being static office machines to being 'personal, invisible and pervasive' [26], applications of mobile technologies in education are likely to become increasingly important [4].

PODCASTING IN EDUCATION

There are now many electronic devices supporting multimedia technology that extend far beyond what is conventionally referred to as a 'computer' [23]. A form of mobile computing technology that is quickly becoming popular and widespread amongst many students is the digital audio 'pod' [27]. Named after the Apple 'iPod', generically, a pod is a device for the mobile playback of MP3 and/or other format audio files. MP3 refers to the file extension commonly given to audio files encoded using the Moving Picture Experts Group (MPEG) audio layer 3 compression standard. Initially, this audio content was primarily music, but, non-music content is now growing, with many radio stations offering archived 'podcasts' of popular programs for download after being broadcast on-air. It is estimated that there are 25 million MP3 players in use, and that the same number of people listen to MP3 files on their personal computers [28]. While digital audio files can be played on a range of computer hardware, and have a natural application in areas such as language studies [7, 23, 27], the compactness, mobility and growing ubiquity of pod devices, and a small, but growing body of educational audio material has led to the recognition of the educational potential of podcasting [28].

Podcasting allows existing educational audio content to be made more widely available to students, as well as allowing educators to develop custom audio content. Similar to radio programme archives, it allows 'time-shifting' of lectures and other instructional material [28]. It provides an additional (audio) channel for the provision of course material and/or supplementary explanation [29]. It may provide additional educational benefits to students who have a preference for auditory learning, for those with sight and/or auditory impairment who rely on audio technology, and, may assist non-native speakers [9]. Experiments in language education suggest that podcasting has the potential to 'foster a more seamless integration of in-class and out-of-class activity' [23]. While digital video production may be beyond the reach of many educators, there are many low-cost or free software packages that make it comparatively quick and easy for educators to develop their own digital audio resources [27]. Capturing suitable educational audio content can be done 'live' during on-campus lectures, or, offline in just about any location with suitable recording equipment. MP3 audio files can then be made available for students to download from the Internet.

It is reported that Stanford University, via the Apple iTunes online music store website, is planning to make lectures and other content available free of charge to the public. In addition, a restricted access iTunes website will enable Stanford students to download course lectures and other audio content [29]. The same source indicates that Stanford is not the first US university to offer course-related audio material via the iTunes online music store website. The continual development and convergence of computer and communication technologies is blurring the nature of podcasting—most new mobile telephones support MP3 playback [28], and, related mobile computing devices such as PDAs also support playback of MP3 files [30]. Some newer model pods also support video playback [9], as do many current PDA-type devices [1]. While currently only intending to offer audio

content, Stanford University is expecting to eventually offer educational video content to take advantage of the video playback supported by new model iPods [29].

A WHOLLY ONLINE STUDY UNIT

In Australia, the Deakin University School of Engineering and Information Technology offers four-year Bachelor of Engineering (BE), Masters and Doctoral engineering programmes in flexible delivery mode. The undergraduate programmes are delivered on-campus, off-campus and offshore in Singapore and Malaysia (through twinning partner institutions). The BE programmes include an 'engineering management' stream, including the second-year study unit SEB221—Managing Industrial Organizations. This unit consists of four modules:

1. System concepts for engineers and technologists;
2. Managing people in organizations;
3. Manufacturing and the environment;
4. Occupational health and safety.

The first author has academic responsibility for the second module, Managing People in Organizations, which addresses the topics of:

a. Behaviour of people in organizations;
b. Designing and maintaining organizational structure;
c. Elements in human resource management;
d. Leadership and motivation;
e. Organizational change.

As part of a university-wide policy to expose students to experiences aimed at developing independent and lifelong learning skills, all Deakin University undergraduate programmes were required to contain at least one 'wholly online' unit from 2004 [31]. A wholly online unit is defined as one which will . . . have all teaching resources and undertake all teaching online including:

- All content (either commercial print-based textbooks or commercial e-texts may be used as supplementary material).
- All communication and interaction with students.
- Assignment submission and feedback . . .
- Each unit will have at least ONE session of interactive communication (synchronous, asynchronous, or both) between teacher and students online at least weekly or as established at the beginning of the course. Such interactive sessions will have an assessable component where appropriate.
- To ensure access for all students until bandwidth issues in Australia are addressed, additional resources such as video and audio will be provided on CD-ROMs for off-campus students where appropriate [32].

In short, a wholly online programme will have no formal face-to-face contact between students and academic staff, and, all interaction will take place online. For the BE courses, the unit selected for wholly online offer by the School of Engineering and Information Technology was SEB221. For the initial wholly online offering in semester two of 2005, the existing print-based off-campus study materials for SEB221 were converted for electronic delivery on CD-ROM and via the Internet. The conversion process included re-producing the text and sequence of the print course material in a structured hierarchy of hypertext mark-up language (HTML) web pages and scanning accompanying unit readings into Adobe portable document format (PDF) files. These materials were supplemented with new electronic resources, including converting some complex diagrams into short graphical animations including an explanatory voiceover, short digital video and audio clips related to the course material, and short video introductions to the overall unit and each module by the academic staff responsible. All of this material was sent to students on CD-ROM, and, minus the video material, was placed online using the existing University course management system (CMS) that provides a website for every study unit. The enrolment in SEB221 in semester two of 2005 was 149 students.

PODCASTING IN SEB221 SEMESTER TWO 2005

It is noted that podcasting can be used to replace online sessions where the material is suitable for audio-only delivery [9]. Rather than attempting to replace the existing online resources for the Managing People in Organizations module of SEB221, the first author recorded a series of four podcasts to supplement the existing electronic resources, and, to provide an alternative audio version of the formerly weekly on-campus classroom lecture. These audio commentaries covered the same topic areas in a conversational manner, which would have notionally been previously covered in the classroom during the corresponding week of the academic semester. The podcast files were mounted on the unit website for students to download.

The audio commentaries were recorded using a microphone, personal computer equipped with a sound card and the Ahead Software Wave Edit program. Based on the fact that the audio material would be a single spoken voice, the audio was recorded as monaural (single channel) 16 bit samples at a sampling rate of 22.1 Kilohertz. This provided a high quality digital audio source file archive, while keeping the file size comparatively small. Once recorded, the audio track was edited on the computer to remove any unwanted background noise and breaks in the flow of the conversation. The resultant audio files were then

compressed using an MPEG layer 3 encoder to produce MP3 files. The encoding specification was:

- Monaural—as the original audio source was a single voice;
- Sampling rate 12 Kilohertz—most of the frequency content of normal human speech lies below 4 Kilohertz; sampling at equal or greater than twice this rate is required to avoid distortion;
- Encoding rate 18 Kilobits (constant)—the MP3 encoding rate was chosen to achieve a compact podcast file size.

In practice, the final sampling and encoding rates were the result of trials to empirically test the trade-off between playback voice quality and podcast file size. The duration of the podcast files ranged from 13.35 minutes to 18.00 minutes, and the file size ranged from 1.39 Megabytes to 2.06 Megabytes, yielding an average podcast file size of 0.124 Megabytes per minute of audio. Figure 1 outlines the steps involved in the production and use of the podcast files.

The first author did not have overall academic responsibility for the unit SEB221, and was unable to conduct a formal evaluation of the student perceptions of this initial podcasting trial. Every unit at Deakin University has an end-of-semester student evaluation of teaching and units (SETU) conducted by a central university administrative department, but, the results for semester two 2005 are not yet available, and, due to its general nature, this evaluation does not contain any question items specifically related to the podcasting trial. However, as the podcasting files were mounted/hosted on the university's online CMS, some basic usage statistics for the podcast pages were available. Of the 288 'components' (pages, files, URL links, announcements, discussions, etc.) identified in the CMS as associated with this study unit, the page containing the links to the podcast files was accessed 156 times, making it the 43rd (out of 288) most accessed component. Given that this page was located in the fourth level of the page hierarchy for this unit (see Figure 2), that places the audio files amongst the most accessed components, just behind the home page (where every session starts), many of the 26 second-level pages (which aggregate the detailed unit resources and typically have to be passed through frequently) and some other frequently-accessed pages, such as the unit online discussion area and the unit guide containing the unit assessment details.

On the basis of 'average time per visit' the page containing the links to the podcast files was ranked tenth (out of 288), behind a number of resources which are required to be viewed for extended periods, including the online discussion area, the unit guide and instructions for submitting assignments online. These results suggest that the podcast resources were given a relatively high priority/value by the class as a whole.

DISCUSSION/CONCLUSIONS

Mobile technologies offer a range of new potential affordances in education, including engineering education. Along with these affordances come potential disruptions, both in the conduct of the classroom and to long-held pedagogical views. Certainly, Stanford University, in planning to make lectures available in podcast format, propose to monitor the impact of this development on class attendance at the 'real thing' [29]. Like all technology, 'mobile technology' is in state of rapid change and constantly being redefined; forward planning for educational technology is a moving target [9]. Portable video, on pods, mobile phones, PDAs and perhaps other devices are likely to be commonplace in the near future, permitting video to accompany the audio in podcasts. When this happens, on-campus students with a lecture podcast option may well find this just as attractive as the real thing. It will certainly be of benefit to students who study off-campus or online, or otherwise are unable to attend synchronously on-campus.

In the Deakin University context, although there are large numbers of off-campus and off-shore students, and a significant enrolment each year that must study SEB221 in wholly online mode, the authors suspect that podcasting may not be taken up widely by academic staff generally. Most academic staff find themselves already required to

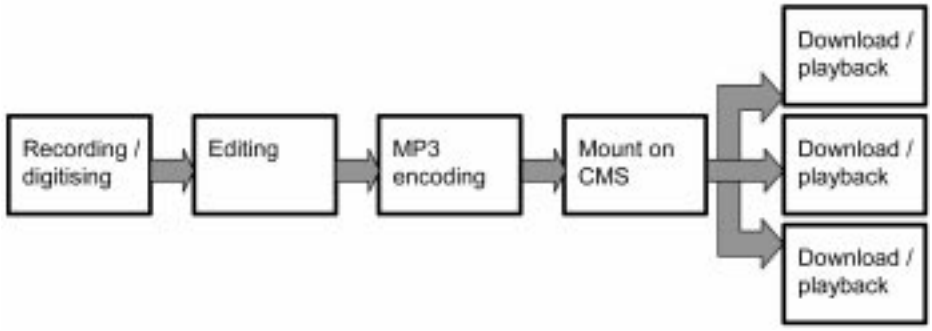

Fig. 1. Production process for podcast audio files.

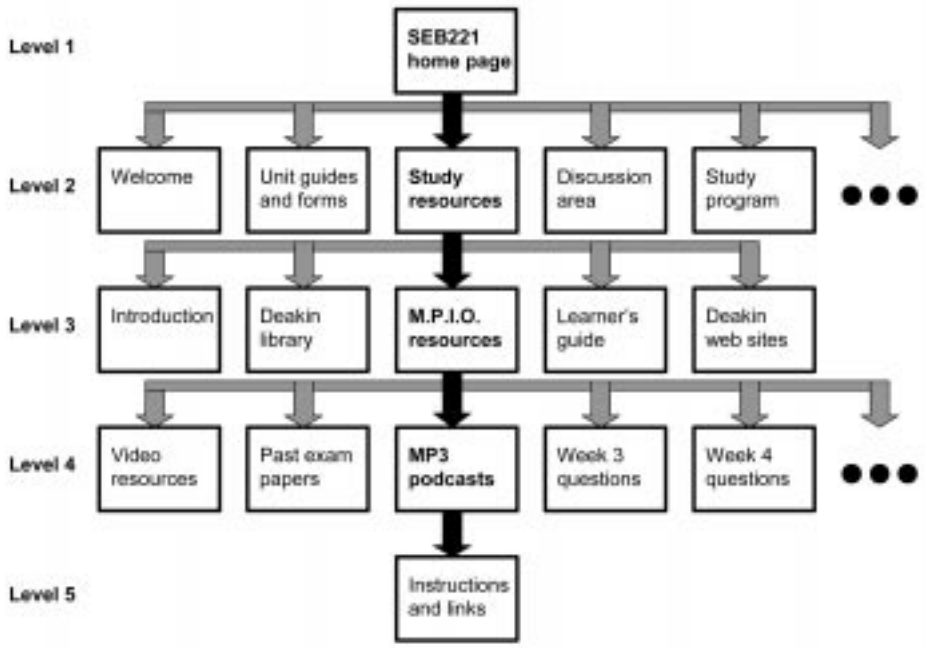

Fig. 2. Web page hierarchy for unit SEB221.

develop, deliver and support their units for on-campus, off-campus and off-shore students, and, must also provide a basic level of online support for all of these students. As each new mode of offer adds more to their academic workload, and the requirement for existing delivery modes is not removed, academic staff are likely to be reluctant to take on additional forms of presentation of their unit material voluntarily.

The limited quantitative evaluation that was possible indicates that the podcast files were popular with students, and, on this basis, can be considered successful. When the results of the semester two SETU central evaluation exercise for 2005 are released, they may provide some additional qualitative student feedback on this initial application of podcasting. The lack of a unit-specific evaluation of the podcasting trial means that it is not possible, at this stage, to know on what types of devices (pods, personal computers, PDAs, telephones, etc.) and with what frequency the students played the podcast files. The authors plan to conduct a future formal student evaluation of podcasting in a unit setting that is appropriate for this mobile technology, where podcasting resources can be employed across the duration of the entire unit, and where they have academic control of the unit conduct.

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