SCREENCASTS IN ENGINEERING

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KEYWORDS:

There is an increasing demand for educational resources that supplement material delivered in lectures and supervision meetings. In some cases, a full lecture recording might be useful; in many cases a short, targeted video of a few slides with audio commentary (a screencast) can achieve this by focussing on the key points. The aim of this project was to develop and evaluate the use of screencasts as part of two Engineering teaching activities. The first was a conventional taught module that is taken by 4th year MEng and MSc students. This was chosen because students have often studied different topics previously, and for many, English is second language. The second case-study was to provide screencasts to help students apply research skills like literature reviewing, referencing and technical report writing specifically to technical reports in Engineering. The study supported many of the advantages suggested in the literature on the use of screencasts in engineering teaching. Pre-session screencasts were found to have particular potential because they encouraged active participation in the subsequent taught session and have great potential when combined with a flipped teaching approach. Such a pre-session screencast would also be useful for students to use after the session as an alternative to a full lecture recording, so the preparation can be argued to be a relatively efficient use of academic time.

1. BACKGROUND

There appears to be increasing student demand for educational resources that supplement conventional teaching activities in Engineering (and related disciplines). This is particularly important for international students, whose lack of English language proficiency may lead them to experience difficulties understanding teaching materials. Additional resources may also help students develop

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research skills required for major 'capstone' research projects, which form a significant part of final year programmes.

Congruent with recent developments in UK Higher Education, the Department of Engineering at the University of Leicester has experienced a significant growth in student numbers at both undergraduate and postgraduate levels over the past decade, leading to a reduction in the staff-to-student ratio. This is seen as one factor that may have a negative impact upon NSS scores and student satisfaction with their courses.

The Department of Engineering at Leicester teaches a number of modules to 4th year MEng students that are also offered to MSc students. Taught MSc students may not have covered exactly the same topics in their previous education and, in general, more students have English as a second language. Engineering students on all programmes undertake at least one major research project. Some Engineering students have traditionally struggled with applying the comprehensive (but generic) literature searching, referencing skills and academic honesty materials provided by central libraries to a substantive engineering technical report. The bridge has traditionally been provided through the conventional relationship between supervisor and student in supervision meetings. As the number of project students supervised by each academic increases this is increasingly challenging – to do so during individual meetings is very repetitive, while to organise group meetings is difficult because of timetabling and room availability. The result is that provision varies significantly between academics, is inefficient and the proficiency demonstrated by students can vary.

A screencast typically consists of lecture slides accompanied by an audio commentary. They are an example of what has been termed a 'Little Open Educational Resource' ('little-OER'), defined by Weller (2011) as being low-cost resources which can contribute to achieving learning outcomes when integrated together with other activities. Screencasts are typically much shorter than a full lecture recording (up to 15 minutes) and they are usually prepared specifically and intended to be complementary to lecture attendance. This teaching technique has previously been piloted in the Department of Media and Communication at the University of Leicester (Reilly, 2015). Although the disciplines are very different, many of the challenges faced by the two Departments appear similar. This study suggested that that student learning was enhanced; both in intended and unintended ways, and that the approach was popular with students (Reilly, 2015).

There have already been a number of studies exploring the efficacy of using screencasts in engineering education. Falconer et al. (2009, 2012) report on a project producing over 400 screencasts on Chemical Engineering topics. The study evaluated students' expressed preferences on how useful they perceived the screencasts and data on when the screencasts were accessed, revealing a peak associated with revision. These screencasts are shared and made available online as OERs.[2] Pinder-Grover et al. (2011) developed and evaluated the use of screencasts as a supplementary resource within a large lecture module (200 students), and found that this technique was especially appropriate for students with varied pre-requisite knowledge. This study was

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[2] http://www.learncheme.com/screencasts

followed by a mixed-methods study comparing students' perceptions with their performance (Green et al. 2012). Most students expressed that they found the screencasts helpful and self-reported a deeper understanding of the course material due to the screencasts. Student performance matched their perception; students who used the screencasts were more likely to perform better in assessment. Notably, the assessment performance was unaffected by the use of screencasts for students who actively chose not to use them. By contrast, students who 'forgot' to use the screencasts performed less well. A key advantage of this study was the large sample size (n=397 over two academic years) which was sufficient for higher statistical confidence. Carter (2012) developed a series of 25 screencasts for 'pre-reading' as an alternative to textbooks. Over 75% of the class accessed at least 20 out of the 25 screencasts; a much higher engagement than students self-reported in previous studies when asked to pre-read from textbooks. This study was using the screencasts as part of a 'flipped teaching' approach and also resulted in good student attendance, which is a common concern for academics when full lecture recordings are provided after the lecture. A number of other studies have argued that an improvement in student performance has been demonstrated using 'before and after' quizzes or by comparing two very similar modules with and without screencasts (Oehrli et al 2011; Loch et al. 2014; Morris et al 2014). Clearly, it would be possible to cite limitations to any method of evaluating the improvement in student performance as a result of a learning approach whilst keeping equitable teaching and assessment approaches. This is an evident challenge with any kind of pedagogic research. However, a reasonable conclusion it that the literature demonstrates that students respond positively to screencasts as a teaching resource and for those that engage positively with them they can be beneficial.

2. PROJECT AIMS AND OBJECTIVES

The aim of the screencasts in engineering project was to build on the successful work in the Department of Media and Communications to undertake a mixed-methods pilot study of using screencasts in engineering to develop experience in their use and assess their use and effectiveness. The specific Research Objectives (ROs) and methodologies used in the study were:

RO1: Review the literature on screencast use specifically in engineering disciplines to identify examples of screencast use and effectiveness in an engineering context and refine the later ROs.

RO2: Produce and evaluate screencasts for use in a traditional lecture module on Aerospace Materials taken by MEng and MSc students. These student cohorts have different academic backgrounds, and the literature review identified that screencasts have proven to be a good way to manage this. The novel development of this study was to compare 'pre-session' screencasts with 'post-session' screencasts. In the academic year 2014/15 this module was taught in 3 sessions per week. For the first session in the week a pre-session screencast was prepared. For the second, no screencast was provided and for the third a post-session screencast was provided. This pattern was kept regular for consistency and to make the type of screencast independent of the particular topic of a session. The expressed preferences of the students were investigated via a written questionnaire at the end of the module and a smaller focus-group conducted at the end of the module with a series of guiding questions where responses were transcribed for later analysis. The revealed preferences of the students would be investigated by using the Blackboard Virtual Learning Environment (VLE) usage statistics to investigate the frequency and time that each screencast was accessed. This would be correlated with the final module marks achieved by each student.

RO3: Produce and evaluate screencasts to assist project students with referencing skills. Here screencasts were prepared which were tailored specifically to signpost existing library resources and give students information that is particularly relevant to referencing conventions in engineering. The language and pace used was intended to be deliberately simple and direct to support students for whom English was not their first language. The screencasts were posted on the appropriate Blackboard course site for the MSc project module on 29th June 2015. These screencasts were evaluated via an online expressed preference questionnaire in August 2015, and the intention was to also evaluate the frequency and time of access.

RO4: Disseminate results via the production of a simple website and through internal seminars at Department and college level.

3. PROJECT OUTCOMES AND ACHIEVEMENTS

In total, 15 screencasts were prepared as part of the project comprising: 7 pre-session screencasts for a conventional taught module, 6 post-session screencasts and 2 screencasts on referencing techniques targeted at students undertaking their major research project. The screencast videos were uploaded to Blackboard and displayed in a preview mode so that they were sequential, adjacent to the relevant lecture slides and would be eye-catching and encourage students to access them. A screenshot of the Blackboard module site in Figure 1 illustrates this.
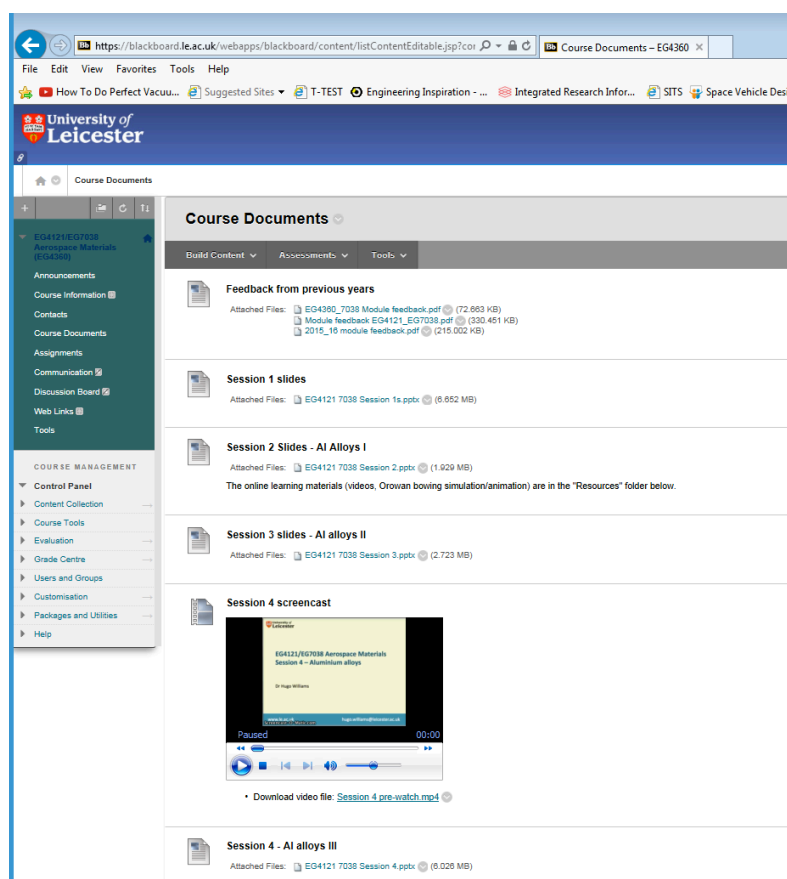

Figure 1 - Screenshot of Aerospace Materials module site on Blackboard showing format adopted to maximise visibility of the screencast, encourage student use and correct sequencing of the material.

The screencasts were re-used for the academic year following the completion of the data collection and continued to receive positive student feedback. This demonstrates that the resources themselves are continuing to enhance the student experience.

The screencasts were evaluated via expressed preference (survey collected on 23rd March 2015, focus-group on 27th March 2015) and revealed preference data (Blackboard access data and final module marks for students evaluated in June 2015). The methodology was subject to Departmental ethics review and approval. The revealed preference study was not as successful as intended due to subtleties in the way Blackboard collects usage data. However, it was possible to conclude that pre-session screencasts are a particularly promising technique because they encourage active participation and learning in the subsequent taught session whilst still being a resource suitable for students to review after the session and for revision. The frequency with which students use screencasts could be improved if email reminders are used when screencasts are released. Numerical worked solutions and explicit signposting to other learning resources could be included as further improvements.

The use of pre-session screencasts is a very natural fit with moving to a more 'flipped teaching' approach. Many of the benefits of pre-session screencasts identified above are in fact the same benefits as those generally accepted to apply to the flipped classroom.

The results of this project have already been disseminated via a number of formal and informal seminars and staff workshops within the Department of Engineering and College of Science and Engineering and via a dedicated website[3]. In at least one case screencasts have been adopted to support one module by an academic colleague in the Department of Physics and Astronomy.

4. EVALUATION

USE OF SCREENCASTS IN A TRADITIONAL TAUGHT MODULE - EXPRESSED PREFERENCES
The module survey questionnaire results (n=38) were reviewed in context with the focus group comments (6 participants) and the key messages and implications for practice are discussed thematically in this section.

DEVICE AND LOCATION OF ACCESS
The device used to access screencasts and the location from which the student reported viewing them are summarised in Figure 2. Most students stated that they accessed the screencasts on a laptop (75%) or personal computer (54%), the location of access was at Home (89%), on Campus (39%) and in the Library (21%). Few students used tablets or smartphones or whilst in transit. This behaviour is, however, is likely to be sensitive to rapid changes in technology and is not really likely to be due to fundamental features of the technique. For example, one focus group participant identified that compatibility of the Blackboard app with particular smartphone operating system influenced when these resources were accessed. The point for practice here is that the majority of screencasts are currently accessed on a relatively large screen and there is no indication that this significantly limits their use at present.

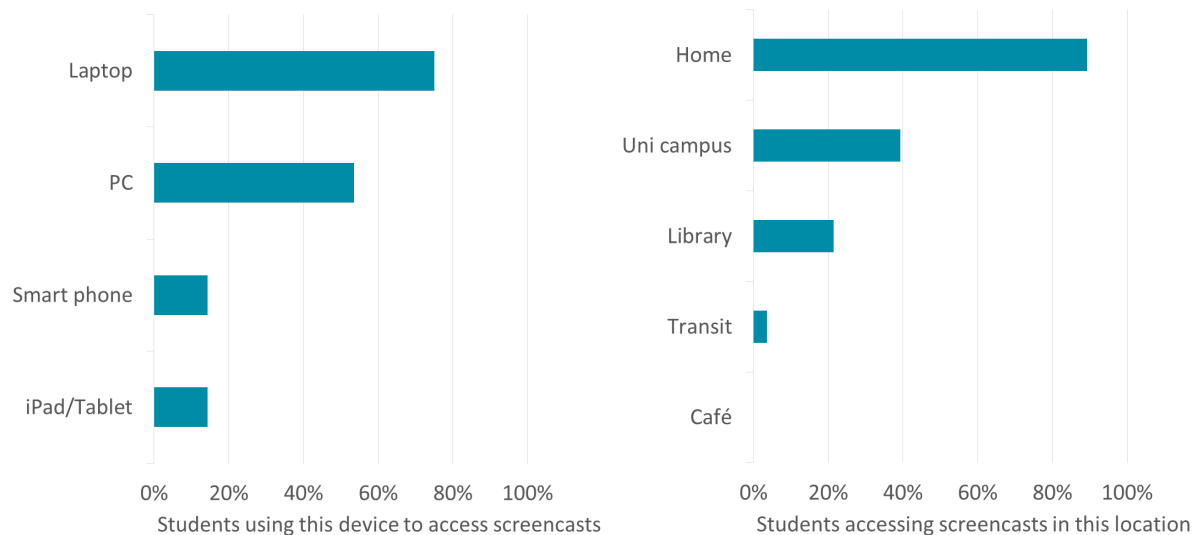
[3] https://screencastsinengineering.wordpress.com/

Figure 2 - Device and location students report using to accessing screencasts. Note: Students were free to pick multiple options for both questions so percentages may sum to >100%.

PRE-SESSION VS POST-SESSION SCREENCAST USE

There was no expressed preference for post-session screencasts alone - students expressed that they were more likely to watch a screencast either exclusively before the lecture (39%), or equally before and after the lecture (43%). Students were less likely to watch screencasts exclusively after a lecture (18%). These data are illustrated in Figure 3.

In the focus group, the comments generally indicated that the pre-session screencasts allowed students to participate more actively in the lecture, and then also subsequently used as revision resources:

"In the screencasts they touched on you know, specifically what the 5000-series do better, you know, those kind of things, so that when he was asking similar kinds of questions in the lectures, I had an idea of what to say. I don't think I would've known that necessarily if he'd just asked willy-nilly….. I think it's important to not lose track of what's going on in in an hour lecture. I think it helps to keep you focused because if you don't understand something and then the pace continues, you tend to switch off and probably not listen to the last 10-15 minutes of the lecture. But the [pre-session] screencasts almost helps you understand so you won't get lost as easily."

(Focus-group participant 1)

"And sometimes to read around it as well. Sometimes you watch it, then read a book, then go back to it and see if it makes more sense. It's like a framework for revisional [sic] learning…. No, it's not passive, it's doing other stuff."
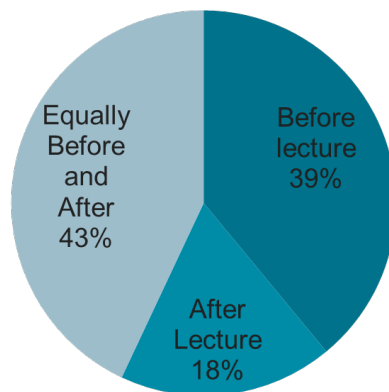*(Focus-group participant 5)*

Figure 3 - Students reports on whether they access screencasts pre- or post-session.

The conclusion here is that a pre-session screencast can serve as both an introduction and summary, and therefore provides benefits in active learning and engagement during the session, helps to scaffold the material and can also serve as a later source of reference in a format that encourages active learning. This is an important difference between a screencast and full lecture capture. There is therefore a reasonable argument that it is a more efficient use of academic time to prepare pre-session, rather than post-session screencasts in most situations, and that this is generally supported by commonly accepted pedagogical models such as Constructivism and Vygotsky's zone of proximal development[4].

LENGTH OF SCREENCASTS

The focus-group participants expressed a clear consensus that the 10 minute length of the screencasts was appropriate. This confirms the views of previous studies and is an important point for practice.

"it would like completely ruin the point of them if you made them longer."

(Focus-group participant 4)

"I think the reason that I have found time to watch them is because they're only ten minutes long."

(Focus-group participant 1)

"I think 10 minutes is about as long as people want to sit down and watch."

(Focus-group participant 5)

NUMBER OF SCREENCASTS WATCHED

The self-reported number of screencasts watched by the questionnaire respondents is shown in Figure 4, separated into home and international students. Frequency of use amongst international students was relatively uniformly distributed, whilst home students appeared more selective with few students reporting watching almost every screencast. Of the students who reported not accessing screencasts at all, 9/10 were MEng students and 7/9 of these reported that this was due to

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[4] Goodhew (2015) provides a summary of these concepts in the context of engineering education.

lack of time. The nature of the MEng courses is that there is signifciant project work running in parallel with taught modules. This is supported by the free-text survey comments and focus-groups. These also reveal that international students particularly appreciate screencasts as a resource:

"I honestly haven't had time due to my 4th year project work. I definitely think they are a great idea/resource." (Questionnaire free-text comment from a UK MEng Aerospace Engineering student)

"The screencast should be used in other modules. It is and has been very helpful to me as an international student." (Questionnaire free-text comment from an International MSc student)
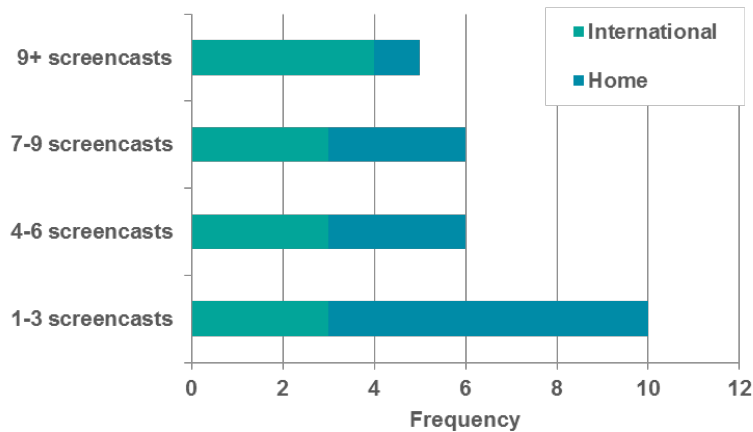

Figure 4 - Student self-reported use of screencasts (n=27 total responses to this question)

OVERALL STUDENT PERCEPTIONS AND SUGGESTED IMPROVEMENTS

Overall, the expressed preference response of students to the screencasts was extremely positive, 93% of respondents reported a better understanding of the course material after watching a screencast and 87% of respondents said they would use screencasts if offered in other modules. Free-text comments and focus-group comments broadly supported these views. This is consistent with the reports in the literature. It is, however, important to highlight that this is expressed preference data and participation in both questionnaire and focus-group was optional and so the participants were self-selecting and probably had higher motivation than some students.

A number of suggested improvements for the screencasts emerged from the expressed preference data, these make valuable practical points for improving practice:

• Email reminders should be sent to students when a new screencast is made available.

• Screencasts that work through numerical examples could be prepared.

• Screencasts should include links or references to other resources, such as textbooks.

USE OF SCREENCASTS IN A TRADITIONAL TAUGHT MODULE - REVEALED PREFERENCES

In order to validate the expressed preferences and to assess the educational benefit of the screencasts, usage data from the Blackboard VLE and final student outcomes were evaluated. As detailed above and illustrated in Figure 1, the screencasts videos were displayed on the module Blackboard site in a preview mode to encourage students to engage with the materials.

Unfortunately this presentation means that every time a students entered the 'Course Documents' page, it was logged as accessing the video. As a result it was not possible to use these data as revealed preferences, or correlate student performance directly with screencast use alone.

The data generated effectively counted total number of times the Course Documents page on Blackboard was accessed. This was therefore correlated with the final module mark for each student to assess whether frequency of access of the VLE learning resources could be linked to performance. This would at least give some indication of whether the suite of learning resources including screencasts had a positive effect on performance. Figure 5 presents these data and shows a relatively weak correlation with signifciant scatter. This is perhaps unsurprising given the variation in learning preferences and approaches. Two interesting messages can be inferred from this analysis. Firstly there is a group of students who can achieve above average performance with relatively little use of supplementary learning resources - they have developed successful approaches to achieving good assessment marks that do not rely on resources like screencasts. This result is consistent with previous findings in the literature (Green et al. 2012), and broadly consistent with the expressed preferences. A second notable observation is that, of the students who failed the module at the first attempt, 70% had accessed the blackboard course site less than once per lecture on average over the whole module.
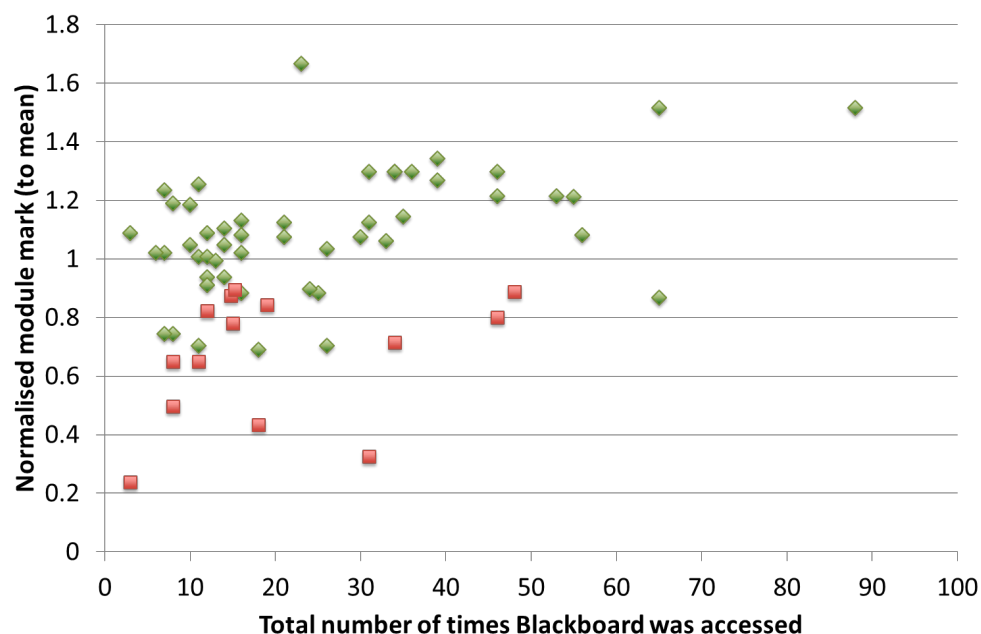

Figure 5 - Student performance (normalised to mean of the individual cohort) compared to total number of times the learning resources on the Blackboard VLE were accessed.

(Note: red points are students who failed the module at first attempt, green are students who passed. Dataset includes both MEng and MSc cohorts with a different pass mark and mean).

USE OF SCREENCASTS FOR REPORT WRITING HELP - EXPRESSED PREFERENCES

An online survey was undertaken to evaluate student perceptions of the two referencing advice screencasts provided to all MSc project students in summer 2015. The response rate to the survey was very low (n=6). The confidence in the results should be viewed in this context, especially as

there is likely to a positive response bias here. Nevertheless, of the 6 students who responded, 5 had viewed one or both screencasts. All of these felt that the coverage of different referencing styles, the length of the screencasts, the examples given and the clarity of the speaker were good or excellent. The results are generally consistent with the literature and other findings of this study; students self-report that they find screencasts beneficial.

ADDITIONAL FEEDBACK AFTER COMPLETION OF MAIN PROJECT

The screencasts were re-used for the academic year following the completion of the data collection, and were specifically mentioned in the student feedback on this module, which scored one of the highest student feedback scores in the Department of Engineering. This demonstrates that the resources themselves are continuing to enhance the student experience.

Following dissemination of the results of this study, screencasts were introduced to support one module by an academic colleague in the Department of Physics and Astronomy. They have received very positive student feedback:

"I meant to say today, but I personally found the screencast extremely helpful. The pace was perfect and it was incredibly useful to be able to pause the explanation and double check my understanding. I know you said it was just a trial run but I think this is a brilliant method of tackling some of the harder derivations and sections with lots of steps involved." (Student feedback, Bannister 2016 [per. com.]).

CONCLUSION

The original aim to obtain comprehensive quantitative evidence of effectiveness of screencasts in a mixed methods study was not achieved. However, by combining a literature review with expressed and revealed preference data it is possible to conclude that students are very positive about screencasts, but there is potential for improving the frequency with which these resources are used by students. In many cases students find approaches to achieve well in the module assessment without accessing the full range of learning resources made available to them, but in other cases students show much weaker engagement and weaker achievement. The latter is an education issue that goes beyond screencasts - for example it is likely the students who had not engaged with the learning resources in the pilot study module would equally have failed to engage with full lecture recordings. The literature, results and experienced gained here do suggest that particular characteristics of screencasting as a technique shows potential to address this. Green et al. (2012) argued that: "Screencasts promote a more active and voluntary form of learning because they present the course material in a manageable format; screencasts are brief, easy to use, and optimal". The use of pre-session screencasts, either in a conventional teaching format or as part of a flipped teaching approach, does show potential as a way of improving student engagement and encouraging active learning. The pre-session screencasts can then serve a dual function as a summary/revision aid.

5. CONTINUATION OF THE PROJECT

Pre-session screencasts and flipped lectures will be rolled out to other modules on the MEng/MSc Department of Engineering in 2016/17. The Screencasts in Engineering project website[5] will be maintained and updated as an information resource, with a series of seminars and workshops planned to disseminate project results during the next academic year.

ACKNOWLEDGEMENTS

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