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Exploring Podcasting as Part of Campus-Based Teaching

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Abstract

The possibility of using the technologies associated with podcasting and MP3 players to augment campus based HE teaching is explored. A study demonstrating its use in five courses, and eliciting favourable learner attitude responses, is briefly reported. A range of educational applications, including and going beyond those demonstrated in the study, are suggested. The different functions entailed are identified: recording, distribution, and playback. The acceptability for each stakeholder group separately is discussed: learners, teachers, IT support. The technology's characteristics are assessed with respect to essential factors for widespread adoption: cost, ease of use (i.e. personal effort and learning costs for users), and educational benefit. The underlying technologies are briefly described, partly to indicate what the fundamental advantages are based on (independently of currently available products) and partly to allow likely longevity to be assessed. Finally some underlying principles from the viewpoint of educational research are proposed and discussed.

Keywords: podcasting, learner-led educational technology.

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Introduction

In 2005 it could be seen that a large proportion of students in the UK were carrying and using MP3 players (technically, highly portable digital audio players mainly used for music), and that the market leader was the Apple iPod, which as our and other surveys showed, was a highly desired object by non-owners as well as owners. Those with a knowledge of current computing science were aware that as well as outstanding design that appealed to young consumers, it was built on recent technological advances and represented early consumer exposure to their potential benefits: physically tiny hard discs for mass digital storage, the RSS protocol to support automatic updating for intermittently connected users, XML for passing around arbitrary multimedia objects. (The appendix gives some explanations for technical acronyms.) Those with an appreciation of Human Computer Interaction (HCI) knew that it was outstandingly easy to use compared to other music players, let alone to other technologies imposed by employers and teachers that require training courses. In addition, increasingly associated with this was the emergence of podcasts: typically a magazine format for audio recordings distributed on the web to "subscribers" and downloaded to MP3 players.

Could this new and emerging technology have an educational application? We decided to conduct a student research project in 2005-6 to explore this. By July 2006, Berkeley, Brown, Stanford, and Duke Universities in the USA had announced similar initiatives, as in the UK had a course at Bradford University, and a high school in Edinburgh. It was beginning to be discussed in the literature (Read, 2005). Thus this was a timely initiative.

The approach adopted in this paper is to start with a new technology popular with students and examine whether it might afford educational benefits. It thus argues from non-educational givens, through practical particulars, and on to ideas about general educational issues and benefits. That this technology is worth considering is first established by reporting a substantial pilot study, done as a final-year undergraduate project by one of the authors, in which it was deployed and favourably received by the students and staff. The rest of the paper then goes on to deal with numerous aspects all of which are relevant to a practitioner's decision on whether to adopt it. First its cost in effort and money is described from each type of participant's viewpoint (two types of student, lecturers, IT support). Next the different educational applications (e.g.

recording seminars) and their benefits are discussed. Next the underlying technologies are briefly introduced, since any serious adopter must consider whether they are fundamental, and how likely they are to persist even as particular products come and go. Finally some ideas are offered on what the most important underlying educational principles and ideas might be. One of these is that the technology is a better match than previous ones to the actual eclectic mix of media, and of planned and informal content, involved in many lectures. Furthermore, in contrast to the technology of printed books, it matches how courses usually have an adaptive, contingent aspect that evolves from week to week, and varies from year to year (as the educational theories of constructivism and situated cognition implicitly predict) as they respond to the particular cohort, i.e. learning community. In this respect, this technology may be productive for educational research as well as for teaching practice, because it draws attention to enduring yet seldom noticed (and so under-theorised) aspects of actual learning and teaching in supposedly traditional formats.

The study

Three lecturers and five courses, involving roughly 60 students (many taking more than one of the courses), in the 2005-6 session agreed to join the study. Lectures and seminars were recorded and distributed (some of which may be inspected at http://podlearn.arts.gla.ac.uk/, Maguire, 2006), and evaluations done based on staff and student opinions. All the equipment used was already owned by either the students or the university. Recordings were either done on iPods borrowed from students or on a Mac laptop a lecturer was bringing in any case. Podcasts were assembled using free software. Server space was provided by the lecturers' department. Playback was either on students' own MP3 players, or on desktop PCs such as those provided by the university for students, which are already configured to play such audio files through earphones. Recordings were made available in both podcast format (maximally convenient for those using iTunes and iPods), and in MP3 files (which can be downloaded like any other web file, and listened to on most PCs and many other MP3 players). In addition, some of the podcasts were "chaptered": in effect, hand indexed so that small portions of them dealing with a specific topic could be selected directly rather than having to listen to the whole recording.

A survey of a psychology class (otherwise not involved in the study) showed that half owned an MP3 player, and two fifths of these (20% of the class) owned an iPod. In the

classes involved in the main study (a mixture of philosophy and IT students), two thirds owned a player including 34% of the sample with an iPod.

Students were given questionnaires early in the courses, and late on. Though attempts at email-ed questionnaires received very poor response rates, those done in class got over a 90% response rate, although not all registered students were present on such occasions. Students in the study were asked before the recordings were made available "Do you think you would use such a service?", 81% of the replies being "yes". After the recordings were published, although before the main revision period, they were asked "Do you feel having [the recordings] is a benefit to learning?" and now 94% of the replies were "yes"; while 75% said they intended to use them. They were also asked to rate the usefulness of each type of available learning resource (on a 1 to 5 scale) (Brown et al. 1996). The recordings were rated less useful than the original lectures, more useful than the lecture slides, and of similar usefulness to their notes and to the course website. We may say therefore that students generally view such recordings as a useful addition (even more so after they have some experience of them).

The main weakness of the evaluation was due to the constraints of the student research project which had to be completed before the exams started, whereas from a research point of view, a better timing would be to interview students shortly after the end of exams asking them to look back on the course as a whole and talk about the relative role and utility of their learning resources from this viewpoint. The other weakness was the small number of open-ended measures, such as interviews, that would allow insight into what the issues were for various individuals. However the open-ended comments from five individuals (labelled a-e) from whom they were obtained may be summarised as follows.

a) Wouldn't use them because she went to all lectures, and organised revision around the PowerPoint files posted.
b) Thinks they are a good idea, and knows one person who did use them to catch up.
c) Did use them, and found it irritating that they were not all available [due to various technical hitches], and that they were posted late. That they wouldn't be useful for revision because they take too long to [re-]listen to.

d) Having originally thought they wouldn't be of value, in fact he immediately changed his approach in lectures and stopped taking notes in favour of concentrating on understanding their meaning, relying on the recordings to go back and take notes on anything he missed.
e) Didn't succeed in using the recordings because she left it until the last few days of revision to try them, and then some technical hitch prevented downloading (even though it worked for her in other cases). She thinks however that the recorded lectures wouldn't have helped her since she attended anyway, but that the recorded seminars would have been very useful since she couldn't take worthwhile notes there as well as participate. Nevertheless she thinks podcasting is a good idea, but that it is likely to take a long time for the habits of both students and staff to adjust to how to use the new resource optimally.

Since the original constrained study ended, the exam results on two of the courses greatly pleased the lecturer, although we are not in a position to draw strong conclusions from a well-matched comparison set of results.

Facets of podcasting as an educational resource

Introducing such a learning resource has numerous aspects, not only the different stakeholder viewpoints (staff, students, etc.), but the educational aspect, the technical, the different applications of the technology, and so on. All of them are relevant to the overall likelihood of developing potential educational worth and to the chances of widespread adoption. What is assessed here is a realistic vision for what can be done now, although the study only demonstrated and investigated part of this.

The commuting student (playing, downloading)

Significant numbers of students at many campus universities in the UK today face long daily commutes (e.g. from a parental home tens of miles from the university). They are particularly likely to have an audio player they use on these journeys. If this listening time could be given an educational value, this would be a considerable help to them in extracting more value from their day. These students are also more likely to have to spend time waiting on campus for their next scheduled activity, and again, something useful to listen to could be helpful.

Using iPod plus iTunes for this involves three tasks, each made very easy. Once the recording is on the player, the iPod user interface for playing audio is widely viewed as exceptionally easy. Downloading the latest recordings is effortless too, requiring zero button clicks. Simply plugging the iPod into an appropriately set up PC will simultaneously recharge its battery and download any new recordings linked to pre-subscribed podcasts. Thirdly, setting this up in the first place requires "subscribing" to the podcast associated with a given course: something that need be done only once for the course, using a particular URL. This at most only involves finding the right webpage and performing a few mouse clicks.

The local student (playing, downloading)

A student living close to campus might not use a personal player, but could use the university student computing clusters (or equally, their own PC in their residence). These are already standardly configured to allow playing to personal earpieces (so that others nearby are not disturbed). Downloading and playing essentially only involves clicking on the relevant file on a website associated with the course. The playback controls will be on screen. Identifying the webpage specifying the podcasts for the particular course and bookmarking it is simple enough and only need to be done once for each course.

The lecturer (recording)

After agreeing with the class to permit and support recording and distribution of audio recordings, the lecturer need do nothing at all. When the lecturer turns up, someone in the class with an iPod goes up to them, puts it into their pocket, connects a microphone, starts the recording. At the end, the owner will naturally remember to retrieve the iPod. The lecturer need arrange nothing, remember nothing. If one student fails to arrive on time, there will be others present also with an iPod. Thus there is no reliance on specially equipped teaching rooms, or booking technician services. Small group (seminar) teaching can (and in the study was) recorded as well as lectures in large rooms.

All iPods are equipped to record. However the slight snag in the sketch just given is that they do not come with microphones as standard (unlike laptops, which now usually do). iPod microphones are available cheaply, but students will not generally have them

without arrangement. A project to promote podcasting might buy a pool and arrange some lease/lend system. In fact the standard iPod microphone, which plugs into the body of the iPod, may be slightly less good than a lapel microphone for recording lectures, while for recording seminar discussions, a condenser microphone that sits on the table in the centre might be optimal.

The publisher (posting the recordings as downloads and podcasts)

A further step is required: copying the recording from the iPod or other recorder, converting it if necessary into different file formats, and posting these on the web either as simple sound files, or "wrapped" as podcasts. Rather like creating a simple web page, this is a few minutes' work for someone familiar with the task and who has the software tools to hand, and one that many students could do, but it is not a standard and pervasive student skill at the moment. (Even simpler, in a suitably set up virtual learning environment, VLE capable of generating its own RSS feeds, posting the file would be enough.) In the study, it was a service we provided to the classes.

There is also great potential at this point for adding value. Podcasts, unlike basic MP3 audio files, can be indexed or "chaptered". While this is of little value for a drama (which is why many novels today have no chapters), for reference and revision it adds great value to be able to jump to the portion dealing with a specific topic (which is why textbooks have both tables of contents, and indexes of keywords). For a lecture, ideally a recording would be indexed a) from the PowerPoint slides, so a student could look at a screenful of thumbnail images of the slides, click on one, and have the audio recording start to play from the corresponding point; b) from keywords chosen by staff or students e.g. "blindsight" or "false consciousness". This requires someone with an understanding of the content to go through the whole recording adding index points. Thus for each 50 minutes of recording, two hours of editorial work is typically required. On the other hand, only one person has to do this for all to benefit. It is therefore a natural opportunity for a class to divide up the work between them to provide a common enhanced revision resource. In the near future, it is probable that such editing could be offered on the web, and that students could offer multiple alternative indexing to each other. In the study, the researcher provided this service for some of the lectures recorded.

The ease with which both basic publishing and indexing/editing can be done is strongly dependent on the quality of the software tools available. This improved dramatically during the study. Currently there is free software (e.g. Apple ChapterTool, and Audacity) to make it moderately easy, and new software (iLife06) to make it very easy for a moderate cost. Still more cheap software is being released as we write that may make it even easier.

IT support

The basic playback facilities, both software and hardware, are typically already owned by students and the university. The server disk space for storing the sizeable audio files will require managing, but is largely available and affordable. The iTunes distribution software is free and available for both Mac and PC platforms, although there may be some concerns about the network traffic generated. The hardware and software for recording is already owned except, currently, for microphones for iPods. It should be easy to arrange for students and staff to be able to post (publish) recordings to servers without IT staff intervention, just as web pages may be published. Thus there will be some management and setup by IT support required, but should be no daily labour.

Educational applications of podcasting

While the first application of podcasting most people think of is to record lectures, in fact the most obvious added value to emerge from our study is recording seminars. Other applications are also promising.

Seminars

In our study, one course split the class into two groups, which had seminars at the same time in adjacent rooms with different staff members. Staff as well as students were very interested in hearing how the discussion had gone in the other group. Because seminars depend strongly on student contributions, there are no slides nor prepared "lecture notes": an audio recording is the only appropriate record to consult. Furthermore, as one interviewee pointed out, the skills of note-taking in lectures do not work in seminars except for non-participating "loafers" because the demands of

participation interfere with reflection and writing notes. Seminars may therefore be the single clearest added benefit of audio recordings for a course.

Lectures

Nevertheless our evaluation made clear that students like the idea, at least, of having recordings of lectures available, and a number used or tried to use them. On the other hand there is a long, if intermittent, history of recording lectures, and many experienced staff feel it has never proved worthwhile. What are the pros and cons, and is the situation any different now?

The most important new aspect to the situation is that it is now a lot cheaper and easier to make the recordings, to distribute them, and to replay them. Instead of needing technicians to attend to make the recording, library space to store them, and booking replay facilities in the library to listen to them, relatively little effort is needed to capture and distribute them, and students can then have them ready to hand either on their own personal equipment or on PCs provided across campus.

The greater efforts now made to support both deaf and foreign students also mean that the routine provision of recordings is now seen as more desirable too. If they are provided to all students, this also helps these groups of students to use only "normal" provisions, rather than having to label themselves as requiring special treatment.

However the actual impact and utility of recording lectures is likely to vary greatly from case to case. Detailed study of this should be a main focus of interest in any future studies. For example, if (for a given student) a lecturer delivers material at or above the limit of what they can process, then (as one interviewee noted) having a recording as backup allows the student to listen for understanding undistracted by the need to take notes on the spot. Indeed, it would become reasonable to add more content than would be intelligible at the time to the least able student in the room. Conversely, if for a given student the lecture is largely redundant with respect to their existing knowledge (e.g. they have read ahead in the textbook, or they covered this topic in an earlier course) then they do not need to attend just to make sure they don't miss one or two new points. Instead, they could play through the recording while travelling just to make sure. A different issue again is that quite often, lectures contain examples and illustrations that are not recorded in books or lecture slides or notes, but are more off

the cuff. The current common practice of making slides available to students usually misses this additional material. An audio recording may be the only record provided of these other than students' own notes. It is thus unlikely that there is any general answer to whether lecture recordings are useful or not. It will depend upon the style of that particular lecture, the study skills and habits of each individual student, how these two interact, and furthermore on whether the student has developed new practices that make use of such recordings. In addition, lecturers too may adapt their practice to the reliable provision of recordings. It seems likely however that significant benefit will often emerge.

Finally another historic objection to making recordings of lectures has been that if you go to that trouble, why not record the world's greatest expert on the subject so that all can share the best? Part of the answer to that is that the effort and cost of recording is now in effect a tiny part of what it was: it doesn't require exceptional value to justify it. The other part is that lectures as given are typically a personal communication to a particular group of learners at a particular moment. They are not addressed to the world, nor to posterity. Podcasting matches this aspect of fleeting timeliness, and its connection with a community of learners is discussed below. In other words, lectures in reality are often both social and adapted on the spot to the audience: podcasting captures these features, while published lecture notes and slides, and canned lectures from experts, do not.

Additional spoken material from lecturers

Podcasting is a new medium, and so offers new opportunities. In our study, one lecturer recorded a 15 minute address that was delivered only over this medium, rather than being a backup recording of a lecture. There is no need to stick to any particular conventional length such as 50 minutes. It can be used for revision advice or delivering something in a different tone or "voice". Many lecturers of course have got used to using email or other text postings for such "side channel" or irregular, supplementary communications. Now voice or video can also conveniently be used.

Gilly Salmon (personal communication) has observed a course where face to face lectures had to be replaced by written materials as the lecturer's administrative duties now prevent him from delivering it conventionally. However weekly podcasts by him have maintained the personal feeling of being in touch, and raised, not lowered, the

student ratings. These podcasts are not written in advance of the course (as lectures often are) but are created from scratch each week, dealing with current events and reactions on the course: so the feeling of being in touch stems from their contingent content.

Additional spoken material from students

We had a clear vision of this before the study began, but failed to create a convincing example. Listening to a lecture, an engaged student may feel like voicing objections and comments at many points, but this of course is socially inappropriate in a large group. Even if some lecturers would welcome at least some sign of interaction, there just isn't time for most of the audience to say anything at all. However if some of this kind of response could be captured, they could then be bundled into a podcast as a kind of radio magazine side channel accompanying the course. And like radio, this could be listened to in relatively idle moments, without the average quality having to be very high for it to be worth checking out.

In principle, short comments could be collected on iPods (with microphones) in corridors, while waiting for a lecture to begin, etc. In practice, there would need the right kind of social leadership among the students to set the tone, have the energy to do it (i.e. play the role of journalist), make it fun, and so make it happen.

Course handbooks on iPods

The newer iPods have a (tiny) video screen. This could be used to display in effect simplified web pages, navigated using the iPod controls. A selection of material from the course handbook could be distributed like this, e.g. contact details for key staff. Most useful might be a service that gave each student a personalised timetable for reference, allowed them to further edit it, and with software to speak it aloud as well as display on an iPod screen. iPods are not always connected (to the internet), but they are mobile and always with their owners. Thus having key reference information, without having to go somewhere to look it up, could be useful. This of course is much more useful to students (who don't have offices with always-on internet information connections, shelves of handbooks and directories, etc.) than to staff (who do).

Audio tours

During the study, a simplified demonstration was created of an audio tour of the library http://www.lib.gla.ac.uk/podcasts/index_podcasts.html (Glasgow University Library, 2006).This is being further developed currently. The idea is for a spoken set of instructions and explanations to be delivered from a podcast to earphones while the visitor walks round the building. The video capability of the newer iPods allows some still photos also to be displayed to help keep the visitor "in sync" with the tour commentary. The tour can be downloaded to the visitor's own iPod at the front desk, or an iPod could be loaned to them. In fact a set of related "tours" could be developed: audio only (for playing while the visitor is travelling to the library), podcast with still photos for use while actually in the building, desktop virtual reality (i.e. elaborate visual material) for remote introductions to the building and its facilities.

In fact it is not just the library, nor buildings, that could usefully be treated in this way. Simple tutorials on how to operate equipment might be delivered like this: photocopiers, lab equipment, how to operate the laminator in a resource room. The spoken voice may have advantages in learning to operate equipment, since the user's eyes may be occupied with the equipment, making reading a printed manual difficult to blend into the activity.

More generally, educationally, this is the domain of short instructional talks. Lectures make some sense when a large class all needs to hear the material at the same time. But when the information is best delivered at different times for different students, they become inefficient: if it is all done at one time, then students forget the words long before they have the opportunity to apply them, or else it is inefficient in staff time if the same material has to be delivered repeatedly to different groups. This is quite common in lab groups in many subjects. How to operate equipment or software are common examples. Podcasts may be a better medium for such cases than any existing one.

Podcast prospectuses

Because podcasts can be copied from player to player, as well as transmitted effortlessly around the world, they may be a good medium for recruiting applicants, particularly foreign students. Not only course prospectuses but campus tours and lab facilities could be presented in this way.

The underlying technologies

Phrases seen in the popular media such as "podcasting" and "MP3 players" are often taken both as tied to one manufacturer, and linked to fashion (and so may vanish at any time). Any investigation of educational potential needs to consider the likely long term prospects of any particular technology, the likely cost implications, and what the fundamental technological features are, as opposed to their current market manifestations. In fact the important formats related to podcasting are all open standards that multiple manufacturers support.

To a computer scientist, an iPod is just a miniature, and so highly portable, hard disk; just as a "pen drive" (i.e. a USB flash drive) is a portable, detachable semiconductor memory. To a user, it doesn't matter whether it conceals a spinning disk or a chip: mass memory has become both small and affordable, so it can be carried around in one's pocket yet contain so much information that not only some word processing files, but sizeable collections of audio and video can be carried. For a young consumer, this can mean carrying a very large music collection around in a device of similar size and weight to a cigarette packet. For education, it can mean that a collection of lecture recordings and printed documents can be carried in far less space and weight than a single paperback book or notepad. Currently it is the playback that limits mobility for educational devices. Hence audio that needs only tiny earphones, rather than text or video that require a relatively bulky screen, has the advantage.

Putting it all together, what does the currently popular, available and cheap combination of iPod and iTunes embody? (Each of the technologies and acronyms mentioned here are briefly explained in the appendix.)

- Audio recordings compressed in the AAC standard format.
- These are wrapped in XML which allows descriptions, indexes, and indeed text files to be transported with them and read by other software.
- Affordable miniaturised digital storage (either hard disk or semiconductor) that will carry large quantities of these in a very small, light, pocketable device.
- Miniature video screens allow both a text interface, and also pictures and video clips as well as audio to be presented on a truly portable player.

- The RSS mechanism allows these bundles to be distributed like a news service so that an intermittently connected mobile device can be synchronised with the latest set of current items without any user actions other than plugging it in periodically.

In the study described here, we mainly recorded on iPods (which used the .WAV (lossless) format for this). We published the recordings in both MP3 and AAC sound files and some, thirdly, in the M4A enhanced container file format with special indexing to support jumping into the recording at multiple labelled places. Additionally we published RSS feeds: creating the RSS files, putting these on view on our web page (where they could be used independently of iTunes), and also having them listed on the Apple podcasting site. These four file formats could all be manually downloaded from a web page, or picked up more automatically in podcasts. These formats can all be played by iPods and by QuickTime software which was installed on the existing university PCs for students (as well as on Macs), while the greater convenience of using podcasts for the distribution was available for those with (free) iTunes software installed on their PC or Mac, or in principle other aggregator software.

In the study, the lecturers were happy for their lectures to be available worldwide, and they were posted on the Apple iTunes website. However if the recordings were instead posted within a VLE, then access could be limited to course members.

Underlying principles

In assessing the meaning of podcasting and related new technologies for education, there are several underlying theoretical issues to explore.

Learner-led educational technology

The approach embodied in this project is remarkable for being one of learner-led educational technology. For a long time, and to a considerable extent still today, initiatives have been led by technology and by the technologists' view of what is good for learners. Despite often raising enthusiasm and money at least among policy makers, this has seldom led to lasting educational advances (Cuban, 1986, 2001). A remedy for that is pedagogically-led initiatives that begin not with the technology but with a real educational problem, which is then addressed (Draper, 1998). In contrast to

both of those strategies, here we began not from education, but by asking what modern technology already has a large niche in student everyday life, and then how it could be given an educational dimension. This is a new strategy for educational research and innovation. Whether it succeeds is still to be determined, ultimately by detailed measures of educational outcomes. However it has some inherent advantages: low barriers to student acceptance, and little additional cost since the equipment is already owned by students and/or the university.

The user interface

Another common barrier to uptake, even if educational benefit has been demonstrated, is the effort required by individuals (both students and staff) to operate the technology (which may appear as subjective nuisance value, training costs, learning costs, or the need for technical staff). As we detailed in earlier sections, for the three major functions of recording, distribution, and playback; and for the three stakeholder classes of students, lecturers, and IT support, the human costs range from low to negligible.

Paying attention to good user interface design and so lowering the usability costs of educational innovation is seldom done, particularly in technology-led innovation, and is another distinctive feature of this initiative. Another way of seeing this is that the lower the costs, not only explicitly financial but also of the hidden human time and effort, then the smaller does the educational benefit need to be to justify the innovation.

Furthermore there is a real prospect for what costs there are to be taken on by the cooperative action of each class of learners. Once the principle is agreed in general, and basic facilities and disk space made available, then if or when the students want recordings, they can make them themselves without any further special action by university staff, and if one student fails to turn up, then in any sizeable group someone else is likely to have an iPod with them. If the class wants well indexed recordings, then they can share the work among themselves, and jointly produce a superior revision resource. This is not only efficient and effective, and is likely to enhance the classes' integration as a group, but it is aligned with the essentially social nature of learning (cf. Illich, 1970; Brown, Collins and Duguid, 1989).

Match to existing practice

Another important aspect is that for the first time we have an educational technology that is a good match to the central activity of our teaching — lecturing — and seeks to get additional value from these occasions. Firstly, seminars can be conveniently recorded and distributed, whereas traditionally, they have not been captured and made available for review. Secondly, the podcasting mechanism allows bundling of the heterogeneous media used in practice in lectures: audio, handouts in PDF files, short videos, etc. This is in contrast to how earlier technologies (e.g. television) have tended to require rewriting lectures and retraining staff to accommodate the limitations of the medium: learning to stand still to make it easier for both cameraman and sound recordist, not using printed handouts because video resolution cannot present an A4 printed page legibly, so no complex diagrams can be used.

Educationally, this is about extracting more value from existing face to face practices in ways not previously possible or at least not normally done: not about new effort, new media, new authoring skills. It focuses around social interaction, not permanent expository products. It is "flexible" in that it allows learning activities while on the move, and at any place, any time; and relistening which is so important for foreign students, and all those whose understanding is slower than the lecturer's torrent of speech. Yet it is centred around synchronous activities (fixed in time, place, duration).

Timeliness and the synchronous nature of courses

That last point draws attention to the nature of learning in almost all courses (both campus and distance): they are loosely coupled but fundamentally synchronous. At a fine time scale of minutes, they are not synchronous: students read and think at different speeds, which is why "self-paced" materials are so important, and one reason that lectures are problematic (since the delivery can never be more than a poor approximation to the optimal pace for all the different people present). But at a larger scale of days, weeks, or months, learning is almost always synchronised for a whole group. Whether it is meetings every evening for a revision study group, weekly programming labs or seminars, fortnightly essays for a tutor, term papers, or end of year exams, learners and teachers come together at the same time at regular intervals, even though in between that solo study is essential. This is a pervasive pattern.

Furthermore, in general this loosely coupled, loosely synchronised activity is contingent: what happens at each meeting is often modified by what happened previously.

Podcasting matches all these features, and does so much better than a textbook or specially made video. It allows individuals to vary the time (and place) of listening, but has regular updates to keep them abreast of what is current in the course and its community. It doesn't expect the material to be prepared long in advance, but instead matches the way most courses evolve during delivery, in response both to the audience (which topics seem to need more time, different examples, etc.), and to the presenter (e.g. material dropped due to lack of time). This responsiveness is a feature, not a defect. The ready mechanism of progressive updates also matches and promotes a sense of community and interaction. If student discussions can be launched as part of the circulated material, then these would be further enhanced.

Again these features are not those of textbook publication by another medium: carefully authored, static, unresponsive to particular groups or individuals. Instead they are the mark of a community learning together (Illich, 1970; Brown, Collins and Duguid, 1989), responding to each other over time, within a limited time frame (a course). The periodic update and the sequence of broadcasts are a match to this, unlike simple, permanent, static postings to a web page. On the other hand it may be appropriate to have privacy controls so that a learning community doesn't have to consider an international internet audience looking over its shoulder, nor what it would sound like if listened to long after the course is over.

Conclusion

This paper presents a first study following a distinctive strategy of "learner-led education technology". It analyses what is now possible using the selected technology of podcasting from a variety of viewpoints, and reports on a first implementation and the favourable staff and student responses to it. We may say that its feasibility and promise are reasonably established, that initial attitudes are markedly favourable, but that objective educational benefit requires further and stronger investigation. Since the participating lecturers wish to continue their use of podcasting, besides strong interest being shown by others, we expect the work to continue. Additionally the library tours and related applications of podcasts are currently being actively developed. (See

http://www.psy.gla.ac.uk/~steve/ipod/ (Draper, 2007) for a list of some of the ongoing activity.

Particularly desirable in future work would be to:

- Measure how much recordings are actually used. The server records only show downloads and/or download attempts, but that is like measuring student photocopying rather than reading, let alone learning. It will be necessary to survey learners after exams to ask what was actually used, and how useful it was judged to be.
- Do much more extensive qualitative work to identify the probably numerous issues not yet even identified in this area.
- Explore whether and how recordings change how students study. This is likely to be quite different for different lecture styles, and also for different learner habits. Such a study would therefore have to be one of detailed student study habits: what they do in lectures, how notes are used e.g. never looked at again, revised within a day or two, repeatedly gone over and condensed down and down (to name just some study practices mentioned in another ongoing study).
- Intervene to see whether student comments for a podcast "magazine" format can be made to succeed.
- Record whether each student has a long commute or not, and whether they use an MP3 player much or not; i.e. link use to the particular context of each student.
- Collect evidence on the amount of value added by indexing ("chaptering") recordings.

Overall the low cost, both in money and effort, the strongly favourable response of participants, and the variety of promising applications suggest that the use of audio recordings and podcasts is likely to expand. However how learners and teachers will adapt their practices, and so what detailed benefits will develop, is hard to predict.

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Appendix: the technologies and their acronyms

This appendix has brief introductory explanations on the underlying technologies. Readers requiring further information are recommended to consult the relevant wikipedia (http://en.wikipedia.org/wiki/) entry. Beyond that, introductory textbooks might be the next step, although these change so fast that citations will become rapidly out of date.

MP3 is an international open standard for a format for compressed digital audio files (although there are patent claims for the encoding software algorithms). A wide range

of current consumer products can play it back: many mobile phones, digital audio players, and desktop PCs.

AAC (Advanced Audio Coding: part of the MPEG-4 standard) is a newer international standard for a format for compressed digital audio files. Since it provides perceptibly higher audio quality, and significantly smaller file sizes, it is preferable, other things being equal. Many of the latest mobile phones, digital audio players (e.g. iPods), and desktop PCs can play it back. It is easy to convert a recording from one format to the other (although converting from one compressed format to another may theoretically degrade sound quality).

XML (eXtensible Markup Language) is an open standard for structuring information. From a formal viewpoint, (re)defining HTML is one application of it (HTML appeared first in 1993, XML first in 1998), while another is the "chaptering" that can be added to podcasts by XML-encoded information associated with the basic sound file in MP4 and M4A container formats. From an applications viewpoint, what HTML does for text and still images to support web pages around the world, more general uses of XML aim to do for mixed media such as audio and video. An intentional feature of XML-defined sublanguages is that software will interpret the parts it expects and understands, and harmlessly ignore any other parts. This strongly contrasts with typical proprietary file formats, where software that doesn't match the exact format and version cannot use the file.

RSS (Really Simple Syndication, Rich Site Summary) is a family of standards originally inspired by "tickertape" news services. In practice the term "RSS" is used to allude to file formats (built on and in XML), to a communications protocol, and to a general approach to organising information distribution. The approach addresses situations where there is a source (server) which intermittently but frequently adds new items to what it offers, and subscribers (clients) who want to keep up to date by fairly frequent, but efficient, checks. The server posts summaries (in RSS format) of what is new and/or currently available (which saves repeated big searches by every client); the client "aggregator" software (of which iTunes is one of many examples) periodically requests this summary, and compares it both to what types of item it has been set to select, and what items it has already got.

Thus the idea is that once the client "subscribes" to a feed, the software then ensures that periodically its collection of items is updated, rather than requiring the user to personally select each item, or requiring the client to be always connected so that it can be updated when a new item first appears on the server. iTunes does it for digital content.

Synchronisation means keeping file collections on two separate devices up to date with each other e.g. keeping computer files on separate home and work PCs up to date with each other. RSS formats can be used by software implementing synchronisation. iTunes will do this for iPods and PCs. Educationally, it could make it easy for a student to keep a mobile device up to date with the latest items released in connection with a course, without knowing when they had been posted.

Container files wrap digital media files in XML, so that information ("metadata") about the content is transmitted with it e.g. title, author, etc. Examples are .MP4, which is a container format defined as part of MPEG-4; and .M4A, which is Apple's development of this that wraps AAC with some XML to support enhanced podcasts. These container file formats are often not official standards but are nevertheless open (because XML is easy for humans as well as software to understand) so that they are not tied to one manufacturer.

Podcasting originated earlier, and is essentially blogging with audio rather than text content. It is currently (although not necessarily for long) best served by Apple's iTunes software (running on both Apple and non-Apple machines). The idea is something like a radio programme or audio magazine: repeated new items are put out under a single "name", identified by an RSS URL. Users can subscribe (or unsubscribe) and will get access to all current items in each podcast, and have newly published items automatically downloaded in future. At present, these are predominantly audio items, but may be any digital content.

Enhanced podcasts allow "chaptering" as additional information encoded in XML and bundled in a container file format, and are supported by iTunes and QuickTime, and so can be played on both PCs and Macs.

Miniature video screens are a feature of a number of new consumer devices, including the latest iPods. Those who haven't tried them often assume that providing

video on a one inch or two inch screen is worthless. It certainly is diametrically opposite to the strong consumer trend for giant screens for domestic TVs. But reports from those who have actually used such technology is often surprisingly positive. In any case it may be that the use of screens on iPods and mobile phones will be different from showing 2 hour DVDs e.g. listening to an audio tour of a museum or the university library, and being able to glance at a miniscreen to help you recognise what you are supposed to be looking at. Apple were taken by surprise by the rapid sale of their new iPod models with video. When even those making the most money from it, and with the most understanding of the technology, are surprised by user attitudes, then trusting our intuitions about what is useful seems even more unwise than ever.