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Balancing e-lectures with podcasts: a case study of an undergraduate engineering module

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Abstract

The work described in this paper is based on an engineering module that has run for six years (each academic year since 2004). The module is run online although the learners are campus-based students. This has provided an unusual opportunity to compare the same students' experiences of on-campus and online courses. The course comprises a rich online environment including e-lectures, podcasts, video clips, website links, animations, background reading, formative quizzes, summative assignments and discussion boards. The e-lectures comprise a PowerPoint-like screen with a spoken audio track and other facilities, including a rolling transcript, video controls (for stopping, pausing and rewinding) and a search facility. Each e-lecture is short (a maximum of ten minutes) and links to some of the learning materials (e.g. video clips and formative quizzes). The podcasts are mp3 audio files, each lasting approximately ten minutes, and are produced weekly and published through the virtual learning environment. This paper presents a pedagogical model that has been designed to develop a structure for combining these virtual learning elements and considers some of the opportunities provided by such innovative approaches for the enhancement of engineering teaching at undergraduate level. It presents research findings on student learning outcomes and provides suggestions for adopting the design for learning model presented in the paper.

Introduction

The use of web-based technologies and virtual learning environments (VLEs) in on-campus learning provides opportunities for blended learning. Blended learning is generally described as a mixture of internet-based technologies and face-to-face methods for learning and teaching (Garrison and Kanuka, 2004). The use of asynchronous remote group

activities and pre-prepared self-accessed web-based resources in blended learning means that students need to carry out some or most of their learning activities in a self-directed way. In a blended learning environment students need to make more choices about where, when and how to study (Sharpe et al., 2006). Self-directed learning, as pointed out by Merriam and Caffarella (1991), requires students to take much of the responsibility for their own learning: planning, carrying out, and evaluating their own learning experience. Self-directed learning, however, can be a new experience for undergraduate students. Students' motivation and availability of time for self-directed learning can also be threatened by a number of factors (Deepwell and Malik, 2008), such as the difficulties of balancing time between part-time jobs, family and social commitments; an overloaded curriculum; declining staff to student ratio; lack of motivation to study; inadequate preparedness to learn at undergraduate level and negative conceptions of learning. Sharpe et al.'s review (2006) of UK higher education (HE) students' experiences of blended learning highlights the need to support them so that they are able to acquire a range of self-directed study skills, including time management, note-taking and class attendance.

This paper describes a case study of an undergraduate engineering module in 'Optical Fibre Communication Systems'. The course was originally taught as a conventional 20-lecture module followed by an unseen written examination. The course has been run in various incarnations since 1994 and was offered as part of a three year BEng and a four year MEng degree programme. It corresponded to five ECTS or ten CATS credits (i.e. approximately 6.5 hours per week for 14 weeks). The course was redesigned to facilitate students carrying out most of the learning activities in a self-directed way online using the Blackboard VLE. It typically attracts 40 students from the second and third years and,

depending on the level of the individual, they follow slightly different pathways and undertake different assessments through the course. The module has run for six years in the current format.

The redesigning involved the use of e-lectures as a means to deliver the core content and podcasts to provide missing features of a face-to-face lecture. We review the use of e-lectures and podcasts and show how these may have a natural reciprocity. We then offer an approach to evaluate student learning outcomes and perceived benefits for students from the redesigned course. The analysis of data shows how the redesign of the course and use of podcasts helped students' self-directed learning.

Background to the case study: recorded live lectures, e-lectures and podcasts

Lecturers now have access to a range of software and web-based delivery platforms to use recorded live lectures for teaching. Many technological solutions are available to capture lectures and seminar discussions for web delivery, for example Lectopia (previously known as iLecture) and, more recently, Echo 360, which can be delivered via a commercial VLE such as Blackboard. However, the effectiveness of recorded live lectures as a primary mechanism to deliver content is somewhat doubtful. Bird (2008) reports on an initiative at the University of Bangor where live lectures have been recorded and made available for download using the VLE. Although the students approved of this, the work suggests that they found this most useful for revision rather than as the primary source of knowledge acquisition. Gommer's use of recorded lectures (2008) also shows that students used them primarily for reviewing specific sections to prepare for exams and assignments. Qvist's comparison of recorded live lectures and specially made video lectures (similar to e-lectures) in Denmark (2006) shows that undergraduates preferred the specially made video lectures.

We can identify a number of shortcomings of using recorded lectures as the primary means of delivering subject content. Recording a live lecture, regardless of the technology used, does not involve any *intentional* design for learning. It does not take into account the personal nature of engagement with a recorded

lecture (e.g. listening or viewing individually can be a solitary activity, compared with being in a long lecture with peers). Neither does it take the advantage of other functionalities that can be used to support learning from a networked computer, such as links to external resources or web-based assessment activities. Recorded live lectures may refer to current events or to issues specific to the current class which may not be appropriate if the lecture is to be used as a primary mechanism for knowledge acquisition by later cohorts of students.

Fothergill (2008) considered that e-lectures provide an alternative approach to deliver content. The term may have been coined by Richard Dawkins who used the 'Boxmind' software to produce e-lectures (see *Star thinkers in 'e-learning' launch*, The Guardian, 5 March 2001). Unfortunately the company Boxmind no longer exists but similar software is still available (e.g. Impatica for PowerPoint, Adobe Presenter, and Elluminate). E-lectures are customised, pedagogically designed online lectures that are significantly different from recorded live lectures. The aim is to personalise the learning experience for students and take advantage of the networked computer. An e-lecture comprises of a set of windows including a PowerPoint-like screen with a spoken audio track, a transcript and a search facility, plus video-type controls for pausing, rewinding, etc.

However, e-lectures on their own can preclude some aspects provided by face-to-face lectures, such as the facility to put the subject matter into the current context (e.g. by referring to recent events), to provide feedback and motivation, for humour and enjoyment and, to some extent, for collaborative work between students. In addition, the e-lecture approach requires students to carry out much of their learning activities online, on their own. As previously mentioned, students require support for their online learning.

The shortcomings of e-lectures mentioned above can potentially be addressed by using podcasting technology. Evans (2008) used podcasts as a revision tool for his undergraduate students. Lee and Chan (2007) used podcasts successfully to help alleviate distance learners' anxieties and to create a sense of supportive community. Harris and Park's review of podcasting (2008) shows that it enables teachers and students to establish

communication and interaction with each other, overcoming the temporal and spatial limitations of conventional face-to-face learning. Salmon and Edirisingha (2008) report a further ten approaches to using podcasting for learning in HE, covering on-campus, online and distance learning. Evaluations of student learning from the above approaches have consistently shown positive benefits of podcasting. Students surveyed reported that they value the flexibility offered by podcasts for accessing and using learning material, the cognitive benefits obtained from listening and the motivational aspects, amongst others.

The redesigning of a conventional face-to-face course for online learning

The availability of a VLE as a platform for teaching and learning meant that it was possible to re-design the traditional face-to-face taught module into small chunks for flexible and personalised access and use. In deciding to re-design the course, it was found that it naturally split into four sections (optical fibres, light detectors, light emitters, and optical fibre systems). In each case, it is important that students have a good understanding of each section before proceeding to the next. This requirement is common, especially in the engineering and science disciplines where one concept often builds upon another. However, it is unusual, (in the authors' experience) for students to be 'actively paced', therefore, in addition to (optional) formative assignments, they need to take a summative assignment, thereby completing one section of the course before moving on to the next. Yet it seems probable that at least some students will 'cram' before final examinations, implying that they have attempted to study later parts of a course without a good understanding of earlier parts. This is not a preferred method of learning and it seems likely that at least part of the success of this course is associated with the 'active pacing' of students by enforcing what is essentially some continuous assessment, rather than because of differences associated with it being online.

The first three sections were then further split into what we have termed 'learning units'. There is no single agreed definition of a learning unit in the literature. They may, however, be identified as the 'smallest self-contained learning lesson, providing at least one learning outcome' (Han, 2006). A learning unit in

this context is intended to convey specific knowledge, develop an appropriate set of skills and lead to understanding in a small coherent area. The size and composition of a learning unit varies according to the subject.

In the redesigned course there were approximately forty learning units, suggesting that a traditional lecture might contain information corresponding typically to one to three learning units which might in turn correspond to a part of a book chapter. Typical subjects were *Historical Development of Optical Fibres*, *Basic Optics for Understanding Optical Fibres* and *Semiconductor Lasers*. A typical learning unit would take around two hours of study.

Section four of the re-designed module was more 'free form'. It was designed to support students working in groups to submit a final assignment in the form of a short project.

The division of the course in sections, learning units and elements is shown in Figure 1.

The online format made it possible to offer the course contemporaneously at different levels (2, 3, and 4) for different cohorts of students by allowing them to follow different pathways and take (somewhat) different assignments. Because of the different pathways available through the course for different cohorts of students, the number of learning units in a section was not fixed. Different cohorts of students also took slightly different assignments.

All learning units start with a list of objectives and contain at least one formative quiz (so-called instead of 'assignment' to ensure that students understood that they were purely formative and that they could tackle them without fear of losing marks through poor performance.) These are particularly important for an online presentation, as students must be explicitly told the desired learning outcomes of a given learning unit so that they are able to test themselves against these criteria. The quizzes are all online, marked automatically and designed particularly for pacing, self-evaluation and the development of engineering skills. Feedback is provided automatically, including links to external websites where the material is presented in a different way. The knowledge acquisition within each learning unit is normally by means of at least one e-lecture,

but they also often include short video clips, links to external websites, animations and background reading material. This is also shown schematically in Figure 1.

E-lectures

The core content delivery was through e-lectures. An e-lecture comprises a set of windows including a PowerPoint-like screen with a spoken audio track, a rolling transcript,

video-type controls for pausing and rewinding and a word search facility. In this module, each e-lecture was quite short, around ten minutes, and contained links to other parts of the learning unit. They were generally designed to be reusable. Within the learning unit were formative quizzes and students were asked to listen to the lecture again if they feel that they had not grasped the principal concepts. Figure 2 shows a screen shot of an e-lecture.

Figure 1.

Division of the course into sections and learning units

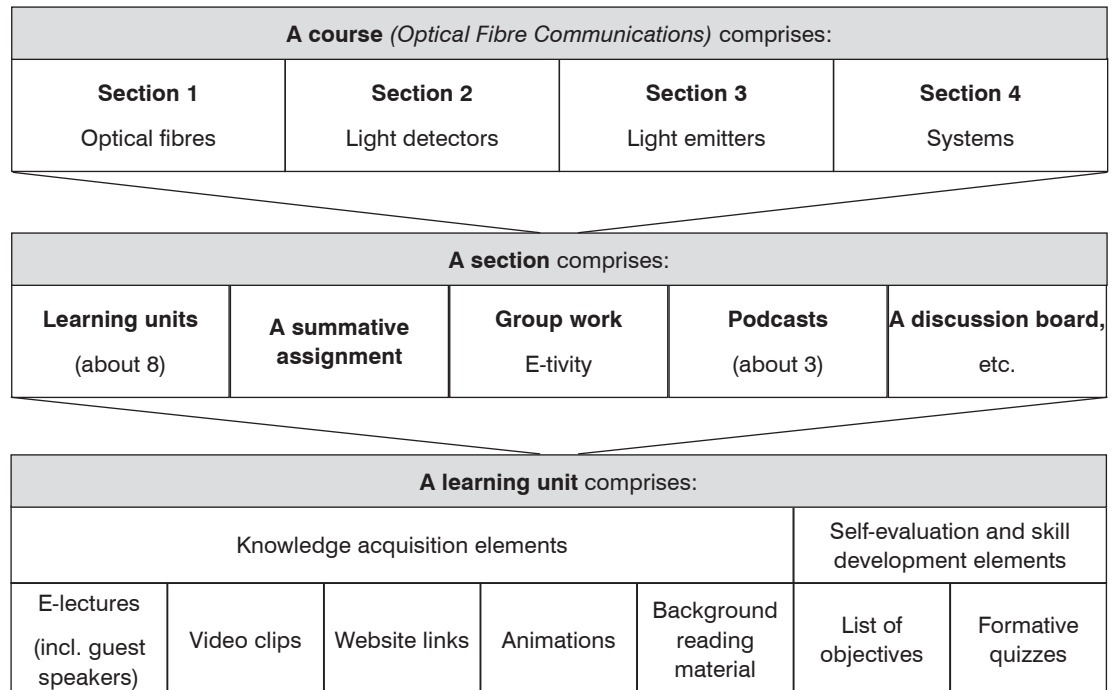


Figure 2.

A screen shot showing the features of an e-lecture

University of Leicester

Light Emission from a pn Junction

status: playing 2:32 / 3:57

Wavelength and band gap

Conduction band

Valence band

$$\lambda = \frac{hc}{E_g}$$

If a radiative transition takes place between states at the bottom edge of the conduction band and the top edge of the valence band then the photon wavelength is given, as for photodetectors, by $\lambda = hc/E_g$.

If the transition is non-radiative, however, the energy ends

While the redesigned course, with its e-lectures and associated 'e-elements', was popular with students, it was felt that these lectures precluded some aspects provided by face-to-face lectures. Face-to-face lectures tend to include current events which cannot be included in an e-lecture that is intended to be reusable. These current events might include:

- contextual information relating the subject matter to events of which the current cohort of students are aware – this could be a news event (for example, a failure of a major optical fibre based internet connection) or perhaps something that took place within the University
- feedback on an assessment or experiment that the students have just undertaken
- advice to students about areas on which they should concentrate, based on their past performance
- a humorous or similar item that brings a sense of time or place to the lecture.

Podcasts

It was felt that podcasts could be used to cover the aspects of face-to-face lectures that were missing in e-lectures. Therefore, from 2006, weekly podcasts were incorporated into the module. Each podcast, about ten minutes long, was recorded and delivered at the beginning of each week via the module site on the Blackboard VLE. Each podcast contained three sections:

1. An introduction containing a comment on current events relating to the subject material. There are sometimes natural events that coincide with material to be understood, for example a lunar eclipse that occurred about the time that the students were learning about light emission. Where there were no spontaneously-occurring events, it was usually possible to find something suitable, even though it might be a little contrived. An example of this was the celebration of the 40th anniversary of the invention of optical fibres one year (a natural event to talk about) followed by the 41st anniversary the following year. This contextual, informal learning helps students to understand and remember concepts by relating them to memorable, tangible events.
2. The second section usually contained feedback and feed-forward. This was easily obtainable from the summative assignments

and the students in any case were eager to get feedback - they might already have known how they did but they also wanted to know how they had got on in comparison with the rest of the class. This gave opportunities to comment on areas where they needed to check their understanding or that they needed to concentrate on when they came to the next section.

Where students had not taken a formal summative assignment, it was still possible to examine the management information provided by the VLE and make comments on their general progress (for example, it is possible to see how many quizzes they have attempted or how many hits they have made to the site). This is very useful at the beginning of the course to motivate the late starters.

3. The final part contained a joke – or at least something that the tutor found amusing. In feedback about the course before it went online, students would often comment (sometimes positively) about the tutor's use of humour in lectures and it seemed a pity to miss it out altogether when organising the online version. The result of this is that students often tuned in to the podcasts to listen to the joke, but hopefully got something out of listening to the first two sections as well.

Data collection, analysis and discussion

We collected both qualitative and quantitative data on the students' use and their perceptions of how the e-lectures, podcasts and, overall, the learning unit approach to presenting the course helped their learning. Qualitative methods included hour-long personal interviews with around six students from each presentation of the module since 2006. Using a semi-structured interview schedule, we explored how the combination of e-lectures, podcasts and other online components supported their learning. The quantitative data were collected using an end-of-semester evaluation questionnaire to identify students' access to technologies for learning from the module, patterns of studying online and perceived benefits of learning online. The present paper focuses on the findings from the qualitative data.

First we present a comparison of overall performance on the module before and after the e-lecture approach was introduced (Figure 3).

In Figure 3, the lines corresponding to 1998, 1999, and 2000 represent students who took the course when it was presented as a traditional lecture course. The other lines correspond to the cohorts who have taken it since the e-lecture approach was adopted (2004 to 2009). The graph presents a cumulative distribution of marks – for example, looking at the horizontal axis, one can find the 50% gridline. Tracing this vertically, one can see that this corresponds to marks of around 60% for the traditional lecture courses. This indicates that 50% of the class got less than 60% (and therefore 50% got more) – the median mark for these cohorts was therefore 60%. However, tracing the gridline up to the online cohorts of 2004 to 2009, this median mark increased to around 73%. Of particular note is that only a very small proportion of students have failed the course (these marks are all for ‘first attempts’) since it was presented in an online format. Indeed, 187 students have taken the course in this format and only one got less than 35% (and therefore failed). In the traditional format, approximately 10% of the cohort failed at the first attempt.

Typical ways of studying the module

In the interviews, students reflected on their experience of learning and studying the module, considering the key differences between learning from face-to-face lectures and from e-lectures. Descriptions of students' experiences of using e-lectures, and their

typical ways of studying the module, show an active engagement in the learning process.

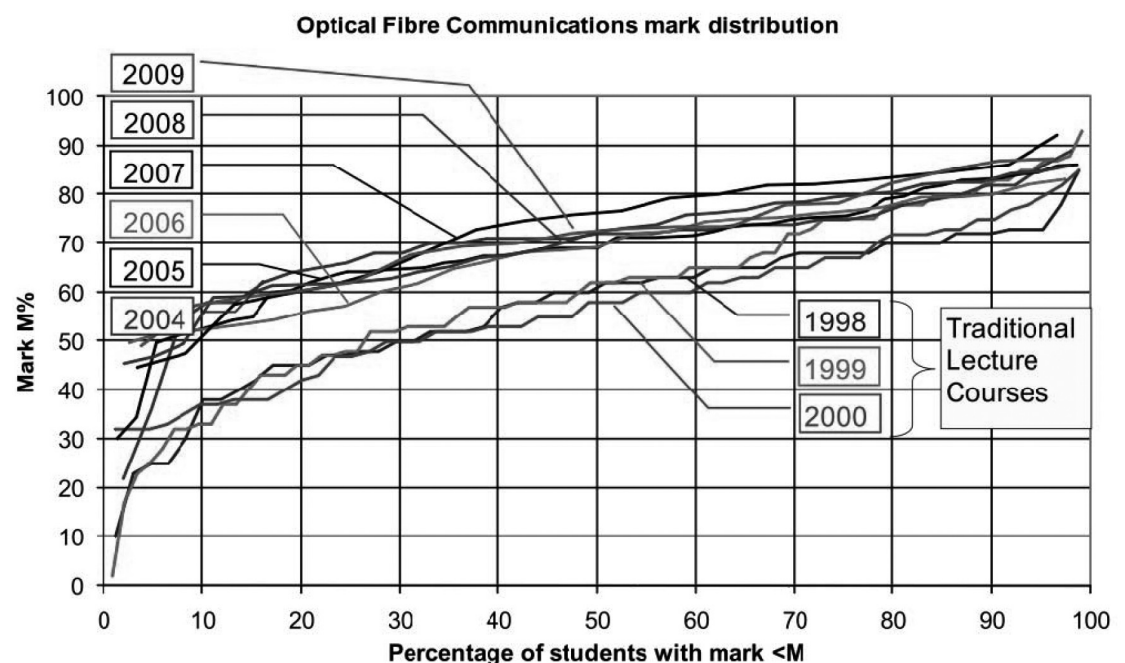
Box 1 shows a student's description of his approach to studying the module: he has developed two-hour chunks of learning time to study it.

A second student's approach also shows an active engagement with the online lecture material (see Box 2).

These students' accounts of their approaches to learning through e-lectures show an active engagement with the content. All students interviewed reported that they spent on average 20 to 30 minutes studying a ten-minute e-lecture and associated e-components. Students were carrying out a number of self-regulated learning activities during this time, including note-taking, filling in gaps in lecture notes and testing their understanding. At the end of each session, the students would have a set of individually tailored notes, incorporating their own comments and interpretations of the content presented by the e-lectures.

Interviews with students showed that, when studying through e-lectures, their focus is on understanding the subject matter. The ability to revisit sections of the e-lectures through video controls (pause, stop, rewind) helps them to achieve this, as illustrated by comments such as: ‘if I have doubts or don't understand

Figure 3.
Comparison
of performance
before and after
adoption
of e-lecture
approach



Box 1. A student's approach to learning and studying the module

Student 1 (S1): I start the lecture and if there are things that I don't understand, I will pause it and go back and listen again. And I will also [...] write down the notes when I'm listening [...]

Interviewer (I): Where do you write notes?

S1: I print out the notes and I will add [my] comments. [...] I will actually write down the things that are not on the page.

I: How long does it take you to do a ten minute lecture?

S1: Well, erm, usually about half an hour because after every sentence, paragraph I will stop it and try to write the important points. [...] yeah, although it's ten minutes, after I finish, it usually take half an hour.

S1: [Pausing and listening again] helps me to understand; if I don't stop and play again, I will miss something.

I: What do you do with notes afterwards?

S1: I will organise it, by the date and content so [...] I [...] read that for revision. [...] also after the lecture, I do the questions, quizzes.

I: Then what do you do?

S1: After the quizzes [...] it's basically finished [...] then I before the assignments, two or three days before, I will do the quizzes again and use the notes that I have written before to try to do some revision. And so I will have more understanding of the course.

Box 2. A second student's approach to learning and studying the module

Student 2 (S2): [...] usually in the evenings when uni is finished I go to the library [...] and listen to the lectures. When I'm listening [...] I usually stop or pause and write my notes down. I write my interpretation of what he's saying and then when it comes to the quizzes I look through my own notes. I make sure I have jotted down key ideas. [...] I do quizzes to [...] boost up my notes – just say to myself 'I missed this point, add it in there.'

Interviewer (I): Where do you write your own interpretation?

S2: On paper.

I: How long do you spend on average to complete a ten minute lecture?

S2: 20 minutes or more.

I: So then, at the end you will have a set of your own notes?

S2: Uhuh.

I: how about quizzes?

S2: I really enjoy doing the quizzes [...] they're very very useful. They test your understanding and [tell you] how much you picked up from these lectures and what you've taken from it.

something I can always go back and listen as much as I want.' Additionally, the quiz function is a mechanism for students to test their understanding of the subject matter. In this way, e-lectures help to overcome a key weakness of lectures, identified by Laurillard in her analysis of methods and media for academic learning (2002), which is that the teacher may not be able to ascertain whether the students have understood the academic concepts being taught. This limitation is common in large classes with limited time for tutor-student

interaction. The e-lecture and learning unit approach offers students a mechanism to test their own understanding and it also offers a way of regulating their learning as they monitor and pace their own studies. Having this level of control helps the learner to engage with the content in a more in-depth manner.

Flexibility and learner control

Students' experiences of learning through e-lectures show that they are being offered flexibility of learning in a variety of ways – one

student described the module as 'a flexible course'. Further comments show appreciation of the flexibility offered by the module:

so usually [...] when I have time, I will listen to the online lectures, whenever I feel OK with that. So it's good, it's flexible.

this one is [...] so much more flexible than the other [face-to-face] lecturers.

The way in which students approach their study of the module shows evidence of them pacing their learning, rather than simply 'cramming' for examinations:

I try to do one lecture a day. If I do a little bit a day, it's a lot easier than doing a huge amount in one day [...] then I just revise them for the assessment. It is ok because if you can't study one day then you study the next day.

Students can choose to study at times to suit them and their circumstances: 'sometimes around midnight, sometimes at about 8, 9pm [...] after I finish labs, I go home and eat and then study, mostly after 8pm.'

Further comments show that students appreciated the e-lecture experience because they were able to study in conditions that were more conducive to learning. As this student bemoans, face-to-face lectures are not always scheduled at times when the class will be receptive:

Today I am in uni from half nine to half six straight. I had labs, lectures, labs, lectures, labs so by the time you get to the lecture at half-past-five, you are tired and hungry, 'cos you don't really have time to eat, you just buy a sandwich and eat it on the way to the next lecture or the next lab, so by the time you go to the half five lecture you are really tired and hungry [...].

E-lectures give students control over their own learning. The following student tells how they gave him the ability to organise his learning activities into 30 minute chunks, as opposed to the conventional hour-long time slot:

I study for 30 minutes, and then take a break and then come back and study for another 30 minutes, so you feel fresh,

you know. You study one lecture and then take a five-minute break and then study another [...]so you understand it a lot better than sitting there for one whole hour] because after about 30 minutes you [...] don't really concentrate.

This shows the student's awareness of the importance of understanding the content presented in a lecture – for him the e-lectures provided him with a tool to manage his learning in such a way that he could sustain his concentration and learning.

Learners found that having flexibility and choice in their learning process helps in making it successful, as identified by Collis and Moonen (2001). The e-lecture and learning unit approach to designing the course seems to provide a range of flexibility dimensions:

- time of day
- day of the week
- location of study
- preferred way of studying (and consequently preferred pace of study)
- facility to revisit the whole module or specific sections as required
- capacity to link to and view original sources and material.

Learning from podcasts

In interviews, students identified the sections and features of podcasts that have been particularly useful and relevant to their learning, for example, the introductory news item. This student found that the informal style of the introductory section helped him to contextualise the academic subject matter in the real world:

I think it is interesting; it is related to the course; you are doing the course because of [its relevance to] networking, so you need to know a bit more about the world around the module.

Two students talk about the value of podcasts in providing advice and information relevant to their studies, helping them to manage and organise their learning in a systematic and targeted way:

He presents what's important, what you need to know [...] the stuff he mentions there, I actually try to focus on in lectures, if he mentions it in the podcasts it is probably an important part of the course. Therefore, I try to pay attention to what he says in podcasts [...]

Obviously he knows whereabouts we are in the course [and] where we should be and therefore he can drop in hints and say 'Okay, this is something that's important, you need to know that and this' and he elaborates on it.

The students also valued the informality of podcasts:

The professor is just like, er, informal chatting. He records these podcasts on Sunday morning in his kitchen and [...] it is not difficult to understand what he is saying. It is not important to write down [what he says in] the podcast. For me, it is really to enjoy what he's saying.

This student commented on the tone and the voice on these podcasts, appreciating the informality:

In the lecture, the sound is more serious, more kind of proper English and more academic [...] but in the podcast, it's different. The podcast is like normal chatting and it's easy to understand.

Other students talked about the motivational aspect of the podcasts:

I listened to [the podcasts] whilst I was trying to do some [physical] exercise in my room and it was good. The first one was about another student who has finished the module and he was just giving us tips, how he found the course. I found it was really good because I felt very attentive, I felt I was really listening to it. I don't really listen to talk shows, but the podcasts seem to actually reach out to me.

When asked how listening to other students' learning experience can help one student replied that:

It helped because [...] he's been through it and anything he's felt that can be an obstacle in learning the course he's relayed it to us. Say for instance [...] he found leaving it to the last minute was pretty hard, or a certain way which worked for him [...] he'd say 'I usually worked in the evenings when I'm chilled out, when I'm relaxed. The day's over, you know, I've had a shower and after uni I'm just cool, I've eaten- I'm just gonna get into it.' Just knowing little tips, how

it works for other people, I know it's not necessarily going to work for myself, but it's good to know that if you ever feel like it's not working for you, you could try something else. I think that the person did well on the course as well. He wishes you luck at the end and it's quite motivational.

As the extracts from student interviews show, podcasts have added value to their learning in a number of ways. The introductory section provided useful information that has helped them to relate their academic learning to real life in an informal manner and the main part has provided advice on weekly study activities and feedback on their progress. Students valued the informal nature of podcasts, which they considered different in tone to a formal lecture. The inclusion of podcasts in the module has added an effective dimension, changing the way in which students perceive academic learning and making it more accessible and student-friendly.

The above results showing students' positive engagement with podcasts support early findings on the use of audio for learning. The medium used in podcasting is audio, a well-researched and documented medium for learning, especially at distance. Durbridge (1984) identified a number of advantages of audio in distance learning contexts, based on research carried out at the UK's Open University:

- responsiveness to sound (understanding spoken language or hearing the lecturer's voice)
- the feeling of being a party to conversations, perhaps about some part of their course
- being 'talked through' tasks in the lab or workshop
- hearing facts, discussions and opinions from experts in their field
- gaining encouragement from the familiar voice of somebody who is known and respected.

How the design of the course has helped learning

We were interested in finding out what other features of the redesigning have helped the students' learning processes. One student mentioned the ease with which he has found learning during this module:

I spend more time in other modules [...] but in this module, optical communication, I find it easier compared with the time spent on it. [...] the maximum I will spend on it maybe two hours a day so 14 hours a week. I can complete sections easily and understand [each] section. But I couldn't really do that [with] other modules because they are not divided [like this module]. [Although] it's like a big module so I [can] study it bit by bit, every week, every day. And then make links throughout [...] so yeah, I found it easier.

The divisions and designing of the module as illustrated in Figure 1 appear to be an effective method. The division of the module into clear sections, and each section into clear learning units and, furthermore, into a series of short e-lectures, appears to be a successful approach. This granularity seems to have helped students to carry out learning activities smoothly and enabled them to make links between the units and sections.

Concluding remarks and implications for practice

In this paper we described the design features and approach to using e-lectures and a range of e-components to redesign a traditional face-to-face module (Optical Fibre Communications) of an undergraduate Engineering degree programme. At the heart of the pedagogical design is the learning unit, with specific learning objectives and outcomes, e-lectures and a range of other e-components for students' self-regulated study and short self-examination tools for evaluating their own learning.

Students on this module were also taking other modules face-to-face and therefore were in a position to compare e-lectures with traditional lectures. The data from student interviews showed that e-lectures were an effective approach as the primary mechanism for delivering content, despite concerns that they may have had early in the course. However, students are concerned that face-to-face teaching should not disappear (Melville, 2009) and we do not advocate replacing face-to-face lectures with the e-lecture approach entirely.

It has also been shown that podcasts may be significant in overcoming the deficiencies of e-lectures when compared to face-to-face lectures. They provide a wrap-around

for learning units, offering advice on study approach, providing feedback on progress and raising motivation to study.

Students' feedback on their experience of learning and studying online suggests that the pedagogical design approach proposed in this paper is worth considering to support their learning. E-lectures could be made to a higher standard of presentation than face-to-face lectures because they can be pre-designed, peer-reviewed and edited to an optimal point. The rationale for using podcasts in this approach was to overcome the limitations of e-lectures by contextualising the subject matter and providing a personal touch.

A number of further general principles and features of the redesigned module can be drawn as follows:

- learning units can be identified as a useful medium in which contiguous, quasi-autonomous learning and assessment is grouped together
- online, self-directed learning allows students at different levels to study the same course by allowing cohorts to take slightly different pathways and assessments
- learning units should include a 'quiz' (or formative assignment) so that students can ensure that they have understood the concepts in the unit before proceeding to the next
- 'active pacing' of students using online summative assignments may be a good way of ensuring that they keep up with taught material and understand earlier sections of the course before proceeding to later ones
- each section of a course should be concluded by the completion of a summative assignment, which may be online
- podcasts appear to enliven a course and help to keep the students engaged by providing contextual information, informal feedback and humour.

In closing, perhaps the students should have the last word:

[If I were to draw a picture of the lecturer] it's not a person standing in front of me. I would draw er, two big circles. The circle inside is about optical fibres and the [circle] outside like a music, a joke,

entertainment. So it's like very good entertainment including a serious core of optical fibre communications. So it's fun, but you have the optical fibre going through.

I called my friends from home and said: 'dude, you have to see this lecturer!' and

I said 'I will show you when I get home!' – it is really interesting and cool! We don't have things like these [podcasts] at home. If all the lecturers were like that, I'm sure all the students would be studying!

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