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# Richness, responsiveness and relationship: Using rich media materials to enhance the teaching of core concepts

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**Abstract:** *The MSc in the Management of Projects is a successful campus based postgraduate programme in the Faculty of Engineering and Physical Science at The University of Manchester which attracts up to 300 students per year. The cohort is highly internationalised with over 85% non-native English speakers.*

*Course material on the programme is typically delivered through weekly face-to-face lectures, supplemented with written unit handbooks covering the core lecture material. However the large size of the cohort coupled with the wide variation in English language ability can conspire against effective learning. As reported by Davis et al 2009, many students have taken matters into their own hands and are using a variety of devices to record lectures for later playback.*

*This paper reports the findings of a pilot project to supplement the existing face-to-face lectures with a set of rich media materials. The materials focused on the teaching of core concepts as well as capturing the full lecture delivery, and comprised audio podcasts, audio narrated slides, and short video segments with supporting slides. Student preference for, and usage of, each of these materials was assessed by means of a questionnaire and focus groups. Key findings are that students overwhelmingly found that these rich media materials aided their learning. Students used the materials in the main as a revision guide and as a means of closing gaps in their understanding, with only a small minority using them as a replacement for lecture attendance. Students rated most highly the full lecture videos, followed by audio narrated slides and then the short video segments with the audio podcasts least favoured by students.*

*Two lines of further enquiry have been identified; validating the results of the pilot project on other course units at The University of Manchester and investigating whether student preferences for different rich media materials is linked to individual student learning styles.*

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## Introduction

The rapid advances made in learning technology over the last decade - particularly in rich media and web based applications - have begun a slow process of revolution in Higher Education Institutions (HEI's) (Parson et al., 2009). Virtual Learning Environments are near ubiquitous, access to the internet is 24-7 and many of today's students are abandoning textbooks and accessing their learning via Facebook groups, lectures downloaded from Apple's iTunes U or YouTube video clips (Thorne and Payne 2005, UCL 2008, Kennedy et al., 2008 and Walls et al., 2010). Many teaching faculty have responded to this shift in the pedagogical landscape by embracing new technology in their classes (Sharpe, Benfield, Roberts and Francis 2006, Laurillard 2007 and Mason and Rennie 2008), which has led to a proliferation of research into the use of rich media materials (e.g. video, audio podcasts, lecture capture) in HEI's (Copley 2007, Parson et al., 2009 and Sutton-Brady et al., 2009). Case studies on the use of rich media materials have been presented across a range of subject disciplines from Business and Education (Sutton Brady et al., 2010 and Walls et al., 2010) to Marketing (Van Zanten et al., 2010), Health Sciences (Pearce and Scutter 2010), Psychology (Parson et al., 2009) and Engineering (Davis et al., 2009). Students are using rich media materials to aid assignment preparation, supplement note-taking in lectures and as a means of reviewing or revising course material (Bollinger et al., 2010 and Heilesen 2010). Donnelly and Berge (2006) report 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 an increased sense of control over their learning, and thirdly

podcasts are portable, giving students the opportunity to listen to or view recordings at a time and place that suits them. 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).

## Student outcomes

A number of studies have also sought to measure the impact of podcasting and rich media on student outcomes. Bollmeier et al (2010) reported that the use of enhanced podcasts (containing audio and slides) in addition to traditional lectures significantly improved final exam performance, when compared to a control group that did not have access to the enhanced material. Similarly Moravec et al (2010) found that student test scores increased by 21% when lectures were supplemented with rich media materials. However studies which simply replaced rather than supplemented face-to-face lectures with podcasting found no significant differences in student outcomes (O' Bannon et al., 2010 and Schreiber et al., 2010), suggesting that rich media is most effective when combined with existing lecture material rather than as a replacement for it.

## Impact on lecture attendance

Although much research has highlighted the benefits of rich media materials to the learner, some researchers have sounded a note of caution. For example, Kazluaskas and Robinson (2011) in a study of nursing and business students found that a minority of students did not engage with audio podcasts, preferring instead to learn from the traditional face-to-face lectures and by reading the set textbooks. 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 entire lecture is captured using video and audio, and made available to students for online viewing. Several studies have investigated whether the use of full lecture capture does indeed impact lecture attendance (Bongey et al., 2006, Deal 2007b and Davis et al., 2009), with the common finding that it has a small but limited impact on lecture attendance. For example Lane (2006) reported that the availability of course podcasts made 16% of students less likely to attend class, and Traphagan et al (2010) reported reduced attendance rates of 9% in a geology class that had access to lectures by video after the class.

Previous research on the use of rich media materials has generally been focused on the uses, benefits and drawbacks of individual rich media tools, whether audio podcasts, enhanced podcasts, video or full lecture capture. To the best of our knowledge, however, there has been no study which compares different rich media materials which each explain the same core concepts. With this in mind, the aim of this research is to broaden the understanding we have of how students on a large, campus based MSc programme use rich media materials. This study assessed which materials students preferred from a set of rich media materials (we used audio podcasts, audio narrated slides, short video segments and full video lecture capture), 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.

## Background

### Context

The context of this study is the MSc in the Management of Projects, a large, campus-based postgraduate taught programme in the Faculty of Engineering and Physical Science 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.

Course material on the programme is delivered through weekly face-to-face lectures, supplemented with written unit handbooks covering the core lecture material. However the large size of the cohort coupled with the wide variation in English language ability frequently leads to difficulties in providing effective teaching. As reported by Davis et al (2009), many students have taken matters into their own hands and are using a variety of devices to record lectures for later playback.

In response to this pedagogical challenge, the authors embarked on a pilot study, the aim of which was to supplement the existing face-to-face lectures with a series of rich media materials and assess student preferences for, and usage of these various materials. The rich media elements focussed on short (5-7mins) recordings of core concepts, those building blocks that "*progress understanding of the subject*" (Meyer and Land, 2003 p4) although two full lectures in which these core concepts were

taught were also recorded to provide an additional comparison of the short format materials with full lecture capture.

The study was undertaken on one unit of the programme in semester 1 of 2011/2012. This unit, called financing infrastructure projects, is an optional course unit, and was delivered on campus to 184 students by means of 10 weekly face-to-face lectures. Acknowledging the limitations in this transmission-based model of course delivery, students on the unit are provided with a workbook comprising core lecture material. In addition, the institution's VLE (Blackboard 9) is used extensively to provide access to additional downloadable material, for online quizzes and as a class communication tool. Financing infrastructure projects has a theoretical focus and there are a number of core concepts that students must grasp before they can engage effectively with the course material. In previous years significant lecture time has been dedicated to helping students master these core concepts, a challenge magnified by the size of the cohort and the wide variation in the standard of students' written and spoken English.

The core concepts for financing infrastructure projects were recorded using a range of multimedia tools comprising:

- 5-7 minute short video segment
- 5-7 minute audio narrated slides
- 5-7 minute audio podcasts
- Full video capture of whole weekly lecture in which core concept is taught.

Each core concept was made available in each of the above formats, as well as continuing to be taught in the face-to-face lectures. Student preference for these different rich media materials was evaluated, by means of a questionnaire and student focus groups, and was compared with student preference for the existing teaching via face-to-face lecture and unit handbook reading.

The specific research questions 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?

## Methodology

The methodological approach in this case study was mixed method based on two sources of data; a web-based quantitative questionnaire of the 2011 student cohort and qualitative data from student focus groups from the same cohort, held once unit assessment had been completed. The use of two sequential forms of data collection enabled the questions what and how to be probed in the questionnaire, and the deeper question of why to be explored in the focus groups.

The structured, anonymised questionnaire was administered to students through the Virtual Learning Environment towards the end of the semester. The questionnaire was designed by the authors and piloted on the lead author's postgraduate tutor group. Eighty-four completed questionnaires were submitted, giving a response rate of 46%. The aim of the questionnaire 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 the materials. The questionnaire data was exported to Microsoft Excel, where descriptive analysis was performed.

Richer, qualitative data was obtained from 3 student focus groups held after the end of the semester, and importantly, once the unit assessment was completed. The focus groups (each containing 5 students) were moderated by two researchers, independent of the unit lecturer. This mitigated against bias in the focus groups. The focus groups were semi-structured, with question prompts provided to ensure that all relevant issues were discussed, whilst allowing flexibility and open discussion. The question prompts were drawn up following analysis of the quantitative data, and were designed to augment the data captured in the questionnaire. For example focus groups were asked "Why did you prefer particular rich media materials", "In what way did the materials aid your understanding - give examples where possible?" and "How did the additional rich media materials compare to traditional face-to-face lectures as a tool for learning?" Collectively both quantitative and qualitative data were designed to answer research questions 1-4 outlined above.

The outputs of the focus groups were recorded and transcribed by the authors and a process of grounded analysis followed (Glaser 1992). Here the process was inductive; the focus group transcripts were reviewed, and reflected upon, allowing more intuition to guide the authors than in the more deductive content analysis approach (Easterby-Smith et al 2008). This enabled concepts to be developed which sought to explain the data. This process was an iterative one, culminating in the selection of key themes such as relationship, responsiveness and richness which are explored in the findings of this paper.

### Preparation and set up

Five core concepts in financing infrastructure projects were chosen for this pilot study. Selection of these was based on the first author's (also the course lecturer) experience of the topics that students in previous years had struggled to understand. For each of the identified core concepts, a set of slides was selected that covered around 5-7 minutes of presentation time. The capture methods are described in more detail below:

1. Short video segment. The lecturer was filmed as they talked through the slide materials, 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, as shown in figure 1. The resulting video was hosted on a streaming server and a link provided on the Blackboard Learn™ Virtual Learning Environment (VLE).

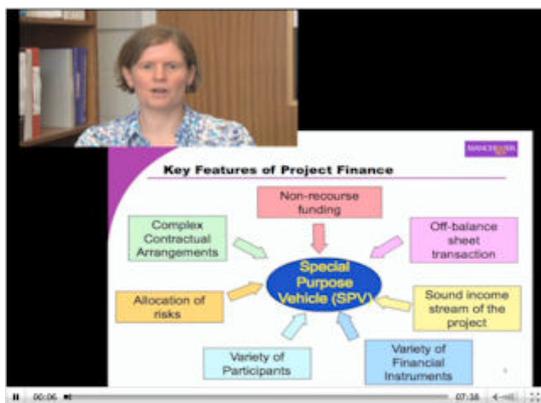


Figure 1: Example of short video segment.

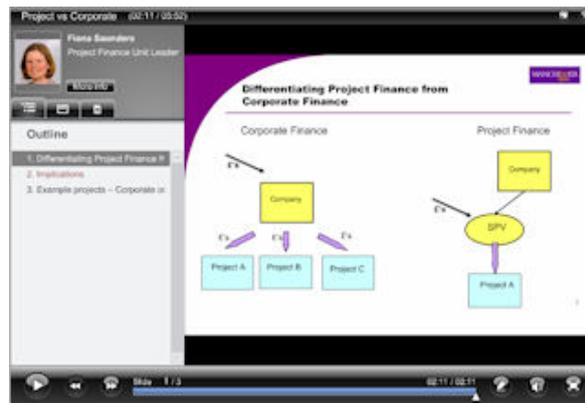


Figure 2: Example of audio narrated slide.

2. Audio narrated slides. The lecturer recorded a narration over the slide presentation, using a headset with microphone. The narration was captured using iSpring®, an add-on to Microsoft® PowerPoint, and then compiled through iSpring® into an Adobe® Flash movie object that included navigation controls, as shown in figure 2. The Flash object was embedded into an HTML page and hosted on the VLE.
3. Audio Podcast. The lecturer recorded a narration of the slides for audio presentation only, using a headset with microphone. The audio presentation was captured using Blackboard Voice Podcaster via the VLE where it was available for student subscription.
4. In addition to the capture of core concepts, the full lectures containing those concepts were filmed. A fixed HD camera and radio microphone were used to capture the lectures and 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.

A comparison of the preparation time required both for the capture of core concepts and lectures and the additional time required for post-production and deployment is shown in table 1.

**Table 1: Summary of capture and processing times**

Method	Estimated average time for preparation/capture (mins)	Estimated average time for processing/deployment (mins)
Short video segment	25	60
Narrated Slides	10	10
Audio Podcast	10	0
Full Lecture Video	Duration of lecture + 20 mins set-up	180

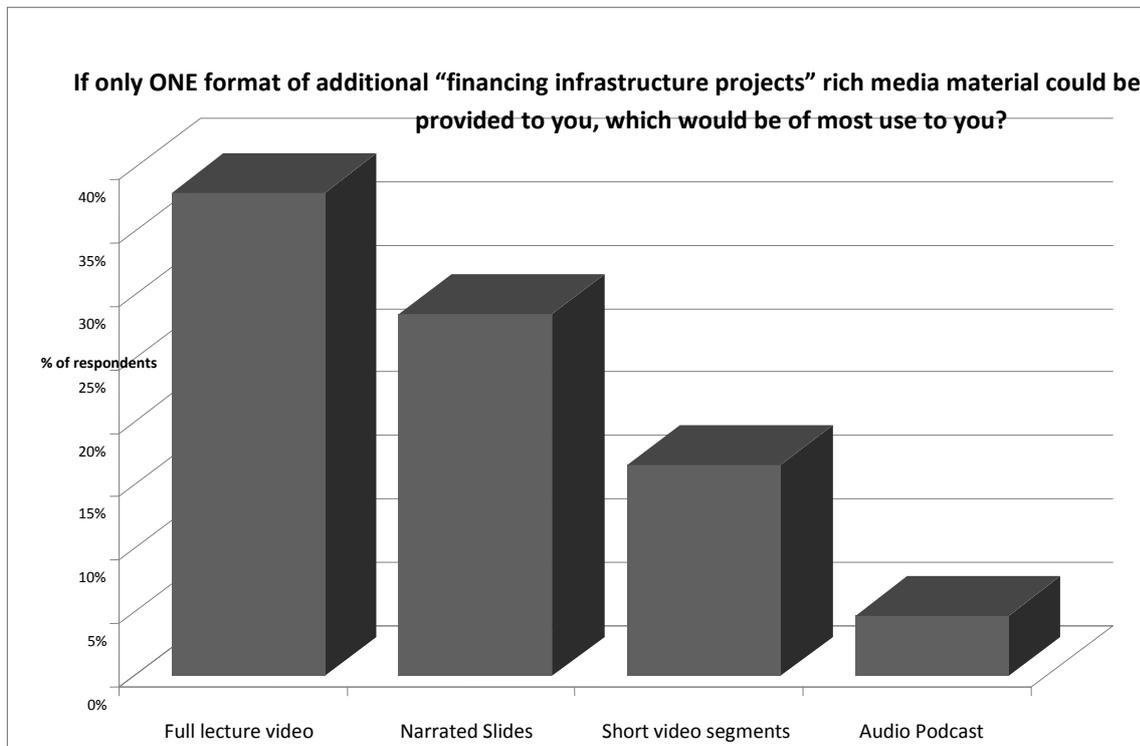
All core concept presentations were made available on the VLE to students 48 hours before the lecture took place. Full lecture videos became available a week after the lecture took place.

### Data Findings and Analysis

The structured 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% male and 26% female, 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. 89% of questionnaire respondents described themselves as having good or excellent IT skills, with 83% having previously accessed rich media resources online.

#### Richness and responsiveness

The first research question posed by the study was “Which rich media materials did the students prefer and why?” Figure 3 shows which materials the students would have retained had only one been available.



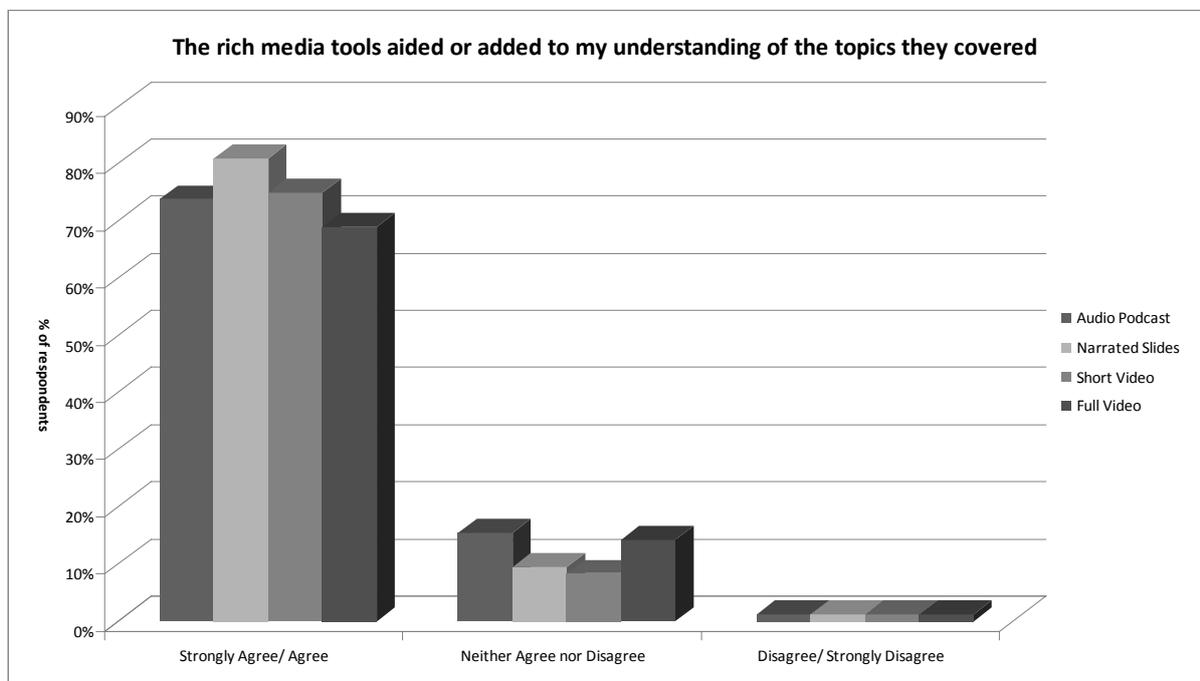
**Figure 3: Student preference for rich media materials**

The graph brings into sharp relief the student preferences for the various rich media materials and shows a clear ranking of the materials, with the full lecture capture being the most preferred approach (by 38% of survey respondents), followed by audio narrated slides (29% of survey respondents), then short video segments and in last place the audio-only podcasts. 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*”, ensuring that the richness of the whole lecture was captured, enabling students to view sections that they had missed, or failed to understand first time round. One student described the full lecture video as “*allowing students to be submersed in the atmosphere of the lecture*”. Replaying the full lecture videos triggered students’ memories of particular moments in the live lecture, helping them to 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 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), narrated slides were the most popular. When asked why this was the case, students replied that the narrated slides, whilst not as content rich as the full lecture, still explained 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 focused on the same key topics, 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*”. 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 were seen to 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 the ability to multitask whilst listening to the audio files.

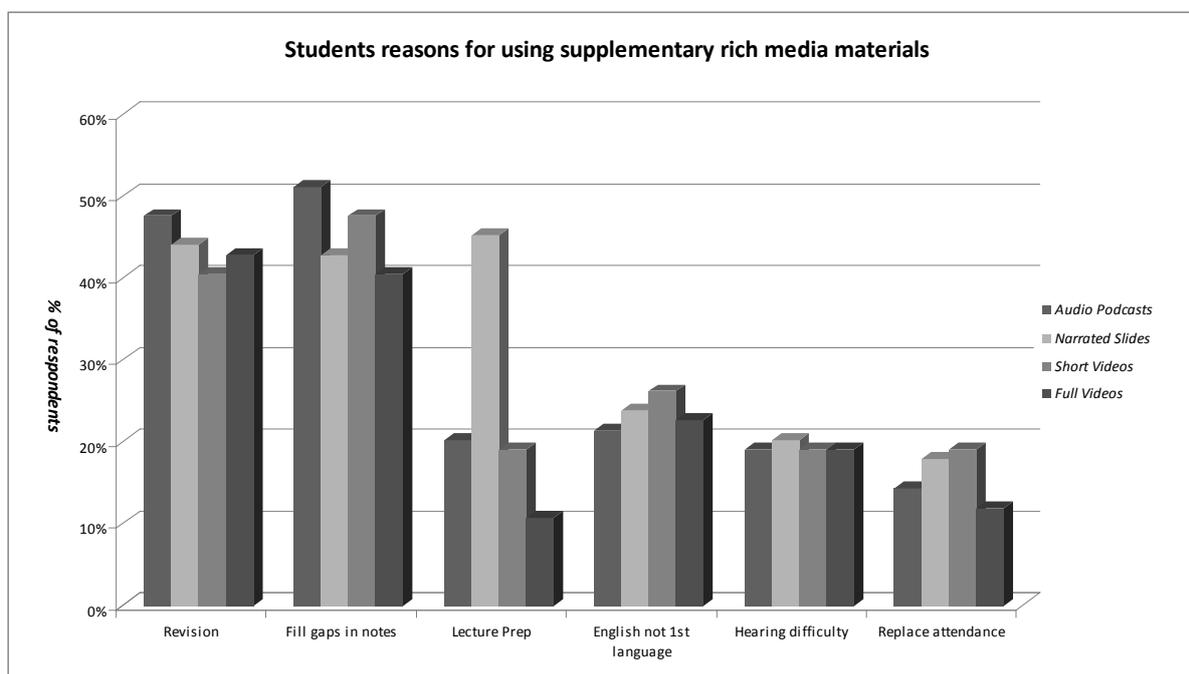
Further explanation of the student preferences is provided in figure 4 below, which is a summary of the survey responses to the question, “to what extent did the rich media materials aid student understanding?”



**Figure 4: Student perceptions of “to what extent using the media rich materials aided their understanding”**

Here the findings paint a picture somewhat at variance with the previous question, namely that a higher proportion of students (81%) agreed or strongly agreed that the narrated slides aided their learning, followed by 75% of students for the short video segments, 74% for the audio podcasts and only 69% agreeing or strongly agreeing that the full lecture videos aided their understanding. This inconsistency in student responses was probed in the focus groups. One possible explanation that emerged was that whilst students gained reassurance from the availability of the full lecture recording, in the sense of it being an insurance against missing material, 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. In addition as figure 5 below shows narrated slides could be used for pre-lecture preparation, a salient use that could not be replicated by the full video capture. It is important here too, not to lose sight of the fact that students still valued highly the short video segments and audio podcasts.

Further insights into the effectiveness of the rich media materials can be gained through an understanding of what the students used the tools for. This is shown in figure 5.



**Figure 5: For what purposes did the students use the rich media tools**

The two most common uses of the rich media materials were as a tool for revision and for filling in the gaps in lecture notes. 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), Bollinger et al (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 all course units in the MSc programme. One notable feature of figure 5 is the sharp peak in usage of narrated slides for lecture preparation. No other material was used to the same extent in lecture preparation, and this unique usage of narrated slides, both supports the findings of Moravec et al (2010), and perhaps explains the perceived usefulness of the narrated slides over short video segments and audio podcasts.

### Relationship

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 Trapagan (2010) and Lane (2006) and supports the emerging consensus that videoing

full lectures does not have a detrimental 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”.

It is this sense of relationship with the lecturer that students are striving for. The rich media were viewed as useful and effective in aiding learning but only ever supplementary to the traditional face-to-face lectures. 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 that “rich media materials are complementary but never a substitute for face-to-face lecture”.

In the face-to-face lecture students are part of a live learning experience; one that is content rich, responsive and based on 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 very much an add-on to the traditional face-to-face lecture. In this study, none of the rich media tools could match the lecture in terms of this richness, responsiveness and relationship, although the rich media material favoured most strongly by students was the full video capture, which is by some measure the most content rich and responsive of all the rich media investigated in this study.

## Implications for practice and areas for further research

The findings of this study show that *on this course unit* the richness, responsiveness and relationship of the face-to-face lecture are hard to replicate using rich media. The closest medium in terms of achieving these aims was the full video recording, which was valued most highly by students in this study, followed in second place by the audio narrated slides which were used extensively for both lecture preparation and revision. The authors do acknowledge that very large class sizes are a sub-optimal environment for personalised learning, and that the level of relationship with and responsiveness of lecturers shown in this study is constrained by this. However due to resource and timetabling constraints and the sheer logistical challenges of very large class sizes, face-to-face lectures are, and are likely to remain the dominant mode of content delivery on this MSc programme. It is anticipated though, that with appropriate use of rich media materials then more time in lectures can be spent in discussion and exercises, as opposed to one-way delivery of course material.

Anecdotal evidence from the lecturer’s experience of this year’s financing infrastructure projects class is that less lecture time was spent on repeated explanations of the same core concepts – the implication being that students spent time listening to or viewing the rich media materials to help them understand the concepts. In addition, less time was spent one-way delivery of course content, as full explanations of the core concepts were available in the form of rich media. This enabled the course lecturer to devote more lecture time to case study-based class discussion work, the purpose of which is to help the students apply the theoretical concepts of finance to real infrastructure projects.

No discernable improvement in unit marks was noted however in this course unit, with the mean unit mark being similar to previous years. In spite of this, students were strongly in favour of the rich media resources, requesting that their use be extended to all units on the programme and that more concepts be covered.

The authors are mindful of a number of limitations in this study. It is only a pilot study and the findings are specific to a particular course unit in a single HEI. In addition the response rate to the survey was under 50% and the focus groups involved less than 10% of the cohort. In spite of these limitations the authors have been invited to present their work at a number of University of Manchester events. The authors are keen to share their experiences in these fora and beyond, believing that the learnings from this study are applicable to a broad range of undergraduate and post graduate engineering programmes around the globe.

## Recommendations for large cohort engineering education

In a non-resource constrained HEI world the authors’ recommendation for large cohort engineering education would be to video capture all lectures and make them available on the institution’s Virtual Learning Environment, supplementing these with narrated slides of core concepts for lecture preparation, consolidation of understanding and revision. This would enable the focus of the lecture to be shifted from one-way delivery of material towards two-way discussion and debate. Given, however that we all operate in a tightly resource constrained world, and that narrated slides are quick and resource-light to produce (20mins for a 10minute core concept vs. several hours for a full lecture

video), the authors in this study will be extending the use of *only* narrated slides for all future classes. This recommendation has also been accepted within the MSc in Management of Projects programme, resulting in a programme of work to prepare similar core concept narrated slides for each of the units in the MSc programme in time for the 2012/2013 academic year.

What this study also illuminated is that students, particularly in a large, international programme need as many resources as possible to help them optimise their learning. The core methods of achieving this in large cohort engineering education, given existing resource and timetabling constraints, are likely to remain effective face-to-face lectures and comprehensive written lecture notes, but rich media materials have an important role to play in supporting student learning.

Future work will involve repeating the study over a much larger number of course units at the University of Manchester and experimenting with less resource intensive methods of lecture capture, for example capturing the lecturers audio feed and slide presentation only. Investigations would also be valuable into whether student preferences for different rich media are linked to individual student learning styles.

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