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Enhancing large-class teaching: a systematic comparison of rich-media materials

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Enhancing large-class teaching: a systematic comparison of rich-media materials

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Large cohorts (>200 students) are an ever-increasing presence in the UK higher education (HE) sector. Providing excellent teaching and learning to these large classes is an ongoing challenge for teaching faculty, a challenge intensified when the cohort comprises 85% non-native English speakers. This paper presents the findings of a project to supplement face-to-face lectures on a large campus-based taught MSc programme with a set of rich-media materials. These resources consisted of audio podcasts, audio-narrated slides, short video segments and full-video lecture capture. The aim of the study was to examine student usage of, and preference for, these different rich-media materials. Key findings are that students valued most highly the full-video lecture capture followed by the audio-narrated slides, using the materials primarily to consolidate their understanding and as revision aids. Students also emphasised the central importance of the face-to-face lecture – viewing the rich-media materials as complementary to, rather than as a replacement for the traditional lecture. Nor did the majority of students see the provision of videoed lectures as a reason for non-attendance at lectures. The findings of this study provide confirmatory evidence of the ongoing importance of the traditional lecture in large cohort HE teaching together with an acknowledgement of the benefits that rich-media materials can bring to the student learning experience.

Keywords: higher education; large class; learning technology; rich-media; student learning

Introduction

Virtual learning environments (VLEs) are near ubiquitous in higher education (HE), access to the Internet is available round the clock and recent research suggests that many of today's students are shunning textbooks in favour of Apple's iTunes U or YouTube video clips (Kennedy, Judd, Churchward, Gray, & Krause, 2008; Thorne & Payne, 2005). Responding to this shift in the pedagogical landscape many teaching faculty have embraced new technology in their classes (Laurillard, 2007; Mason & Rennie, 2008; Sharpe, Benfield, Roberts, & Francis, 2006) leading to a proliferation of research into the use of rich-media materials in HE institutions (Copley, 2007; Parson, Reddy, Wood, & Senior, 2009; Sutton-Brady, Scott, Taylor, Carabetta, & Clark, 2009). For the purposes of this study, the authors use the expression 'rich-media' to include any pre-prepared video, audio and images (both still and animated) which are created for the purposes of teaching and learning. In order to ensure a

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systematic and controlled comparison of a set of number of formats of rich-media materials, this study excluded social media or other more interactive rich-media materials.

Previous research on the use of rich-media materials has generally focused on individual rich-media tools. To the best of our knowledge there is no work which systematically examines student usage of and preference for a range of formats of rich-media materials, which each cover the same core material. With this in mind, we assessed which rich-media materials the students preferred, for what purposes the students used the different materials and how these rich-media materials compare with the more traditional face-to-face lecture in terms of the student learning experience. This study, whilst original in terms of a systematic comparison of a set of rich-media materials is still largely predicated on a transmission model of learning. Both face-to-face lectures and rich-media materials were made available with students free to choose which of these learning resources to make use of. In this respect the underlying pedagogy of the unit was not radically altered in this study; a choice that was justified given the large size of the cohort and the available resources to run the unit (a limitation to which we shall return during the discussion and conclusions).

Background and theoretical framework

Accompanying the rapid developments in the domain of educational technology has been a siren call for the replacement of face-to-face lectures with various technological alternatives ranging from increasing use of social media, online discussion forums and massive open online courses. As the debate intensifies, it is helpful to take a step back and consider what face-to-face lectures can offer that technology cannot and also what benefits technology can bring to HE teaching and learning. McKenzie and colleagues (2013) argue that lectures offer a unique opportunity to extend prior knowledge and to engage in debate and learning with an individual expert in the discipline. Evidence from Sharpe, Benfield, Roberts, and Francis (2006), Ipsos (2007) and Saunders and Gale (2012) confirms that students continue to value highly the traditional lecture, viewing technology only as an adjunct to effective face-to-face teaching. This is not to say that all traditional lectures provide an effective platform for student learning; a good lecture will include well-delivered, engaging core material, accompanied by ample opportunities for students to test their understanding, ask questions and receive feedback – a challenging endeavour with cohorts in excess of 200 students (McKenzie et al., 2013). Whilst face-to-face lectures are still largely predicated on a transmission mode of learning (Sfard, 1998), it is here that technologies can enrich the student learning experience and improve student learning (see, for instance, Collis & Moonen, 2001; Davidson & Orsini-Jones, 2002; Laurillard, 2002; Mason & Rennie, 2008; Sharpe et al., 2006). Learning technologies, if considered as an intrinsic part of course design, can help students move from learning centred on knowledge acquisition to learning based on participation (Collis & Moonen, 2001). It is highly responsive and can be tailored to fit the pedagogy of a particular course unit (Laurillard, 2002). Technology can also enable students to learn at their own pace, incorporating elements of peer-to-peer learning to foster interaction and collaboration amongst students (Bolliger, Supanakorn, & Boggs, 2010; Matulich, Papp, & Haytko, 2008).

Much of the literature on using rich-media in teaching and learning draws on Mayer's (2001) cognitive theory of multi-media learning as its theoretical framework (see, for instance, Walls et al., 2010). Mayer states that the learner is 'a knowledge

constructor, who actively selects and connects pieces of visual and verbal knowledge' (Mayer, 1997, p. 4). Mayer's theory also assumes that students have limited capacity for processing learning and that students learn best when interacting actively with course material (Mayer, 2001) – something which cannot necessarily be relied upon in a large cohort face-to-face lecture. However, the ability of rich-media in all its forms to be paused, replayed and reflected upon can provide a powerful tool for learning. Presenting the same core material in a range of delivery styles including both face-to-face lecture and rich-media formats might also foster the creation of networks of connections that Siemens (2005) argues are central to ongoing learning.

Rich-media terminology

Podcasts are defined as 'digital media files distributed through the internet and downloaded through syndication for playback through a computer or MP3 player' (O'Bannon, Lubke, Beard, & Britt, 2011, p. 1). Podcasts may be audio-only files (audio podcasts), enhanced podcasts (files containing both audio and visual elements such as narrated PowerPoint presentations) or video segments which integrate both video and audio elements (Bolliger, Supanakorn, & Boggs, 2010; Holbrook & Dupont, 2010). Common to all types of podcasts is the ability to subscribe via really simple syndication feeds, which allows teaching faculty to 'push' content out to the student users.

Lecture capture is defined as 'a solution that captures classroom based activities in a digital format that is available for download or consumption over the internet' (McClure, 2008, p. 1). It involves either audio-only or both video and audio recording of a live lecture (see, for instance, Balfour, 2006; Davis, Connolly, & Linfield, 2009; Dey, 2008; Winer & Cooperstock, 2002). As the availability of high-specification lecture capture equipment increases, and its associated cost decreases, it seems likely that more and more lectures in HE institutions will be captured and posted to either the closed environment of the institution's VLE or more open ecosystems such as iTunes U.

Previous studies on rich-media in HE

Case studies on the use of rich-media in HE have been presented across a range of subject disciplines from business and education to biology, health sciences, psychology and engineering. A synthesis of this literature is provided in Tables 1 and 2. Table 1 divides the previous studies according to the type of rich-media material used – whether audio-only podcasts, enhanced podcasts, video segments or full lecture capture. Table 2 organises the extant literature in terms of Van Zanten, Somogyi, and Curro's (2010) 3Ps framework of pedagogy, purpose and preference – adding a fourth P of performance to assess whether previous studies have demonstrated a link between the use of rich-media materials and improved student performance.

Pedagogy

Table 2 demonstrates that the overwhelming majority of previous studies reported on the implementation of rich-media materials alongside face-to-face lectures, with only two studies (Beilke, Stuve, & Williams-Hawkins, 2008; Bolliger et al., 2010) employing rich-media materials in isolation. Rich-media materials supplemented, rather than

Table 1. Previous research studies classified according to type of rich-media materials.

Type of rich-media	Previous studies
Audio podcasts	Bongey, Cizadlo, and Kalnbach (2006); Donnelly and Berge (2006); Beilke, Stuve, and Williams-Hawkins (2008); Sutton-Brady et al. (2009); Bolliger et al. (2010); Pearce and Scutter (2010); Van Zanten, Somogyi, and Curro (2010); Walls et al. (2010) and Kazlauskas and Robinson (2012)
Enhanced podcasts (audio-narrated slides)	Copley (2007); Parson et al. (2009) and Holbrook and Dupont (2010)
Short video segments	Walls et al. (2010)
Full-lecture capture	Winer and Cooperstock (2002); Dey (2008); Davis et al. (2009); Parson et al. (2009); Pearce and Scutter (2010); Kazlauskas and Robinson (2012) and Leadbeater, Shuttleworth, Couperthwaite, and Nightingale (2013)

supplanted, existing course designs; with the aim of offering students either the opportunity to re-engage with already presented lecture content or to access supplementary course content. Pedagogical decisions were typically limited to choice of format and content of the rich-media materials (Van Zanten et al., 2010).

Purpose

These studies show that students use rich-media materials to aid assignment preparation, supplement note-taking in lectures and as a means of reviewing or revising course material. Audio podcasts are typically used as a tool for communication, for example, providing administrative information to students, or as a means of allowing students to replay a recorded lecture at a time convenient to them or to provide additional course materials (e.g., special lecture series or revision guides). Where the use of rich-media materials broadens to capturing full lecture content, their advantages extend to allowing students to catch up on missed lectures, improving accessibility to lectures for non-native English speakers, providing repeated access to lecture material to maximise understanding and increased support for student revision (Balfour, 2006). In the majority of studies, the rich-media materials are made available to students as optional additional resources, rather than as core material aimed at fostering specific learning strategies or increasing students' critical thinking.

Preferences

In spite of this, several studies were able to demonstrate clear benefits of rich-media materials (Table 2). Students found the additional materials useful in terms of revision and assessment and as a complement to existing lectures (Parson, Reddy, Wood, & Senior, 2009). Dey (2008) reports that the provision of lecture capture led to changed behaviour in lectures as students concentrated on listening rather than on note-taking. Donnelly and Berge (2006) conclude that podcasts, in particular, appeal to students for a number of reasons: firstly they offer a more personal style of delivery, secondly podcasts give students additional control over their learning and thirdly podcasts are portable, allowing students to replay recordings at a time and place which suits them.

Table 2. Four themes in the literature: pedagogy, purpose, preference and performance.

<i>Pedagogy</i>	
Rich-media materials used to supplement face-to-face lectures	Bongey, Cizadlo, and Kalnbach (2006); Copley (2007); Davis et al. (2009); Dey (2008); Holbrook and Dupont (2010); Kazlauskas and Robinson (2012); Leadbeater et al. (2013); Parson et al. (2009); Pearce and Scutter (2010); Sutton-Brady et al. (2009); Van Zanten et al. (2010); Walls et al. (2010) and Winer and Cooperstock (2002)
Rich-media materials used without face-to-face lectures	Beilke et al. (2008) and Bolliger et al. (2010)
<i>Purpose</i>	
Assignment preparation	Copley (2007); Parson et al. (2009) and Sutton-Brady et al. (2009)
Improving understanding and note-taking	Bolliger et al. (2010); Bongey et al. (2006); Dey (2008); Leadbeater et al. (2013); Parson et al. (2009); Pearce and Scutter (2010); Winer and Cooperstock (2002) and Van Zanten et al. (2010)
Revision	Copley (2007); Davis et al. (2009); Bolliger et al. (2010); Pearce and Scutter (2010) and Van Zanten et al. (2010)
<i>Student preference</i>	
Rich-media materials delivered learning benefits	Copley (2007); Davis et al. (2009); Dey (2008); Holbrook and Dupont (2010); Parson et al. (2009); Pearce and Scutter (2010); Sutton-Brady et al. (2009); Walls et al. (2010) and Winer and Cooperstock (2002)
Rich-media materials did not impact lecture attendance	Bongey et al. (2006); Walls et al. (2010) and Winer and Cooperstock (2002)
Rich-media materials had limited impact on lecture attendance (12–15% reduction)	Copley (2007); Davis et al. (2009); Dey (2008); Holbrook and Dupont (2010); Leadbeater et al. (2013) and Pearce and Scutter (2010)
<i>Student performance</i>	
Use of supplementary rich-media materials improved student outcomes	Bollmeier, Wenger, and Forinash (2010) and Moravec, Williams, Aguilar-Roca, and O'Dowd (2010)
Use of supplementary rich-media materials had no impact on student outcomes	Leadbeater et al. (2013)
Replacement of face-to-face lecture with rich-media materials had no significant impact on student outcomes	O'Bannon et al. (2011) and Schreiber, Fukuta, and Gordon (2010)

However, other researchers have sounded a note of caution. For example, in a study of nursing and business students, Kazluaskas and Robinson (2012) found that a minority of students did not engage with audio podcasts, preferring instead to learn from lectures and by reading the set texts. This finding is consistent with previous learning styles studies (see, for instance, Fleming & Bonwell, 1998) which suggest that students have preferences for different modes of absorbing material.

The other major concern expressed in the literature is that the provision of rich-media resources may lead to a decline in lecture attendance, especially if the whole lecture is captured using video and audio. Several studies (Copley, 2007; Davis, Connolly, & Linfield, 2009; Dey, 2008; Leadbeater, Shuttleworth, Couperthwaite, &

Nightingale, 2013) have investigated whether the use of full-lecture capture does indeed impact lecture attendance. These studies coalesce around the view that lecture capture can have a limited impact on lecture attendance, with estimates of reduced attendance ranging from 12% to 15%.

Performance

A number of studies have also sought to measure the impact of rich-media materials on student outcomes. Bollmeier, Wenger, and Forinash (2010) reported that the use of enhanced podcasts (containing audio-narrated PowerPoint slides) alongside existing lectures improved final exam performance, when compared to a control group that did not have access to the enhanced material. Similarly, Moravec, Williams, Aguilar-Roca, and O'Dowd (2010) found that student test scores increased by 21% when lectures were supplemented with enhanced podcasts. However, studies which simply replaced rather than supplemented face-to-face lectures with podcasting found no significant differences in student outcomes (O'Bannon, Lubke, Beard, & Britt, 2011; Schreiber, Fukuta, & Gordon, 2010), suggesting that the richness and effectiveness of rich-media is most effective when combined with existing lecture material rather than as a replacement for it – a hypothesis that this study sought to explore further by comparing the effectiveness of the different rich-media materials with traditional face-to-face lectures.

Method

The context of this study is the MSc in the Management of Projects, a large, campus-based postgraduate taught programme at The University of Manchester, which attracts over 300 students each year. The cohort is highly internationalised with upwards of 30 nationalities represented, of whom 85% have English as a second language. The large size of the cohort coupled with the wide variation in English language ability frequently leads to difficulties in providing effective teaching.

The aim of the study was to supplement existing face-to-face lectures on a semester-long optional unit of the programme (cohort size 184) with a series of rich-media materials and assess student preferences for, and usage of, these various tools. The rich-media elements focused on short (five to seven minutes) recordings of five core concepts, those building blocks that 'progress understanding of the subject' (Meyer & Land, 2003, p. 4).

Each core concept was made available in four different formats; an audio-only podcast, as audio-narrated PowerPoint slides, as a short video segment and as a video recording of the full lectures in which these core concepts were taught. Student preferences for these different rich-media materials were evaluated, by means of a questionnaire and student focus groups. The specific research questions posed were:

- (1) Which rich-media materials did the students prefer and why?
- (2) To what extent did the materials aid student learning?
- (3) For what purposes did the students use the rich-media materials?
- (4) How did the additional rich-media materials compare to traditional face-to-face lectures as a tool for learning?

Preparation and set-up

Selection of core concepts was based on the lecturer's experience of the topics that students in previous years had struggled to understand. The various recording methods are described in more detail below:

- (1) *Short video segment.* The lecturer was filmed whilst talking through a PowerPoint presentation, using a fixed HD camera and radio microphone. This footage was then edited in Apple Final Cut Pro so that the film and slide presentation were synchronised and presented together (Figure 1). The resulting video was hosted on a streaming server and a link provided on the Blackboard Learn™ VLE.
- (2) *Audio-narrated slides.* The lecturer recorded an audio narration over the PowerPoint presentation, using a headset with microphone. The narration was recorded using iSpring®, an add-on to Microsoft® PowerPoint, and then compiled through iSpring® into an Adobe® Flash movie object that included navigation controls (Figure 2). The Flash object was embedded into an HTML page and hosted on the VLE.
- (3) *Audio podcast.* The lecturer recorded audio commentary on the core concepts for audio presentation only, using a headset with microphone. The audio commentary was captured using Blackboard Voice Podcaster via the VLE where it was available for student subscription.
- (4) *Full-lecture video capture.* A fixed HD camera and radio microphone were used to capture the full lectures in which the core concepts were taught and

Figure 1. Short video segment.

Figure 2. Audio-narrated slides.

Final Cut Pro was used for some minor edits and to add titles. The resulting video was hosted on a streaming server and displayed through the VLE.

All core concept rich-media materials were made available to students a few days before the lecture they related to. Full-lecture videos became available a week after the lecture took place.

Data collection

There were two sources of data for the study; an anonymised web-based questionnaire of the 2011 student cohort (reproduced in Appendix 1) and student focus groups held once unit assessment had been completed. Eighty-four completed questionnaires were submitted, giving a response rate of 46%. The aim of the survey was to gather basic demographic information on the cohort, then to explore which rich-media materials the students preferred, to what extent they aided the students' learning and for what purpose they had used them. The questionnaire data were exported to Microsoft Excel, where descriptive analysis was performed.

Qualitative data were obtained from three student focus groups held after the end of the semester once the unit assessment was completed. The focus groups (each containing five students), were moderated by two researchers, independent of the unit lecturer to minimise the risk of students participating in the focus groups as a means of influencing their assessment marks, and ensure that the data gathered was focused solely on understanding why students preferred particular rich-media materials and how the materials compared to the face-to-face lectures. The focus groups were

semi-structured, with question prompts provided to encourage open discussion. The outputs of the focus groups were recorded, transcribed and textual analysis carried out (McCracken, 1988).

Data findings and analysis

The questionnaire and the focus groups provided a rich picture of students' usage of the rich-media materials. Respondents' demographics can be broken down into 74% men and 26% women, which equates broadly to the gender balance within the overall cohort. Only 18% of respondents were native English speakers; again this figure is in line with the overall cohort profile. Eighty-nine per cent of respondents described themselves as having good or excellent IT skills, with 83% having previously accessed rich-media resources online. Only a small minority of respondents experienced technical problems with the rich-media materials (Figure 3). Typical examples of problems were the slowness of the video streaming, and the inability to view the materials on particular devices.

Which rich-media materials did the students prefer?

Full-lecture capture was the most preferred form of rich-media (by 38% of respondents), followed by audio-narrated slides (29% of respondents), then short video segments and, in last place, the audio-only podcasts (Figure 4).

The focus groups confirmed these findings, with participants expressing a strong preference for as much content-rich material as possible. Full-lecture video capture was viewed by students as a 'comfort blanket', enabling students to view sections that they had missed, or failed to understand first time round. Replaying the full-lecture videos triggered students' memories of particular moments in the live lecture, helping them embed the learning more easily. Or, as one focus group participant said: 'parts of the lecture you forget when you go home, but as you watch the video

Figure 3. Percentage of respondents experiencing problems accessing the rich-media materials.

Figure 4. Student preference for different rich-media materials.

of the lecture, it triggers memories of the lecture and more content comes back into your head’.

Of the three shorter rich-media formats (audio-narrated slides, short video segments and audio podcasts), audio-narrated slides were the most popular. Students explained that the narrated slides, whilst not as content rich as the full lecture, still described the same slides as had been shown in the lecture, and so were seen as consistent with the lecture material. The narrated slides served as a focused source of both lecture preparation and revision material for students, enabling them to review key concepts in a time-efficient manner. Students also valued being able to ‘see and hear the slides’ simultaneously. In contrast, whilst the short video segments covered the same material, they were perceived by students as being visually less effective, as the slide text was made smaller to allow space for the lecturer’s ‘talking head’. Perhaps the narrated slides provided the optimum blend of audio and visual in view of students’ limited capacity for processing learning (Mayer, 2001). Introducing a third element of the lecturer’s talking head into the rich media, as was the case in the short video segments, may have overloaded the students with visual stimuli, thereby detracting from their usefulness for learning.

The audio podcasts were viewed least favourably in both the survey and focus groups, with participants commenting on the lack of visuals. However, the audio podcasts did have two advantages over other media: firstly that the students were able to ‘focus on the intonation and emphasis in the lecturer’s voice’ and secondly they provided the ability to multitask whilst listening to the audio files.

To what extent did the rich-media materials aid student learning?

A higher proportion of respondents (81%) agreed or strongly agreed that the narrated slides aided their learning, followed by 75% of respondents for the short video segments, 74% for the audio podcasts and only 69% agreeing or strongly agreeing that

Figure 5. The extent to which the rich-media tools aided learning.

the full-lecture videos aided their understanding (Figure 5). These findings are somewhat at variance with the previous question with this inconsistency probed in the focus groups. One explanation that emerged was that whilst students gained reassurance from the availability of the full-lecture recording, the most efficient aid to learning was the narrated slides, which allowed students to quickly replay short segments of material focused on a particular learning concept. At least 70% of respondents strongly agreed that the rich-media materials improved their understanding of a particular topic, irrespective of format used, a finding consistent with previous case studies (Holbrook & Dupont, 2010; Sutton-Brady, Scott, Taylor, Carabetta, & Clark, 2009; Walls et al., 2010). A small minority of respondents, however, did not find the rich-media materials helpful to their learning, echoing the findings of Kazluaskas and Robinson (2012). It is important that the needs of this small number of students are not neglected when designing additional rich-media materials. In this study, concepts covered by the rich-media resources remained a key part of the face-to-face lectures, ensuring that those students unable or unwilling to engage with the rich-media resources were not disadvantaged in any way.

For what purposes did the students use the rich-media materials?

Further insights into the effectiveness of the rich-media materials can be gained through an understanding of what the students used the tools for (Figure 6).

The two most common uses of the rich-media materials were as a tool for revision and for filling in gaps in lecture materials (Figure 6). The availability of the additional materials enabled students to review particular points of understanding, prepare for the assessment and revise for the exam. This finding supports earlier work by Balfour (2006), Bolliger and colleagues. (2010) and Heilesen (2010). This facility was particularly important in a class dominated by non-native English speakers, and was stressed in the focus groups, with students requesting that the rich-media material be made available for

Figure 6. Uses of rich-media broken down by format.

all course units in the MSc programme. Figure 6 also reflects the spike in usage of the audio-narrated slides to prepare for lectures. No other material was used to the same extent pre-lecture, and this unique usage of audio-narrated slides perhaps explains the perceived usefulness of the narrated slides over short video segments and audio podcasts.

How did the rich-media materials compare with face-to-face lectures?

The ongoing debate in the literature over the desirability of capturing full lectures, and the impact of this on lecture attendance is illuminated further in this study, with only 10% of students stating that they used the full-lecture video as a replacement for attending a lecture. This finding is consistent with earlier work by Copley (2007), Dey (2008), Davis and colleagues (2009) and Leadbeater and colleagues (2013) and lends weight to the emerging consensus that videoing full lectures has a small but not disruptive impact on lecture attendance. Participants in the focus groups provided clear confirmation of this view, stating that ‘lectures are too rich to miss, and they allow the opportunity to ask questions’. In a lecture, students are part of a live learning experience; one that is content rich, responsive, and based on a relationship with the course lecturer. Whilst the rich-media materials offer an additional source of material to support learning and revision, they were viewed by the students as being supplementary to the face-to-face lecture. Two comments from students in the focus groups sum this up most clearly: ‘rich-media materials are good, but in no way replace normal lectures’ and ‘rich-media materials are complementary but never a substitute for face-to-face lecture[s]’.

Conclusions

This study assessed which rich-media materials the students preferred, for what purposes the students used the different materials and how these rich-media materials compare with face-to-face lectures in terms of the student learning experience.

Its central finding is that the audio-narrated slides provide an optimal combination of audio and visual learning material that is also quick and easy for teaching faculty to

produce (20 minutes preparation time for a 10-minute core concept vs. several hours for a full-lecture video). Many of the study findings are also broadly consistent with previous studies in that students reacted positively to the availability of supplementary rich-media materials using them to improve their understanding of the lecture material and as revision aids, rather than to foster the development of particular critical thinking skills. Students, particularly in this large, non-native English speaker dominated programme valued highly any resources that help them overcome the language barrier and optimise their learning. The core methods of achieving this remained effective face-to-face lectures but audio-narrated slides and if resources allow, full-lecture capture, have an important role to play in supporting student learning.

This study also demonstrated that the richness and relationship of the face-to-face lecture is hard to replicate using rich-media, providing confirmatory evidence of the continuing centrality of the traditional lecture in large cohort HE teaching. In this respect, the findings, although located in the context of a single MSc programme in a UK HE institution, are reliable across a broader sweep of HE where the future of the traditional lecture is under debate, and where large cohorts of international students must be educated with a finite and often limited amount of resources.

Limitations and further work

This study, whilst novel in terms of a systematic comparison of a number of different rich-media formats, was still predicated on a transmission model of learning. No radical alterations were made to the course unit pedagogy to incorporate additional feedback and reinforcement activities that might have underpinned a deeper learning in the cohort. Perhaps as a consequence of this, no discernible improvement in unit marks was noted when compared with previous years.

The authors also acknowledge that very large class sizes are a sub-optimal environment for personalised and participative learning (McKenzie et al., 2013). As a consequence, the level of student engagement, provision of feedback and opportunity for active learning is often lower in a large class. However, due to resource and timetabling constraints and the sheer logistical challenges of very large cohorts, face-to-face lectures are, and are likely to remain, the dominant mode of content delivery on this, as on many other HE programmes. The challenge – both for the authors of this study and for other teaching faculty – is to refine rich-media materials, improve their interactivity and their integration with the face-to-face lectures so that more time in lectures can be spent in discussion and exercises, as opposed to one-way delivery of course material. With this in mind we propose three future avenues of research: firstly, paying closer attention to the pedagogy and purpose of the rich-media materials within the overall course design; secondly, considering ways in which interactive online resources (discussion boards and other feedback mechanisms) might enhance learning and thirdly, piloting how student-generated rich-media content could be incorporated within the course unit.

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Appendix 1. Questionnaire

General & Demographic Information	
1. Gender?	2. Age?
Male	21-25
Female	26-30
	31-35
	36-40
	41+
3. Is English your first language?	
Yes	
No	
4. How would you describe your familiarity with computing and internet technology?	
Excellent	
Good	
Average	
Poor	
Very Poor	
5. Have you previously listened to or viewed any of the following podcasts and/or video recordings online? Please tick all that apply.	
General Interest / Entertainment	
Academic Lectures	
6. Did you experience any technical problems when listening to/viewing the podcasts, slides or videos?	
Yes - Serious problems prevented me from viewing/listening to one or more presentations.	
Yes - Some problems that were resolved after seeking support.	
Yes - Minor problems I was able to solve myself.	
No technical problems experienced.	
7. If you experienced any major or minor technical problems, please provide brief details below...	
8. Did you use any of the following mobile devices to view/listen to the podcasts, slides or videos? Please tick all that apply.	
MP3 Player	
Smartphone	
Tablet	
Audio Podcasts	
9. On average, how many times did you listen to each podcast?	
None 1 2 3 4+	
10. For which of the following reasons did you listen to the podcasts? Please tick all that apply.	
Before the lecture as lecture preparation.	
To replace attendance at lectures.	
After the lecture to fill in gaps in lecture notes.	
After the lecture as English is not my first language.	
After the lecture as I have difficulty hearing.	
After the lecture for revision and preparation for assessment.	
Please indicate the extent to which you agree with the following statements...	
1. Strongly Agree	
2. Agree	
3. Neither Agree nor Disagree	
4. Disagree	
5. Strongly Disagree	
11. The podcasts were a useful supplement to the other teaching material.	
12. I enjoyed listening to the podcasts.	
13. The podcasts aided or added to my understanding of the topics they covered.	
Audio-Narrated Slides	
14. On average, how many times did you view each narrated slide presentation?	
None 1 2 3 4+	

15. For which of the following reasons did you view the audio-narrated slide presentations? Please tick all that apply.

Before the lecture as lecture preparation.

To replace attendance at lectures.

After the lecture to fill in gaps in lecture notes.

After the lecture as English is not my first language.

After the lecture as I have difficulty hearing.

After the lecture for revision and preparation for assessment.

Please indicate the extent to which you agree with the following statements...

1. Strongly Agree

2. Agree

3. Neither Agree nor Disagree

4. Disagree

5. Strongly Disagree

16. The audio-narrated slides were a useful supplement to the other teaching material.

17. I enjoyed viewing the audio-narrated slide presentations.

18. The audio-narrated slides aided or added to my understanding of the topics they covered.

Short Videos

19. On average, how many times did you view each short video presentation?

None 1 2 3 4+

20. For which of the following reasons did you view the short videos? Please tick all that apply.

Before the lecture as lecture preparation.

To replace attendance at lectures.

After the lecture to fill in gaps in lecture notes.

After the lecture as English is not my first language.

After the lecture as I have difficulty hearing.

After the lecture for revision and preparation for assessment.

Please indicate the extent to which you agree with the following statements...

1. Strongly Agree

2. Agree

3. Neither Agree nor Disagree

4. Disagree

5. Strongly Disagree

21. The short videos were a useful supplement to the other teaching material.

22. I enjoyed viewing the short video presentations.

23. The short videos aided or added to my understanding of the topics they covered.

Full-lecture videos

24. On average, how many times did you view each full-lecture video?

None 1 2 3 4+

25. For which of the following reasons did you view the full-lecture videos? Please tick all that apply.

Before the lecture as lecture preparation.

To replace attendance at lectures.

After the lecture to fill in gaps in lecture notes.

After the lecture as English is not my first language.

After the lecture as I have difficulty hearing.

After the lecture for revision and preparation for assessment.

Please indicate the extent to which you agree with the following statements...

1. Strongly Agree

2. Agree

3. Neither Agree nor Disagree

4. Disagree

5. Strongly Disagree

26. The full-lecture videos were a useful supplement to the other teaching material.

27. I enjoyed viewing the full-lecture videos.
28. The full-lecture videos aided or added to my understanding of the topics they covered.
29. If only one format of additional video/audio material could be provided to you, which would you find most useful?
- Audio podcast*
- Audio-narrated slides*
- Short video segments*
- Full-lecture video*
30. Was there anything you particularly liked or disliked about the additional video/audio material provided on Blackboard, or do you have any other comments to make?