New technology, new pedagogy? Employing video podcasts in learning and teaching about exotic ecosystems

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Abstract

This article examines the experiences of undergraduate university students in response to the employment of video podcasts to support learning and teaching about exotic ecosystems. Six 15-20 minute podcasts were made accessible to students through a virtual learning environment, either on-line or to download to mobile technology. The students were free to watch the podcasts whenever and wherever they chose to. The perceived and actual effectiveness of the technology was assessed by written questionnaire, focus groups and summative assessment results. Students agreed that the podcasts were effective in supporting learning and teaching on the course, largely by offering a flexible and visual learning experience. The podcasts were also perceived as a useful resource for revision and assessment, providing visual images that stimulated factual recall and highlighted knowledge gaps. There were no significant differences, however, in examination essay grades comparing cohorts prior to and post adoption of podcasts. The key to improving the student learning experience appears to lie not in adopting new pedagogy, but in reflexively developing the existing pedagogic strategies employed by both teachers and learners. Of primary importance is uniting the individual learning experience of podcasts with group exploration and critical discussion in a collaborative learning framework.

Introduction

Podcasting is a particular form of information and communications technology (ICT) and its use in higher education refers to the production of digital audio or video files that are made available to students via an intra- or inter-net. As with technology generally (HEFCE 2009), there has been much written on the potential of podcasting to enhance student learning, but there is limited empirical evidence as to how learners engage with podcasts and, more particularly, how they influence learning and teaching in positive ways (Edirisingha and Salmon 2007; Lynch et al. 2008; Evans 2008; Lazzari 2009; Fernandez et al. 2009). Whilst initial reviews have emerged since 2008 in journals such as *Computers and Education* (e.g. Fernandez et al. 2009; Bolliger et al. 2010), *The Internet and Higher Education* (e.g. Lonn and Teasley 2009; Lee et al. 2009), *British Journal of Educational Technology* (e.g. Harris and Park 2008) and *ALT-J: Research in Learning Technology* (e.g. Sutton-Brady et al. 2009), there has been relatively little published in peer reviewed journals evidencing the utility of podcasts in environmental education. Notably, there have been no articles published in *Environmental Education Research* concerning podcasts since the journal's inception in 1995. By contrast, there have been numerous articles concerning the teaching and learning of ecology, both inside and outside the classroom and in relation to students of all ages (for example, Harris 1996; Gayford 2000; Rauch 2000; Jurin and Hutchinson 2005; Baumgartner and Zabin 2008; Lindemann-Matthies et al. 2009). One study linked ecology with technology in schools (Parry 2002), finding that the creation of storyboards for multimedia presentations about local wildlife led to deeper understanding.

The research presented here complements the IMPALA 2 project (a collaboration of six UK institutions exploring the broad pedagogical benefits of podcasting in geography, earth and environmental science subjects) by utilising audio-visual material from field locations to directly supplement lecture material. Under IMPALA 2 (as elsewhere), the use of

video podcasts to provide field guides and lecture summaries were examined separately (Nie 2008; Nie et al. undated). This paper thereby reports a novel application and evaluation of audio-visual podcasts in teaching and learning.

The primary aim of the project is to assess student perceptions of the learning utility of video podcasts, with particular reference to their understanding of exotic ecosystems within a second year undergraduate course delivered at UWE, Bristol (UK) entitled 'Biogeography and Conservation'. This is an optional course on a Geography and Environmental Management programme. The course aims to develop understanding of ecosystem structure and dynamics; how human influences can affect ecosystems; and how biogeographical knowledge can inform conservation theory and practice. Whilst the authors do not wish to suggest a replacement of student field visits with video podcasts, there may be utility in bringing the 'outside' (especially exotic locations) into the classroom and/or wider learning experience. Video podcasts, as a form of film, might help to engage students and exemplify novel processes and concepts from environments with which they have limited or no direct experience (Ansell 2002). Communicating such material visually can be an important first step for students in their understanding (Johnson 2002; Winterbottom 2007). Indeed, Kuzma and Haney (2001) contend that film stimulates the senses, grounds and contextualizes abstract concepts, engages emotions and facilitates active learning. It must be stated, however, that academic film, via the intrinsic selection of visual content and narrative, conveys a subjective portrayal of the 'real world' that necessitates critical appraisal (Jenkins and Youngs 1983; Gold et al. 1996).

To examine the utility of podcast technology in promoting a positive student experience, the following research objectives were established:

1. To examine student engagement with podcast technology (locations, times and methods of use);

2. To assess the perceived value of podcasts by students as a learning and teaching resource (both benefits and disadvantages);

3. To assess the perceived value of podcasts by students for revision and summative assessment;

4. To examine actual student learning through comparative studies of assessment results.

The paper concludes by inferring from the data the potential use of the podcasts in more active learning environments through the broad lens of social constructivism and its descendant pedagogies. Social constructivism recognises that learning takes place from a range of sources, with students 'co-constructing' knowledge via dialogue with each other and their teacher (Vygotsky 1978). This model allows alternative viewpoints to be negotiated and 'taught back', and hence provides an explicit learning process (Pask 1975). Laurillard (2002) has recently encapsulated these learning theories in her iterative 'conversational framework', which she hopes will enable teachers to deliver the true potential of digital technologies to learners.

Methods

Podcast preparation and instructions for use

Six video podcasts were created by the lecturer, which articulated specific session learning objectives and thematic content, and they were aligned to the course specification and assessment criteria. The podcasts provided a visual representation of environments and processes discussed in lectures and seminars. Two environments were represented: hot deserts and tropical rain forests, with three podcasts created per ecosystem (Table 1). Each podcast was approximately 15-20 minutes in duration. Podcast material was shot digitally in the field, with the subsequent story board dictated by lecture content. Some voice-over work was recorded in an anechoic sound chamber after filming had taken place. Each podcast was made

available via a Faculty Virtual Learning Environment (VLE), or intranet, as Windows Media Video (WMV) and QuickTime (M4V) files.

Students were informed at the start of each appropriate session that there was a bespoke podcast in support of that session, and that this could be accessed via the course web pages of the intranet. As these sessions were time-tabled at the start of the second semester of teaching, students were familiar with accessing materials from the web pages. Nevertheless, instructions were provided on the web page for viewing and downloading files. At the close of each set of formal sessions for the hot deserts and tropical rain forests, students were allocated a seminar session and informed about computer laboratories in which they could watch the podcasts if they wished to. This offered students an opportunity to watch the podcasts in timetabled sessions, so they were not necessarily perceived as an extra-curricular activity. Additionally, this opportunity was provided so as not to disadvantage any student who had no access to ICT resources at home. It was made clear to students, however, that they were free to watch the podcasts whenever and wherever they chose to in support of their learning on the course. Students could access podcasts on-line through the VLE, or they could choose to download them to mobile devices.

Evaluating the effectiveness of the podcasts

In order to address the research objectives, it was necessary to explore student engagement with the podcasts, to examine their perceptions of the podcasts as a perceived learning and teaching resource, and to try to measure tangible learning outcomes in terms of the impact of engagement on summative assessment. A mixed methods approach was adopted, which included administering a written questionnaire, undertaking focus groups, and examining results from summative assessment.

The written questionnaire was administered to students on the course one week after the final session covering deserts and rain forests. In total, 24 students responded to the survey from 33 students registered on the course (a response rate of 73%). Engagement with the podcasts was primarily measured through frequency counts, whilst perceptions of the utility of podcasts as a teaching and learning resource were measured predominantly using a Likert attitudinal scale. To gain deeper understanding of factors that might have enabled or inhibited engagement, and to further explore perceptions of the resource, open-ended questions were included throughout.

To allow qualitative exploration of the more quantitative questionnaire responses, the students were invited to participate in a series of focus groups. The first focus group session was undertaken immediately post-questionnaire, in the form of two classes of 12 students. The classes lasted between 35 and 40 minutes and consisted of 10 broad questions that expanded upon those in the questionnaire. The second focus group session took place after the summer exam. The purpose of discussions here was to examine whether students engaged with the podcasts in their exam revision and, subsequently, how they perceived the podcasts had aided them with their exam answers. Two classes of four and six self-selecting students took part in the discussion (n=10, response rate of 30%). These classes followed the same protocol as the first classes and they were between 40 and 50 minutes in duration.

As a more objective test of student learning, the results for the final course summative assessment were examined. This assessment is a two hour examination, in which students answer two out of six essay questions. The examination covers the semester two syllabus, including the ecology of deserts and rain forests. Following the exam, the questions that students chose to answer were compared to question selection from the academic year 2006-2007. This year was chosen as both the number of students taking the course (n=32) and the themes covered in the exam questions were broadly comparable. The exam results were

reviewed to ascertain whether there were any significant differences in student grades for particular themed questions as a result of engagement with the podcasts.

Results

Student engagement with the podcasts

At the close of the ecosystem teaching block, 22 out of 24 respondents had watched at least one of the six podcasts and over half had watched a minimum of three podcasts. There was evidence of multiple viewing, especially with respect to the earlier podcasts (Deserts 1 watched by 20 respondents between one and four times). Later podcasts had not been watched by as many students or with as great a frequency (Rain forests 3 watched by five respondents between one and two times). Students commonly cited a lack of time as the key reason not to have watched the later podcasts (13 from 22 responses). This was most often related to them having had only one week to watch the final rain forest podcast. Many students (n=14) commented that they intended to watch podcasts (both viewed and non-viewed) at a later date, typically as part of their revision:

> 'I will watch the podcasts during revision … I believe this will utilise the material more effectively. It will also stimulate learning and revision pre-exam' [Questionnaire 12]

Students were asked how and where they accessed the podcasts and their responses indicated that they largely elected to engage with the technology at home, split almost equally between accessing the Faculty VLE remotely (15 respondents) and downloading files to their laptops (13 respondents) (note that some students accessed the podcasts in more than one way). The majority of respondents (18 out of 22) reported no problems with accessing the files and all but one (who expressed 'no view') agreed/strongly agreed that they were easy to use. Where problems were reported, they related to the speed of downloads, typically associated with older personal equipment. Watching the podcasts at home on a laptop was

perceived to be the most convenient option, providing flexibility for students in terms of when they watched them and how they utilised them:

'I chose to watch it on my lap top at home … so that I could start and stop when I needed to. I could also make a good series of notes from them' [Questionnaire 11]

'At home, online. It was the easiest option and I find it easier to work from home' [Questionnaire 10]

In terms of mobile technology, a small number of respondents (n=4) elected to watch the podcasts via their iPods. They indicated that they watched the podcasts at home or whilst travelling:

'i-pod is a good, convenient way to watch them. Useful on train journeys' [Questionnaire 13]

'Flexibility of watching them when I had a spare 5 minutes and could access them from anywhere' [Questionnaire 19]

There were only three responses to watching the podcasts on campus via the Faculty VLE and these students also indicated that they progressed to watching the podcasts via the VLE or other means at home. They particularly noted the convenience of viewing at home without disturbing other people in the computer laboratory.

In terms of when students elected to access the podcasts, 10 stated that they accessed them within a week of each lecture, with a further seven indicating that they watched them before the close of the desert and rain forest teaching block. Only two respondents used the allocated seminar slots to watch any of the podcasts. Additionally, over half of the respondents (n=15) stated that they watched the podcasts outside of usual working hours (between 6pm and 8am).

Evaluating the effectiveness of the podcasts as a learning and teaching resource

Students agreed that the learning objectives expressed within the podcasts were clear. One student noted the utility of the podcast aims and learning objectives in providing a hand-rail through the information:

'Good clear titles and aims helped me to follow presentations - gave a good focus' [Questionnaire 23]

Students were asked to rate the overall utility of the podcasts as a teaching and learning resource. Nineteen out of 22 respondents rated the podcasts as useful to very useful (Figure 1). When this broad evaluation was deconstructed by asking students to indicate how far they agreed with more specific statements about the learning utility of the podcasts, all agreed/strongly agreed that they could access them whenever they wanted, 19 agreed/strongly agreed that they could access them wherever they wanted, and 16 agreed that they were able to pace their learning with them (Figure 2). Students commented in the open-ended questions:

'It was good being able to refer to the information unlimited times whenever I wanted' [Questionnaire 3]

'I was able to go over them at my own pace and was able to watch them more than once, which means you don't miss any information' [Questionnaire 18]

Both the open-ended questions and post-questionnaire focus groups elucidated other useful attributes of the podcasts for student learning. The benefit of 'accessing' remote environments and thereby establishing their context was noted by seven questionnaire respondents and discussed in the focus groups. Comments included:

'Not all the locations will be accessible, so good to see them via podcasts. Puts information into context and helps me to remember key points' [Questionnaire 6]

'Some things are quite abstract … just reading about them or hearing about them, but to see them was quite good. It puts them in the context of the environment' [Focus Group 1]

These quotations also highlight an associated issue. Students perceived that the visual nature of the podcasts, bringing material to life, helped them with their understanding. Thirteen students noted the words 'see' and 'visual'/'visually' in their questionnaire responses. Examples are:

'Seeing the environments the lecture material is based on - helped visually to understand the context. It is easy to feel detached from the environments we learn about on the course, especially having not been there. The podcasts helped the understanding of the environments' [Questionnaire 19]

'Visually being able to look at the plants and species helped me to link together all my learning' [Questionnaire 11]

The podcasts added variety to the teaching and learning experience on the course, extending resources beyond lecture material and textbooks, and further facilitating understanding:

'… useful having another means of learning information … different way rather than just looking at a book and reading back through my notes. I found it was effective doing it some other way' [Focus Group 2]

'… they supported the lecture notes and added more detail, so verified parts that I didn't fully understand' [Questionnaire 10]

'I found that being able to see 'real life' images etc and listen to processes being talked about was far more beneficial than still images and text from books' [Questionnaire 23]

Students were asked in the questionnaire to identify the extent to which podcasts helped them with specific aspects of their learning. They responded favourably with respect to the extent to which podcasts helped them to remember facts. Nine students agreed 'greatly' with this statement and the remaining 13 agreed 'partially' (n=22). The comprehension of processes did not receive such a favourable response. Seven students agreed 'greatly' with the

statement that podcasts helped them to understand processes and 12 agreed 'partially'. Additionally, twenty-one students agreed/strongly agreed that the podcasts helped them to actively engage with their learning (n=22) (Figure 3).

Respondents agreed broadly that the podcasts were both interesting and informative (21 from 22 questionnaire responses, with one student expressing 'no view'). When asked via the questionnaire to compare the podcasts directly with other teaching and learning methods, there was a general perception that the podcasts were more useful than seminars and reading. However, they were perceived as equivalent to, or less useful than, lectures and field work. It was noted that podcasts should not be used as an alternative to lectures, but as a supporting resource:

'I think that podcasts are a good idea but they shouldn't be more important than lecture notes' [Questionnaire 9]

'They just sort of build to the whole university experience' [Focus Group 2]

Overall, 20 of 21 respondents agreed/strongly agreed that the podcasts supported the lectures and all agreed that the podcasts supported their learning generally.

When students were asked explicitly in the questionnaire and focus groups to identify any weaknesses of the podcasts for their learning, they commented largely on poor sound quality in the desert podcasts (due to the windy nature of these environments), which rendered it difficult to hear some field narration to camera. Some students also noted repetition in content between lectures and podcasts. It must be stated, however, that other respondents considered such repetition to usefully reinforce key points.

The questionnaire and follow-on focus groups concluded by asking students how the podcasts themselves, or their use on the course, could be improved. There were only 12 responses to this in the questionnaire. Apart from the poor sound quality in the desert podcasts

(n=3), respondents commented upon the addition of material beyond lecture notes to stretch and challenge them (n=2):

'Expand on lecture material to provide a bit more detailed information' [Questionnaire 19]

A further issue was integrating the flexible technology into the scheduled sessions to allow interaction and feedback (n=3):

'could be used as part of a lecture or as a seminar with group discussion' [Questionnaire 7]

The focus groups elicited general agreement from students about being able to interact with podcast content and having the facility to ask questions immediately in order to chart their progress and understanding:

'Have questions on them so it's more interactive … instead of just watching it you actually interact with it … maybe have feedback in seminars' [Focus Group 2]

Overall, however, comments for improvement were concerned with deploying the podcasts over further parts of the course (and even across the programme) (n=4):

'A podcast to support key topics is very good - summarises points as good revision aid. If all [courses] had visual learning it would be very beneficial' [Questionnaire 23]

Evaluating the effectiveness of the podcasts for revision and summative assessment
Responses from the questionnaire survey undertaken at the close of the ecosystem teaching block indicated that students expected the podcasts to help with their course revision and examination (22 out of 23 respondents). Respondents stated repeatedly that they would access the podcasts prior to revision, because the resource offered an accessible method of revision in a variety of ways:

'They are a good source of information and can be watched more than once to test yourself'
[Questionnaire 18]

'Getting away from books helps, different methods keep me interested and concentrating'
[Questionnaire 13]

'It will allow me to think of the podcast images which could trigger key points to my answers'
[Questionnaire 15]

Half the respondents made specific reference to visual learning associated with podcasts and the fact that they expected this to be an easier way to learn and remember information and subsequently extract it in relation to assessment when compared to reading written material.

Following the course examination, responses in the focus groups (n=10) indicated that the podcasts were universally perceived as useful/very useful for revision and assessment. By the end of the course, the majority of respondents had watched the podcasts two or three times, with one respondent having watched the first desert podcast six times. On average, with respect to frequency of viewing, each of the respondents watched each podcast twice as part of their learning and revision activities. In terms of when the podcasts were watched, there was a duality of engagement, with students viewing podcasts within a week of the lecture and/or at a later date in support of exam revision. It remained common for students to watch the podcasts outside of usual working hours (between 6pm and 8am).

Reasons cited regarding the usefulness of the podcasts as a revision aid included:

'They provided visual references … useful for an essay structure guide' [Post-exam Focus Group 1]

'visual aspect of podcasts helped with remembering key things – I was able to picture images from the podcast in my mind. They were also an enjoyable alternative to revising with books' [Post-exam Focus Group 2]

'… allowed me to assess how much I had actually remembered and how much I needed to re-read, or read first time' [Post-exam Focus Group 2]

Students indicated generally, however, that they used the podcasts in conjunction with other aids such as lecture notes and textbooks/journal articles, often as a starting point to their revision:

'I struggle sometimes trying to actually start revision … and then I could make notes from the podcasts and then go and expand those notes by reading stuff from the library' [Post-exam Focus Group 1]

'It was a good starting place for my revision as I looked at my notes and got a bit scared that there was a lot of material there … and then having watched the podcasts go back to my notes and think oh well that makes a bit more sense now' [Post-exam Focus Group 2]

In order to examine whether student perceptions were matched by assessment performance, exam results were reviewed to ascertain whether there were any significant differences in grades for particular themed questions comparing 2008-2009 (with podcasts) to 2006-2007 (prior to podcasts). In both years, the two most popular questions answered concerned desert ecosystems and rain forest diversity (82% and 52% respectively in 2009 compared to 97% and 38% respectively in 2007). The average mark for the desert question in 2009 was 60.4% compared to 57.9% in 2007. There was no significant difference in the grades for the desert questions when comparing the years 2009 and 2007 (student t test at p=0.05). Likewise, for the rain forest diversity questions, the average mark in 2009 was 56.2% compared to 58.1% in 2007. This also represented an insignificant difference in performance (student t test at p=0.05). Whilst 70% of students gained an upper second or first class pass on the desert question in 2009 (compared with 45% in 2007), only 35% gained these classes for the rainforest diversity question in 2009 (compared with 58% in 2007). As a

baseline comparison, there were no significant differences in average Level 2 performance between these two cohorts.

Discussion

Agreeing with findings of the IMPALA 2 report (Nie et al. undated), students engaged with the podcasts, watching them numerous times largely within a week of lectures and/or during revision for summative assessment. They rated them generally as enjoyable and informative. It was intended, through the deployment of podcasts in multiple formats, to empower students to elect when, where and how to use the technology. In other words, students were allowed to control this element of their learning according to individual preferences and learning styles (Hartley and Bendixen 2001). The results highlighted the creation of flexible spaces and times of learning (France and Fletcher 2007; Lynch et al. 2008), defined by the students as users of technology. The exotic 'outside' was brought into the learning experience, but not necessarily into the classroom and often not within working hours. Students tended to watch the podcasts at home, but some opted to view them during bus/train journeys. The traditional learning space of the classroom was expanded by technology into user-defined informal spaces, which were, to a certain extent, both spatially and temporally fluid in nature. Engagement with academic subject matter was absorbed into everyday life using the technology, blurring social and academic territories and prompting personalised interactions with the material (Knight 2006).

The convenience of accessing the podcasts at home and engaging with their content by making written notes was highlighted by many respondents, as was the ability to repeat podcasts in order to retrieve information, clarify issues and highlight knowledge gaps. Thus, although the visual nature of the podcasts was relatively novel in terms of teaching methods, the way in which students integrated podcast information into their learning experience was

often traditional (McKinney et al. 2009). Many students preferred to view the podcasts at home in order to concentrate on the learning process. This linking of virtual with traditional learning mediated spatial flexibility more so than temporal flexibility.

There was agreement amongst students that the podcasts could be used as a resource to support learning and teaching on the course (Salmon and Edirisingha 2008; Fernandez et al. 2009). They were keen to stress, however, that podcasts should not replace lectures and field trips, but be used as an additional resource. The visual aspect of the podcasts - seeing specific environments and ecological processes in context and with immediacy - was considered to be a key strength of the resource, providing variety and interest in the teaching and learning experience (Kuzma and Haney 2001; Ansell 2002; Fox 2005). Students were provided with access, albeit remote, to external environments which they might not otherwise have the opportunity to see. In this way, abstract concepts were provided with referents so that students could see what the lecturer was trying to explain, moving the concepts from a detached explanation in a lecture into students' visually connected worlds. Whilst the podcasts were deemed particularly useful by those students who self-avowed a more visual approach to learning (Felder 1993), many respondents in the focus groups articulated a perception that a combination of different media could improve their learning (Robert and Dennis 2005). In conjunction with other teaching methods, podcasts consequently add variety to learning resources to support a range of learner styles.

Students believed the podcasts reinforced and built on lecture notes. However, they perceived the primary strength of the podcasts to be helping them remember facts, as opposed to facilitating deeper understanding of processes. There is a need, therefore, to anchor the flexibility of the technology within more traditional learning frameworks such as seminar discussions, with activities scaffolded (supported) and anchored (made purposeful) by the tutor. Such interactive discussion might help students move from the acquisition of factual

information to the understanding of 'threshold concepts' and 'troublesome knowledge' in environmental studies (Bradbeer 2005; Meyer and Land 2006). Thus, although learning can be undertaken autonomously by students in technological spaces, social constructivist approaches to learning (Vygotsky 1978) recognise the importance of communities of learners and the social construction of knowledge (Livingstone and Lynch 2002). There is a need to unite social constructivist and critical pedagogies when employing podcast technology, as has already been noted with respect to video/film more generally (Huckle 1995; Gold et al. 1996; Kuzma and Haney 2001; Staddon et al. 2002).

The podcasts were perceived as a useful resource for revision and assessment (see also Copley 2007; Evans 2008; Lazzari 2009). Students commented that podcasts provided visual images that helped them to remember facts, highlighted their knowledge gaps and, during the exam itself, triggered their memories and offered a structure for their answers. What is notable in terms of revision is that some students, in repeatedly accessing the 'original' material, never compiled summary notes. This offers advantages and disadvantages in that, whilst they referred repeatedly to detailed information in context (an activity not undertaken as frequently with respect to written text), they did not necessarily process the podcasted material nor synthesize it to make synoptic revision notes.

Although the results suggested an improved learning experience as far as subjective student perceptions were concerned, there were no significant differences in examination essay grades when comparing cohorts prior to and post adoption of podcasts. Although only implicit inferences can be made about the effectiveness of the podcasts on student learning due to the coarse nature of the comparison, viewing the podcasts did not significantly improve the performance of a cohort overall. However, for a desert question that was supported by all three desert podcasts, it did seem to inflate the number of students gaining upper second or first class grades as opposed to lower second or third class grades. By contrast, a rain forest

diversity question, supported by a single podcast, actually returned lower proportions of upper second and first class grades than in a previous year when podcasts were unavailable. These results contrast with the findings of Lazzari (2009), which might be explained by the latter study requiring students to create their own podcasts. As such, their work in podcast design, recording and editing may have enhanced factual retention and deep learning. These results indicate a need to engage students further with the podcasts, prompting them to examine and discuss podcast content, structure and application.

Conclusions and future development

While student responses were positive in terms of engagement with and utility of podcasts in support of learning and teaching, issues have arisen that need to be addressed if the technology is to be both extended and integrated successfully into the teaching and learning toolkit. The key to improving the student learning experience with regard to video podcasts appears to lie not in adopting new pedagogy, but in reflexively developing the existing pedagogic strategies employed by both teachers and learners. Of primary importance here is the deployment of podcasts strategically in two senses:

1. To blend multiple spaces of learning from the technologically virtual to the spatially defined classroom in order to enrich the student learning experience;
2. To unite the individual learning experience of podcasts with group exploration and discussion in a collaborative learning framework.

Thus, although podcast technology might be described as relatively new, with resultant learning and teaching spaces (and times) displaying a more fluid nature, pedagogical strategies supporting student learning remain traditional. Students and teachers still need to

work together in a social constructivist mode (Vygotsky 1978), as advocated by proponents of film in the classroom (Kuzma and Haney 2001; Ansell 2002). This reasoning is based on the advantages of conversation (Pask 1975), whereby students are afforded the opportunity to iteratively build on the knowledge they have gained from podcasts by reflecting and negotiating alternative viewpoints. It is also based on the contention by Laurillard (2002) that the success of learning technologies depends on embedding them in existing collaborative learning contexts.

As a consequence, over the academic year 2009-2010 independent viewing of podcasts is being integrated with formal group seminars to prompt student discursive engagement ('teach back'), student-staff interactive dialogue and reflection. The aim is to advance students along the hierarchy of the affective learning domain (Krathwohl et al. 1964). By watching the podcasts the students place themselves at the lowest stage of the affective hierarchy; receiving information. If they discuss the podcasts in a group seminar, they advance along the hierarchy; responding to the information the podcasts contain. They can also be directed, to some extent, to value and organize information by considering how to apply it to various forms of critical enquiry, including formal assessment. Advancing along the affective hierarchy tends to support progression through the stages of the cognitive learning domain, from knowledge to comprehension, application and analysis (Bloom et al. 1956). The application of the podcast information in seminars will also allow students to benchmark themselves in order to ascertain what they have learnt from adopting the technology and it will help the tutor to assess levels of student comprehension. In short, there is a need for the technology to be integrated effectively into the learning environment, supporting and enhancing existing structures and practices, with the aim of offering a structured autonomy to students.

Acknowledgements

Notes on contributors

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Table 1. The content of the video podcasts used in the research

Hot Desert	Tropical Rain Forest
1) Types, climate and vegetation survival mechanisms (14.57 minutes) *Learning objectives:* i) Understand that there are different types of hot desert around the world ii) Understand that vegetation is adapted to survive in a number of ways	**1) Occurrence types and vegetation characteristics** (21.28 minutes) *Learning objectives:* i) Identify where rain forests are found and describe the nature of their climate ii) Explain the different types of rain forest found at varying spatial scales iii) Understand the vertical structure of the rain forest iv) Understand vegetation is adapted to the environment, creating specialist life forms v) Understand the forest growth cycle
2) Habitat variability, local resource partitioning and community characteristics (14.10 minutes) *Learning objectives:* i) Understand how plant species adapt to differing amounts and qualities of water and to varying topography, soil types and soil nutrients	**2) Biological diversity over space and time** (17.47 minutes) *Learning objectives:* i) Explain the concept of biodiversity ii) Explain theories/processes maintaining high diversity in the rain forest
3) Animal survival mechanisms and synecological interactions (13.54 minutes) *Learning objectives:* i) Understand that animals possess a number of survival mechanisms ii) Understand that animals are adapted synecologically	**3) Destruction and management** (20.28 minutes) *Learning objectives:* i) Identify agents of rain forest destruction and where they occur ii) Evaluate amounts of loss iii) Understand ecological impacts of different agents of destruction iv) Recognise the complexity inherent in rain forest conservation

Note: Filmed on location in Tunisia, Australia, the Caribbean, French Guyana and Brazil

Figure legends

Figure 1. Student perceptions of the overall utility of the podcasts as a teaching and learning resource

Figure 2. Specific student perceptions of the learning utility of the podcasts

Figure 3. Student perceptions of specific aspects of learning as supported by the podcasts