The use of streamed lecture recordings: patterns of use, student experience and effects on learning outcomes

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Abstract
We describe a study conducted during 2008–2009 that investigated three issues relating to the use of streamed video recordings of classes by students at the University of the Highlands and Islands. We investigated (i) the pattern of use of the resource, (ii) the student experience and (iii) the impact of watching the streamed classes on learning outcomes measured by retention of factual content. We found that most (61%) of the recordings were being used by students, with a peak in usage mid-semester. Students were mainly using recordings to replace class attendance on occasions when they could not be present, though routine use of the resource by fully online students was also common. Significant technical issues reduced the quality of the experience, although the experience was still reported as positive by most (65%) of students who had used the resource. All students who had not used the recordings reported that they would be interested in such a resource. We could find no difference in retention of factual content between our sample of students who attended classes compared with those who viewed a recording, however our sample was small. We suggest that this technology should be fully adopted, and recommend elements of development that should be addressed to maximise the full benefits to learning.

Keywords
Blended learning; recorded lectures; learning outcomes

Introduction
Many institutions are now investing heavily in the technology that enables the recording of lecture material for distribution in a media file which can be disseminated either over the internet ('streamed') or downloaded (podcast) for playback by students. Science, engineering and computer-based courses have adopted the technologies most readily (Hew, 2009). These technologies provide clear opportunities for staff **and** students, but to enhance the learning experience, there needs to be an understanding of the way in which it is used.

The University of the Highlands and Islands (UHI) links over 8,000 students dispersed across the highlands and islands of Scotland. Teaching and learning are structured around a blend of face-to-face elements and distance provision. Some courses are delivered fully face-to-face, while others are delivered fully online. Many courses employ a mixture of delivery modes within the programme of study. This mix permits flexible learning in terms of time, place and pace for many students, but it also presents complex challenges, relating to the differences in pedagogy of distance versus face-to-face education. Key features of effective learning (achieving active engagement, group participation and cohesion, frequent interaction and feedback and presenting ideas in real world contexts) are achieved using different structures and pedagogies in face-to-face versus online learning (McFarlane, 2011).

In this study, we explore the pedagogical issues relating to one aspect of technology (the streaming of video conference classes) which forms part of the toolkit of resources available to lecturers at UHI to foster learning in a diverse student cohort.

To date, there has been little evaluation of streamed lecture recordings, with podcasts, mainly audio rather than video, receiving more attention than streamed recordings (Salmon and Edirisingha, 2008, Hew 2009). As the distinction between streamed media and podcasts relates to the mode of distribution of material rather than inherent differences in content, results may have some relevance across the breadth of technologies.

In general, studies have found that students are enthusiastic to use recorded materials and that their voluntary uptake of such resources is high (Copely, 2007; Salmon and Edirisingha, 2008). However, staff often voice concerns about the limited possibility for interaction with such resources (Woo et al., 2008). Students generally report a positive experience of using these web-based learning technologies (Copely, 2007; Pilarski et al., 2008; Woo et al., 2008) although technical issues with sound or audio quality were issues for some streamed recordings (Akiyama et al., 2008).

Evidence suggests that students mainly use podcasts to aid revision for examinations (Copely, 2007; White, 2009; Hew, 2009). A positive impact on assessment performance has been associated with viewing online recordings (Akiyama et al 2008, Wieling and Hofman 2010). Despite the concerns of lecturers (Woo et al., 2008), no evidence has been found to show that class attendance falls with the availability and use of lecture recordings (Copely, 2007; Hew, 2009; Nast et al., 2009; White, 2009). Students report the advantages of regular scheduled study and the opportunity to ask questions as being important factors in influencing their decision to attend classes, if they can (Copely, 2007).

Video recordings of lecture material have been less widely used than audio, in part because of the additional complexities and hardware requirements needed to record video at most institutions (Copely, 2007). However, for institutions that routinely use video conference (VC) technology these barriers are much less of an issue. The UHI links students from 13 academic partners and many additional learning centres with their tutors and peers via a combination of technologies, with video conferencing being a major component of the blend of learning in many programmes. In 2007, the university adopted technology (Codian IPVCR 2200) to initiate a pilot project to permit recording of VC classes and subsequent distribution to students via a web link. Recordings are made at the request of the tutor, capture the elements of the VC class (tutor, students, visual material, e.g. PowerPoint slides) and are stored for two weeks. However, during our study, server space permitted recordings to be stored for the course of the semester. Tutors provided the web link and a unique code for each recording via the virtual learning environment (Blackboard).

The purpose of this research was therefore to contribute to building an understanding of the use of recorded lecture material by students, particularly within the specific context of video conferencing employed at the UHI. To do this, we identified three aims:

1. to investigate the **pattern of use** of the recordings.
2. to describe the **student experience** of using the recordings.
3. to evaluate the impact of using recordings on **retention of factual information**.

Methodology

Pattern of use

The number of completed playbacks of recorded video classes and the date on which the playback took place was collated and analysed to establish the pattern of use during January–May 2009 (semester 2). Downloads were excluded from the analysis as students were thought to be unlikely to download such large files. Thus we may underestimate the extent of the use (157 downloads recorded).

A total of 578 of the 2201 video conference classes (26%) held during this semester were recorded, spanning 47 different courses. Recording length reflected the most frequent VC teaching slot (1hr 27 min 35 sec, s. d. 0.08 minutes).

Survey of student experience

An online survey (Survey Monkey) consisting of a mix of 24 open and closed questions (responses recorded on a Likert scale), was emailed to all current enrolled students at the UHI (approximately 8000 students) from November 2009 to January 2010.

A USB stick was offered to a randomly chosen participant as an incentive to participation. Data were treated confidentially and anonymously.

The impact of watching the streamed classes on learning outcomes, assessed by retention of factual content

We investigated how effective watching the recorded classes was as a learning tool by assessing the retention of factual content by students as a variable which we considered to be relevant to the achievement of learning outcomes. However, clearly this does not capture all elements of learning.

The study involved voluntary participation from students taking a first-year ecology module at UHI. The cohort of 34 students were geographically dispersed across the highlands and islands, with some attending weekly VC classes, while others were distance learners, studying fully online using the virtual learning environment (Blackboard). The study was explained to the whole class (34 students) before they volunteered, and a book voucher was presented to one random participant as an incentive. All data were anonymised.

Nineteen students who chose to participate in the trial were randomly divided into two groups and the trial conducted over two classes in April 2009.

- Group A students attended the first class (termed **'attend'**) by participating in the video conference session. They did not attend the second class, but instead viewed the streamed recording of the class (referred to as **'view'**).
- Group B were asked to 'view' the streamed recording of the first class, then 'attend' the VC for the second class.

All students were then asked to take a short (17 questions) factually based quiz delivered through the virtual learning environment (VLE) (Blackboard) 7 ± 2.7 (n = 14) days after either attending the class or viewing the recording. This 'matched pairs' design aimed to limit the influence of individual variation in performance and thus to maximise the power of the test with a small sample (Sokal and Rohlf, 1994).

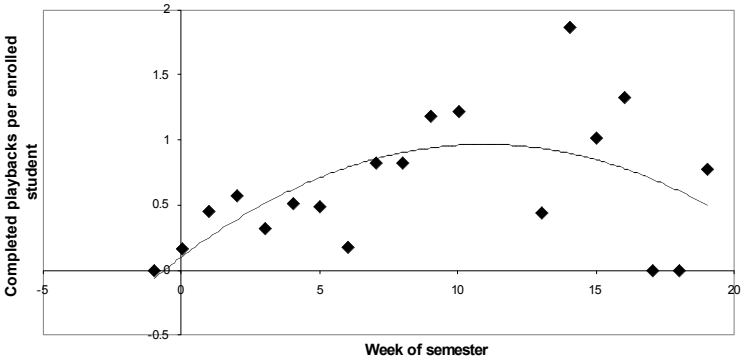
Results

Pattern of use

Sixty one percent (354 recordings) of recordings had at least one playback. The median number of playbacks per recording was 2 (IQR 0, 7), with a maximum of 53 playbacks for a single recording. As the number of playbacks may be expected to vary with class size, the number of completed playbacks for each recording was expressed per student enrolled on each module, where these data were available. The mean number of playbacks per student was 0.78 +/- 1.5 per head, n = 564 (median = 0.157).

To examine the temporal pattern of use throughout the semester, a mean weekly value for the mean number of playbacks per student was calculated across modules. There was a trend towards increasing use during the early part of the semester, peaking mid-semester, represented by the polynomial regression line in Figure 1.

Figure 1.



Mean number of completed playbacks per enrolled student during the course of the semester. Excluding a two week 'reading period' (weeks 11–12, when only one module held classes), the data are described by a quadratic polynomial function:

(F2,16 = 4.075, p = 0.037, y = 0.158x – 0.007x2 +0.100, adjusted r2 = 0.225).

Survey of student experience

A total of 175 students responded to the survey. This low return rate (approximately 2%) was a consequence of our inability to target students with experience of delivery by VC. However, this issue was addressed within the survey by filtering the appropriate student groups for questioning according to their responses.

Sample profile

Our sample comprised mainly undergraduate degree students, with some participation by HNC/D and postgraduate students. 55% of respondents said that either their current or a previous course had included some teaching by video conferencing. Many (58%) of these students were aware that VC classes were recorded in their programme of study, although 33% said they didn't know whether this facility was used or not.

Accessing the recordings

Of those students who knew that recordings were being made for their programme, 65% knew how to access them, the remainder either having some knowledge but not feeling confident (19%) or having no knowledge (16%). Most of these students had watched the recordings, either once or twice (40%), or regularly (at least once per week, 31%). The majority (94%) accessed the recordings on their home computer, with only a small minority using college equipment (6%). Most (77%) of students found they had the appropriate software to access the recording, although recordings played smoothly for only 46%.

Reasons for using the recordings

Students not aware of the recordings were asked whether they would be interested in such a resource and all (100%) indicated that they would. Students were asked to select the main reasons why they would be interested in using the recordings and to rate these on a three-point scale. Students who already used recordings were asked to rate their reasons on the same scale. For both groups, the main reason was 'I can catch up on occasional classes that I cannot attend' (Table 1). Subsidiary reasons included the ability to navigate within the recordings, and the opportunity for recordings to be used as a revision aid. Students indicating that 'other' reasons for non-use were important cited:

- routine difficulties in attending classes due to work commitments;
- difficulties in hearing or taking notes in class; and
- specific support needs which made it difficult to participate in VC classes.

Answer Options	Response Count for students using the resource	Response Count for students not currently using the resource
I can catch up on occasional classes that I cannot attend	84	88
I can study at a time which suits me	67	72
I can use the recordings as a revision aid prior to exams	75	85
The recordings are useful for my specific learning requirements which make it difficult to take notes in class	46	41
I study fully online and rarely / never attend a college or learning centre	37	47
These recordings give me a chance to see tutor or classmates	38	46
I like having the flexibility to move backwards and forwards (to recap on important points)	74	85
Other	24	13

Table 1.

The response rating count (calculated as number of responses by importance, very important = 3, important = 2, least important = 1) indicating the main reasons for using the streamed VC recordings, for 35 students currently using the resource and for 35 students not aware of the resource.

Playing the recordings

Most students who used the recordings found the experience 'positive' (51%) or 'very positive' (14%), although the experience was 'negative' for 17% and 'very negative' for a further 9%. Technical issues (buffering, recordings not playing fully or poor sound or picture quality) were by far the main issue reported as detracting from the experience.

Teaching and learning

Tutors at UHI are encouraged to adopt a seminar or tutorial approach to structuring VC sessions, rather than a more traditional lecture which is not thought to engage students across the VC. Students were asked to identify the format of material included in the recorded classes and also to identify formats that they would like to see in classes. The results (Table 2) indicated that most classes contain a lecturer delivering content to the camera, but illustrations such as PowerPoint slides and other images are also commonly used, as are group discussions and question-and-answer sessions. Students would like to see more multimedia, e.g. video, and fewer discussions or question-and-answer sessions in their recorded VCs. While some students did not feel part of the class and missed opportunities for interaction, others felt the recordings gave a good opportunity to see and hear discussions from other members of the class.

Answer Options	Classes contain	Would like to see…
A talking head (lecturer delivering content directly to the camera)	85.7%	62.5%
Lectures illustrated with documents, PowerPoint slides, images	74.3%	87.5%
Lectures illustrated with multimedia eg; video clips	34.3%	59.4%
Group discussions	77.1%	56.3%
Questions and answers	68.6%	46.9%
Tasks	31.4%	31.3%
Other (please specify)	14.3%	5.7%

Table 2.

Percentage of respondents indicating that their recorded classes contain certain types of teaching formats, compared with the percentage of respondents indicating a preference for these formats to be included in recorded sessions.

To improve the experience of the recorded classes, students identified better audio and image quality as being of primary importance (91%). Some (30%) would like to see shorter edited recordings and some (27%) would prefer focused delivery of lecture content rather than class discussions, though comments were mixed, with some (distance learning) students noting strongly how important they find this opportunity.

The impact of watching the streamed classes on learning outcomes, assessed by retention of factual content

Due to practical difficulties, some students were unable to engage with the classes in both study modes as scheduled. This meant that the group sizes were uneven, with 6 attending class 1, and 8 viewing that recording, 6 attending class 2 and 12 viewing the recording. Only 6 students completed both quizzes after attendance in each of the two modes, 3 in group A (attended first, viewed second) and 3 in group B (viewed first, attended second).

As the sample size for the matched pairs analysis was reduced, we decided to undertake:

(a) non-parametric statistical analysis in both with the matched sample (with n = 6);
(b) and (b) an independent samples analysis using all complete quizzes.

Using data from 7 students who took both tests after engaging with both classes in the same mode, (5 'viewed' both classes and 2 'attended' both classes), there was no significant difference in median score between the two quizzes for these students (Wilcoxon test, a = 0.338, P = 0.735) suggesting that the two quizzes were comparable tests of information retention.

Matched pairs analysis

There was no significant difference (Wilcoxon z = 1.214, p = 0.225) between median scores following class attendance (14.25, 9.8–15.4 (IQR)) compared with those following viewing the streamed recording (13.0, 9.6 – 14.0, n = 6).

Independent samples analysis

Again we could find no significant difference (Mann-Whitney u test u = 92.5, p = 0.289), between the median score for students who attended the class (12.1, 10.4–14.4, n = 12,) compared with that for students who viewed the recorded class (13.4, 12.9–14.0, n = 20).

Conclusion

Through a triangulation of three approaches, this study has demonstrated the potential positive impact that the recording and streaming of lectures on effective learning in a multi-campus university. The study has quantified the extent of current usage of the streaming technology at UHI and described both the positive aspects and the current constraints on the student experience of using streamed recordings. We have also demonstrated a robust methodology to compare learning outcomes in a class setting in order to evaluate such advances in technology.

Implications for practice

In summary, both students and staff were engaging with the recording technology during this pilot phase and most recordings were being used by some students. The pattern of use rose during the early part of the semester then tailed off before the end. This suggests that the peak in use before assessments, which has been reported elsewhere and which may have been expected from the student survey, did not take place. Barriers to this use include short storage times for recordings, or at least an expectation that storage times would be short. The issue of persistence of recordings throughout the semester should be addressed if this type of use is to be facilitated.

Despite significant technical problems both with playing the recordings and with the audio and image quality of the product, there was a strong enthusiasm among students for the streamed video resource, both from those who had, and those who had not yet, used the resource. Significant upgrades to video conferencing hardware and to the means of storing recordings at the University of the Highlands and Islands during 2009–10 should have addressed some of these issues.

If the technology is to be fully adopted by staff and students across the university, our student survey suggests there are significant training needs, which must now be addressed. Students must be made fully aware of the existence of the resource and the way to access recordings. Staff must also be made aware of the importance of distributing the link to the recorded classes in a timely manner. The ability to edit the recording and to provide index marks to identify significant points in the lecture would improve the experience of watching the recordings.

We suggest that practitioners should define the educational goals to be met by using the recordings, so they can identify the appropriate content and format for the recordings. At present, our recordings are being used mainly by students who attend VCs but who require a backup for classes that are missed or to recap on complex material. Although the class recordings may be enriched for this purpose by the further addition of multimedia resources, the product does not require major changes to suit this use. However, students who cannot attend classes at all (fully online students) are also users of the resource at the university, and the requirements of this group may be significantly different.

We had anticipated that a shorter recording of a tutor delivering content directly to the camera may have been more appropriate for these students; however our study suggests that at least some of these students feel that they gain significantly from being able to see and hear class discussions. The lack of ability to interact is a significant concern and it is essential that these students are offered an alternative form of interaction with staff and peers in other components of their course. Discussion boards and quizzes are examples of asynchronous interactivity which are routinely used to engage online students. At UHI, synchronous virtual classes (facilitated using the Blackboard 'Chat' or 'Virtual Classroom' facility, or using technologies such as Skype, phone calls or audio conferences) are also currently used to give opportunities for questions, immediate feedback and peer interaction.

Although our investigation into the retention of factual content was restricted by our small sample size, we felt that the methodology was sound and that the approach should be applied to a larger cohort to provide a more robust test. Our results were consistent with previous studies, which found that retention in students who have watched recordings of lectures was at least as high as those who attended the class (Akiyama, Teramoto and Kozono, 2008: McKinney, Dyck and Luber, 2009). This may suggest that concerns over the quality of the learning experience of students viewing recorded classes should focus on aspects of the experience other than retention, for example, engagement, enjoyment and group cohesion.

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