A pilot evaluation study using LectureTools to enhance interactivity in classroom-based teaching in a project management course

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Abstract

With students' ownership of laptops and mobile devices increasing, there exists an opportunity to harness their use to support interactivity within the traditional classroom. Two educators, motivated to enhance interactivity in a two-day project management course at a UK university, trialled LectureTools, a cloud-based audience-response system. To assess potential benefits to learning and teaching, as well as identifying accompanying challenges, an evaluation study was carried out comprising a range of data sources. These included observation of a LectureTools-based lecture and a student questionnaire followed by a focus group discussion with a subset of students about their experiences throughout the two days. Interviews with both teachers were also conducted, adding to the evaluation research data and giving them an opportunity to reflect on their teaching practice. All participants recognised the benefits of LectureTools in promoting student engagement, learning and discussion while students acknowledged the distractive potential of having laptops in the lecture theatre. Efforts are required by educators to ensure that the interactive potential of laptops in classrooms to enhance learning and teaching is supported while controlling the potential for distraction. Future research is needed to ascertain the impact of using LectureTools on approaches to learning and teaching.

Keywords: LectureTools, electronic voting, interactive lectures, audience response, evaluation

Introduction

Educators have long recognised the need to incorporate interactivity in their teaching, to motivate and engage students and to encourage them to become more critical and questioning. The Socratic method of instruction is based on the principle of questioning students so that they discover knowledge for themselves (Gurung and Schwartz, 2009). However, one limitation of the Socratic method is that learners can feel 'put on the spot' and, in medical education, it has been suggested that this has the potential to cause embarrassment to the learner (Aldeen and Gisondi, 2006).

While questioning is not dependent on technology, certain technological advances have encouraged its use in the classroom and have the added benefit of allowing learners to respond anonymously in addition to supporting interaction in larger class sizes. An early example of technology-enhanced learning to support interactivity in lectures includes the 'feedback machine' used at the Royal Veterinary College to allow

students to respond to multiple-choice questions via a selector dial on their desk (Appleby, 1968). More recently, 'clicker' technology has enabled students to respond to multiple choice questions in the lecture, using an electronic handset device which transmits radio signals to a receiver on the presenter's computer. Clickers have been shown to promote interactivity in lectures and, in comparison with their earlier counterparts, have the added advantage of not being fixed to a single classroom (Draper and Brown, 2004). However, limitations include the logistics of transporting handsets across campus, and technical issues such as handsets and receivers being set to different frequencies.

An alternative system for supporting classroom-based interaction is LectureTools. LectureTools is a cloud-based audience-response system which facilitates a wider variety of question formats than that afforded by clicker technology. It also removes the need for dedicated voting equipment other than the students' own laptops or mobile devices, ownership of which has significantly increased in recent years, as evidenced in a survey of students at University College London (UCL) (Dale et al., 2013). LectureTools is owned by the same company who market the Echo360 lecture capture system. As Echo360 users, educators at UCL had the opportunity to trial LectureTools. The system merges the functionality of clickers with social media such as Twitter and text walls, which have been used to promote student engagement during a live lecture (Folley and Jabbar, 2010; Forgie et al., 2013). In one study of LectureTools use by its creator, it was shown that "students felt more attentive with the technology, significantly more engaged, and able to learn more with the technology than in similar classes without it … [it] also led to a dramatic increase in the number of students posing questions during class time" (Samson, 2010, p.1). The LectureTools interface which the student sees is shown in Figure 1, and the 'dashboard' used to monitor student responses and feedback is shown in Figure 2.
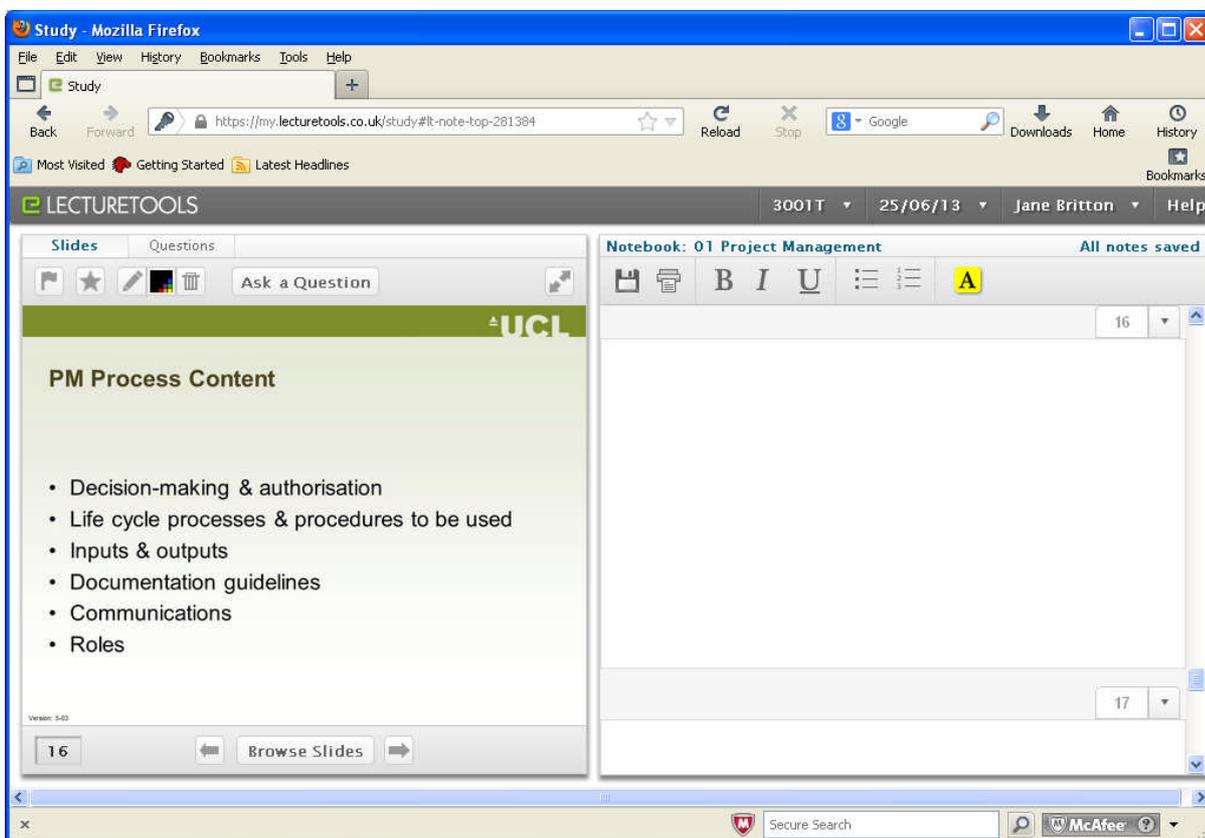

Figure 1: LectureTools student interface, showing the PowerPoint slides on the left with the interactive options above and the note-taking area on the right.
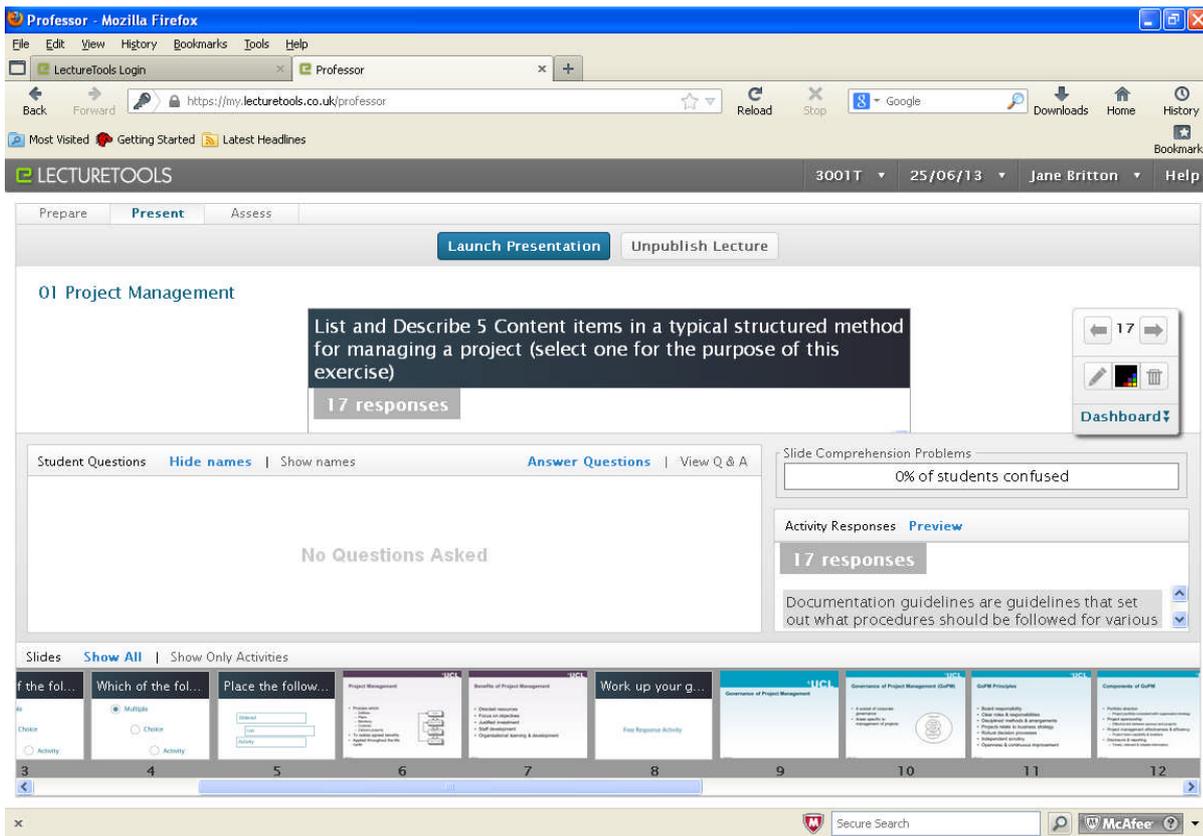
Figure 2: LectureTools presenter interface, showing an activity slide at the top, student responses and comprehension on the right, and a panel displaying student questions on the middle left. A preview of the adjacent slides is shown at the bottom of the screen.

Two of the authors (JB and MW) were keen to pilot the system in a two-day project management course with the intention of making their classroom-based teaching more interactive and also to explore the functionality of LectureTools. The research question underpinning this study was whether LectureTools would make a traditional lecture more interactive. This pilot evaluation study also sought to explore perceived benefits and limitations of LectureTools from the perspectives of students and their teachers in a discipline where it is recognised that students are increasingly technologically 'savvy' (Ojiako et al., 2011), with a view to informing future studies across a range of disciplines.

Methods

Seventeen students (third and fourth year undergraduates, and Masters students, from across a range of disciplines) were enrolled on a short course for the Association of Project Management APMP qualification. Initial preparation for using LectureTools involved the educators (JB and MW) liaising with the Innovations Officer (JD, a learning technology role) to explore the possibilities of the software for supporting interactivity in the classroom, as well as registering students' details with the system, which involved creating a unique login for each student. Before the live teaching session, a trial session was run in a lecture theatre with members of the E-Learning Environments (ELE) team using a range of devices (PC and Apple laptops, iPads and an Android phone). The educator (JB) worked through the LectureTools activities as they would in the live sessions with students.

At the beginning of the two-day course, the educator (JB) introduced students to the LectureTools interface and its tools for note-taking and interaction. LectureTools was used throughout the two days. A one-hour, interactive lecture by JB on project management was observed by the E-Learning Evaluation Specialist (VHD), having been identified in advance as an appropriate class to observe due to its potential for significantly increased interactivity in the classroom. The lecture was intended to introduce the topic of project management and help students prepare for their forthcoming APMP professional qualification; thus, the session afforded the opportunity to pose questions similar to those which candidates would be expected to encounter in the exam.

At the end of the course, all students were invited to take part in an evaluation study co-designed by VHD and JB. This comprised an anonymous survey, partly conducted using the electronic voting system (TurningPoint with clickers) and partly via handwritten comments on paper, followed by a focus group discussion on their experiences of LectureTools throughout the two day course. One student was not able to attend the focus group but provided additional information via an audio 'sound bite' while six others volunteered to participate in the focus group. Both educators were subsequently interviewed by VHD about their experiences of LectureTools, which gave them the opportunity to reflect on their teaching practice as well as contributing research data to this study. The quantitative data are shown graphically and summarised using the median. The qualitative data from survey comments, the focus group and interviews were imported into NVivo to identify recurring responses and are described along with representative quotes.

Results

E-Learning Environments (ELE) trial

The trial session with ELE staff as 'students' confirmed that, in principle, LectureTools was capable of supporting interactivity in the classroom. None of the participants was able to submit their answers via the SMS text feature, due to the fact that mobile phone numbers had not been registered with each account beforehand. However, participants were able to make notes, flag problematic slides, and submit questions or comments online. Some participants also successfully experimented with the drawing tool. However, individuals with mobile devices struggled with drag and drop exercises, and it was observed that it was not possible to drag options B to E in the sequencing question type to the A position on any device. It was also found that if participants did not 'submit' their answers to open questions before the teacher 'published' them, those answers were lost. There were also some visual differences between the web-based version of LectureTools and the LectureTools app, with graphical answer displays differing markedly. Therefore, while the educators were reassured about the overall stability of the platform to continue to pilot the technology with students, they decided to advise them against using the app version for now, and were able to advise them in advance of any software limitations.

Observation

Seventeen students participated in the observed session. Most were using laptops (a mixture of PC and Mac); two students had brought a tablet (iPad) and one student was using LectureTools via her mobile phone (iPhone). The educator (JB) was observed to have provided explicit signposting throughout the session in terms of advancing the slides (the teacher and students' slides are not automatically synchronised), explaining how to respond to questions, and how to avoid potential technical difficulties which had been encountered in the trial run.

During the presentation of informative slides, students were listening and typing notes using the note-taking feature within LectureTools, which they appeared to be very comfortable with. One student was observed using the highlighting tool within the notes to emphasise key points. In relation to the activities, no students appeared to have any difficulty answering multiple-choice questions or compiling text responses on the various devices, although students using mobile devices took longer to type answers due to the virtual keyboard and smaller screen. The drag and drop exercises proved to be problematic for students on mobile devices such that they were unable to answer that type of question.

The laptops and mobile devices did create the opportunity for distraction, and this appeared to occur mostly when students were waiting for other students to submit their text responses to open questions. Students were observed accessing up to four different websites during the session. While some were relevant, such as the use of Wikipedia to find out more about core concepts, students were also observed using email, social media and online shopping. When this happened, distracted students often missed the start of the discussion around the submitted answers.

Student survey and focus group

Survey
The results of the survey are shown in Figure 1.

(Compared with traditional lectures) LectureTools…
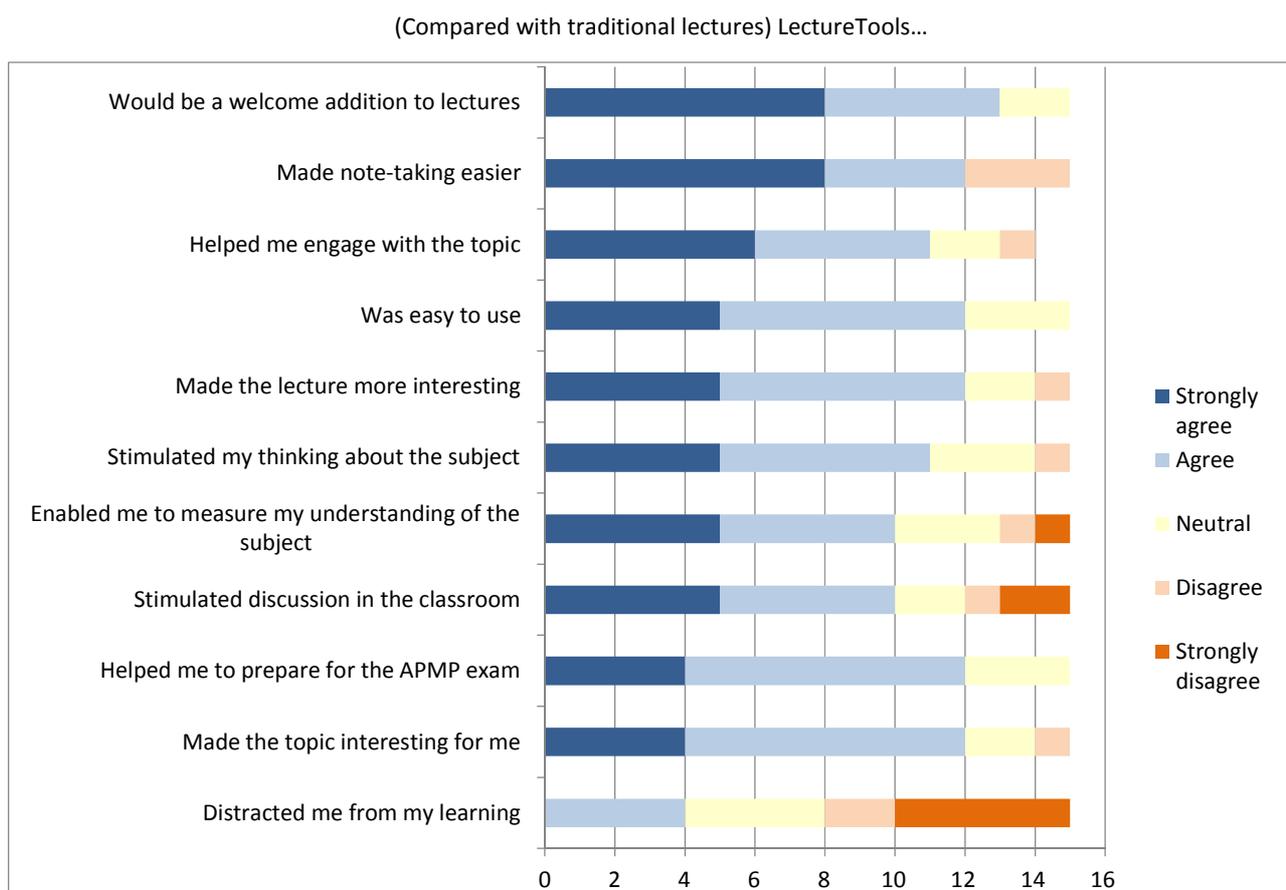
Figure 1: Quantitative results from the student survey (n)

This quantitative feedback indicated that most students found LectureTools to be stimulating and engaging. It made the topics and the lectures more interesting, facilitated note-taking and helped stimulate discussion. While a number of students acknowledged that it was a distraction in class, most students felt that it aided their exam preparation and that it would be a welcome addition to their lectures in general. This feedback was mirrored in the written comments, summarised in Figures 2a, 2b and 2c.
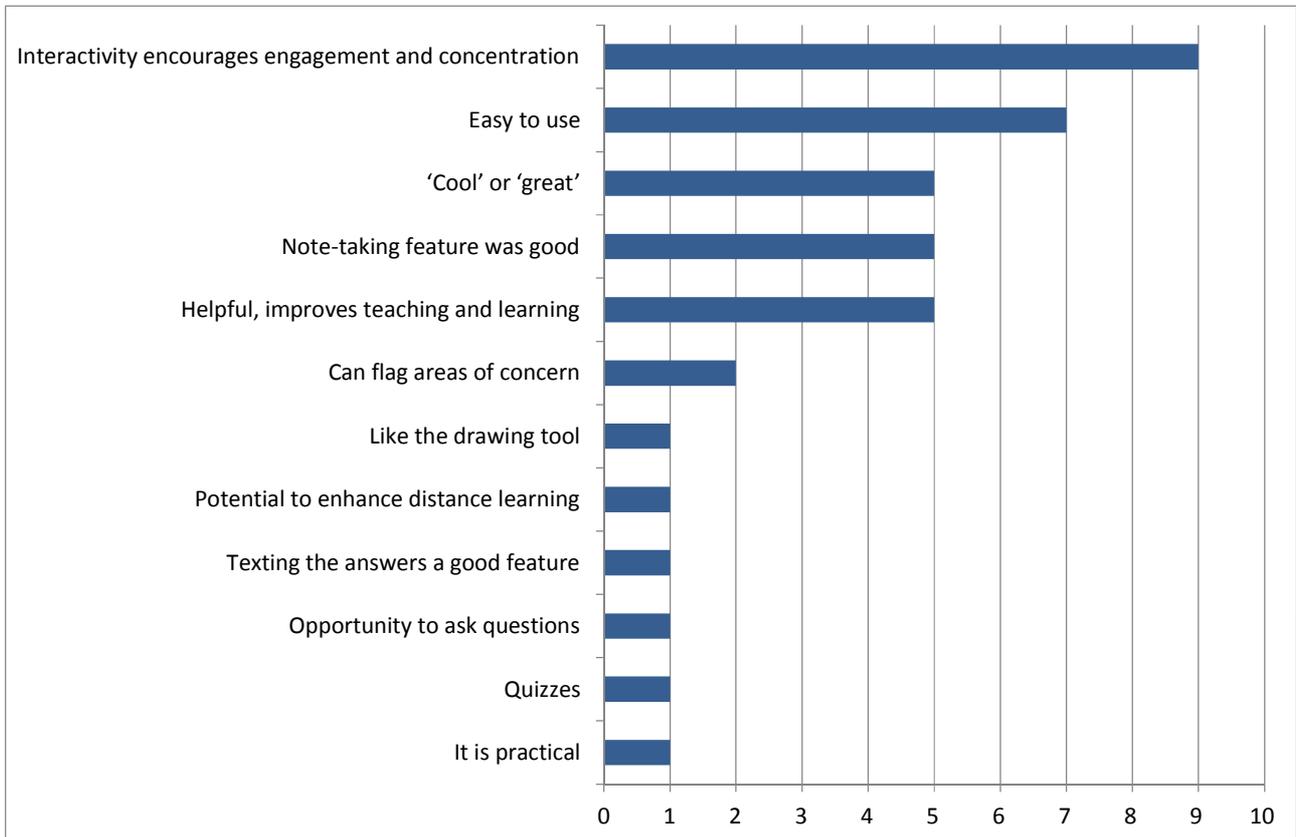

Figure 2a: Categories of student comments relating to perceived benefits of LectureTools (n)

Some comments which summarised the perceived value to students were as follows:

"The interactive parts are good, helping keep students focus on the class instead of daydreaming."

"It's easy and very useful. Interactive bits were good too. Aided learning."
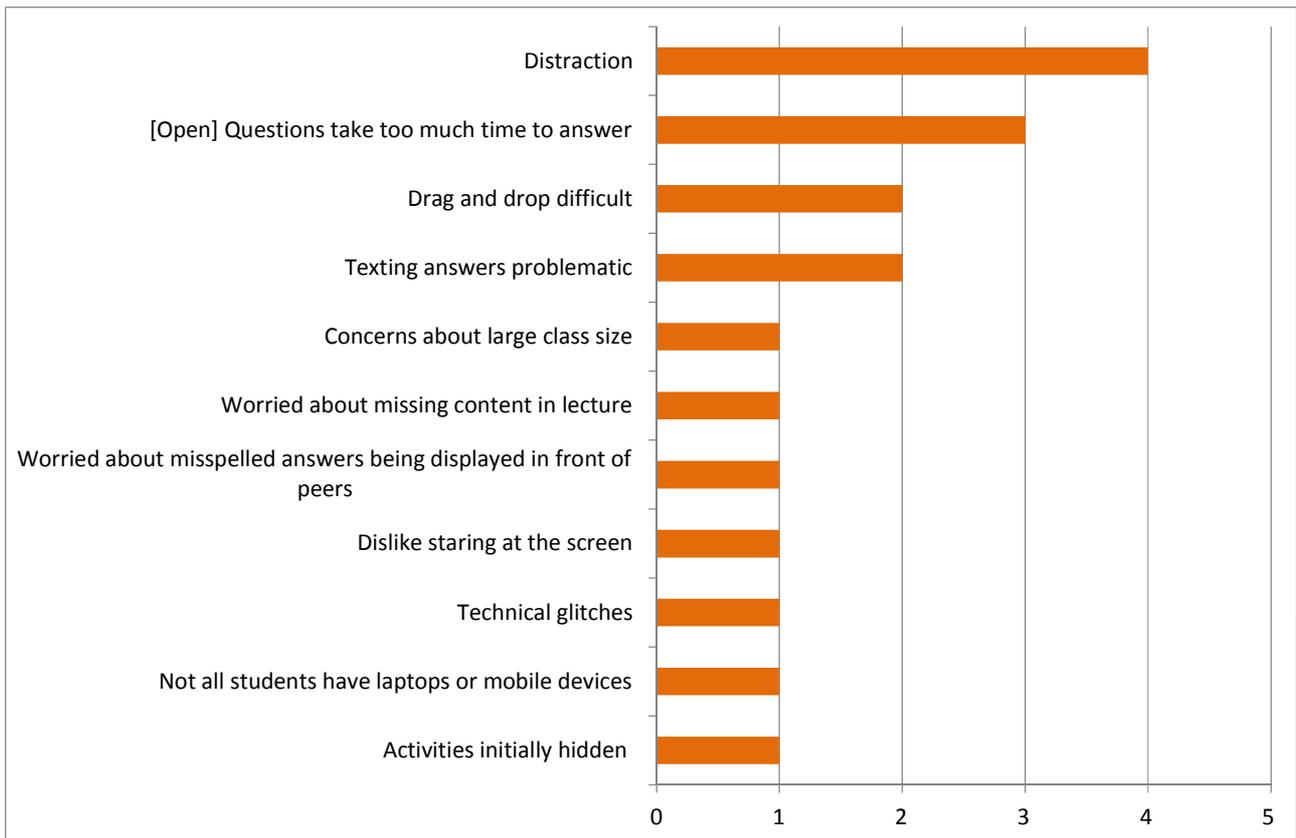
Figure 2b: Categories of student comments relating to perceived difficulties and concerns with LectureTools (n)
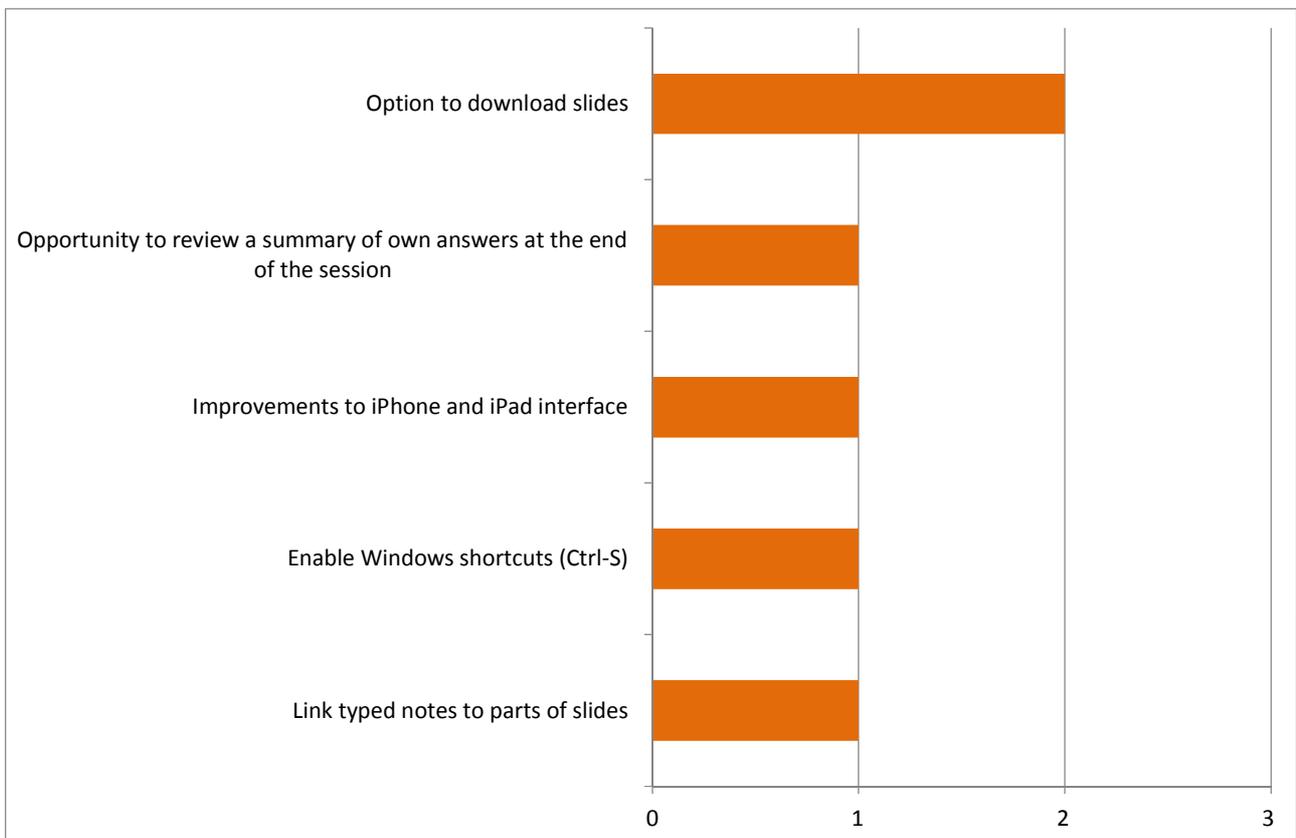
Figure 2c: Categories of student comments relating to suggested improvements (n)

One student also commented that the interactivity was influenced by the quality of the questions and another acknowledged that the students' and teachers' unfamiliarity with LectureTools meant that the session was 'slow'.

Focus group

The focus group provided students with an opportunity to elaborate on the survey responses. In terms of benefits, students noted that LectureTools was helpful for learning, one student saying:

> "I liked the LectureTools a lot. I'm really impressed by it. It's so easy to use and so helpful and most of us nowadays work on computers anyway during the lecture so it just makes it easier not to write everything in Word, copy the slides, we have everything on one screen."

However, not all students were comfortable typing their notes:

> "I found almost that because I was so busy trying to type away and make notes on the actual software, and we were covering an awful lot of ground, was I really taking all of that in as well as I would have done with a pen and a piece of paper?"

> "I just don't like typing. I found it a massive distraction. I was there – because I was in Google Chrome and spell check and my typing's awful – so I was there correcting words I spelled wrongly, missing what Jane was saying, not really engaging so vocally in the class. But then once I thought 'ok, I'll just type what I want, forget how formatted it is', it was fine."

The student who was quoted immediately above went through a transformative experience in relation to LectureTools:

> "I didn't use the notes function at all for the first half of yesterday and then I got into it – now I love it … It grows on you, I didn't like it, but now I think it's really good."

Students compared the functionality of the note-taking feature to Microsoft Word, and commented that the formatting capability was significantly reduced, and the usual shortcuts (like Ctrl-S for Save) did not work, although one student expressed satisfaction that the notes saved automatically.

Although none of the students used the facility, some did consider that the ability to ask questions during lectures would beneficial:

> "We haven't really asked a question to a lecturer but I think that's great, that you can write a question and then the lecturer looks there and then they can answer it."

Students did comment that open questions needed careful handling, as these had the potential to slow the classes down significantly, leading to the opportunity for distractions:

> "I do think that the multiple choice questions, or putting the order questions, those are very good ones because all of us answered relatively quickly and Jane gave us feedback relatively quickly so we had no time for distractions but the written ones – it's ok when there is 15 of us here – but I cannot imagine this with 100 [students] … Matt was talking to other people, helping them and discussing the options, but then when you don't have anything to do you start to do other things, and obviously I was distracted … and then it's hard to come back.

Although students considered that LectureTools would be suitable for a number of other classes, some commented on the limitations of the drawing tool and questioned the value of LectureTools for note-taking in courses where they would be expected to draw diagrams:

> "I cannot see how it will be useful for the courses where I either have a lot of graphs or a lot of equations like maths."

Students also commented on some technical glitches and the difficulty locating slides if the teacher did not publish them in advance of the sessions. There was also a request to be able to download the notes.

Interviews with staff

In relation to their motivation to use LectureTools, one teacher (JB) explained in her interview that she was keen to explore the interactivity afforded by it, having previously found other audience response systems awkward and unintuitive. The other teacher (MW) was very aware of the 'death by PowerPoint' phenomenon that he thought could be alleviated by using an interactive classroom technology.

Both teachers acknowledged in the interviews that they did not use all the functionality within LectureTools, and this was partly due to their lack of familiarity with the technology. However, in terms of benefits to teaching and learning, one teacher (MW) perceived that the polls and quizzes allowed him to ascertain what students were thinking and that articulating their thoughts in the form of open question responses gave students confidence about their knowledge and understanding. The other teacher (JB) appreciated the ability to publish the open text responses and to provide feedback on the answers, recognising that the questions provided an opportunity to open up discussion:

> "I liked the fact that I could publish the results and comment on them and they were anonymous. So what we were doing on the course I used it for – it was preparation for an exam, an external exam – so we had practice questions and students could put up their answers and then I could go through and put them all up and say to everyone 'Look, this is a really good answer', because when I publish the results, the students then get them all. So they had that as a revision tool and they could note – make a note of which ones I said were the way to do it, so I think it was – for the purpose I was using it – that seemed to work well." (JB)

Both teachers commented that LectureTools changed the dynamics of the classroom, in that students were often quietly focused on their individual devices in isolation, rather than making eye contact with the teacher or conversing with each other. While they recognised that this did not mean that students were not working, it was something that the teachers were unprepared for:

> "It changed the dynamics of the class, actually, because everyone was focused on their computers. It really was noticeably different. They weren't looking at me, they weren't looking at each other, they were interacting with each other but via their devices. That felt strange, it made the class quiet." (JB)

In terms of challenges, the teachers observed that there was a lack of parity between students on different devices; those on mobile devices experiencing difficulties with drag and drop exercises, as well as taking longer to respond to open ended questions, to the extent that some students 'lost' their answers if they had not submitted them before the lecturer published their responses on screen.

Both teachers commented on the difficulty monitoring the dashboard during live teaching. Although this was partially due to the time available, there was an additional challenge in that the lecture theatres were equipped with PCs with only one monitor. To overcome this, one lecturer (MW) ran LectureTools from his laptop connected to the podium and was able to 'extend' the screen so that the projected image was of the slides and the questions, while the dashboard was displayed on the laptop screen. The other lecturer (JB) attempted to run her LectureTools presentations in presenter mode independently on the laptop using a second login, although this was cumbersome to maintain. Other limitations of the software identified by the

teachers were that they were unable to print slide handouts or download their presentations, because LectureTools is cloud-based:

> "Say if I wanted to show an accreditor what I do in a lesson, I've got to be able to pull it off and exhibit it in some way. At the moment, one does that with PDFs of slides or things like that, do you know what I mean?" (MW)

One teacher (JB) also observed that some PowerPoint functionality was removed once slides had been converted into LectureTools, including transitions used for animations and the ability to edit slides directly. The other teacher (MW) suggested that the linear nature of PowerPoint, on which the LectureTools presentation was based, did not allow him to respond as flexibly to students learning needs as he would like:

> "I can probably describe my nirvana tool if you like. Because I think when you're teaching you're not necessarily just delivering an author's view of something – it's not so much like you're performing a piece of music, I think it's more of a DJ [disc jockey] experience … you're mashing together lots of different sources … for me it would be lovely to be able to see a lot of sources at once and to be able to integrate them more or less in real time … … and then obviously students like to be able to see something to refer back to … you want to point to some digital resource at the end of the teaching experience and say 'Well this is what we talked about'." (MW)

In terms of support required for effective use of LectureTools, one teacher (MW) said that ideally, the software should be intuitive, although he recognised that some introductory support on how to convert PowerPoint slides into a LectureTools presentation would be required. The other teacher (JB) suggested that written instructions would be helpful, and acknowledged the importance of having a local support person once the technology had been embedded as a core service. Both teachers were asked if graduate teaching assistants could be brought in to monitor the LectureTools dashboard while the lecturers delivered the live sessions; however, while they acknowledged the usefulness of having a fellow university teacher in the room, they were concerned that teaching assistants would not have the required depth of subject knowledge to be able to answer complex questions on their behalf.

Both teachers agreed that they would use the technology again but expressed reluctance to use it with larger student numbers at this point in time, because of the relative infancy of the software and the challenge of supporting a larger number of students with technical difficulties in a live classroom. There was also a concern that it would not be possible to review the text responses from large numbers of students in the live teaching situation.

Discussion and conclusions

The results from the study are encouraging, in that the majority of students agreed that LectureTools helped them to engage with the topics in their lectures, which they found more interesting, and it stimulated their thinking and discussion in the classroom. This parallels findings in other studies of LectureTools (van der Pluijm, 2008; Samson and van der Pluijm, 2009; Samson, 2010). Students also recognised that LectureTools helped them to prepare for the forthcoming examination. As with clickers (Draper and Brown, 2004), this would be an appropriate use of LectureTools to advocate, since it enables students to test their knowledge, which is a core component of self-regulated learning (White and Gruppen, 2010). Indeed, the usefulness of LectureTools as an aid to metacognition (students understanding their own learning) has been evidenced (Mazumder, 2010).

Some students in this study commented that LectureTools interfered to some extent with the transmission of content which they were trying to accumulate, and they were concerned that by typing notes on the screen, they may 'miss' information being imparted by the lecturer. This concern among strategic learners studying business and marketing has been evidenced elsewhere (Masikunas et al., 2007). It is recognised that in classes where LectureTools is employed and where students are required to think and participate in discussions, that the same amount of material cannot be covered (van der Pluijm, 2008). However, an approach to lecturing dependent entirely on information transmission is somewhat questionable, as attention is known to drop off significantly after a short time in lectures if students are not stimulated to think (Bligh, 2000).

One of the significant advantages of clickers, which by extension applies to LectureTools, is the ability of the teacher to engage in contingent teaching (Draper and Brown, 2004). Dependent on students' level of understanding as gauged by their responses, the teacher can adapt the material being delivered to the students' needs, rather than following a predetermined script. One teacher in this study commented that being based on PowerPoint, the LectureTools presentation felt somewhat linear, and he would like to be able to interact with a more flexible and accessible resource which would allow him to prepare the session almost 'on the fly' – this will be dependent on the future development of LectureTools. The future integration of LectureTools with the Echo360 lecture capture system is a promising indication of how LectureTools might interface with different media.

Technically, LectureTools appears relatively easy to use and aided students with note-taking. Although some students take notes on their laptops anyway, some stated that they would prefer to use LectureTools for up to an hour at a time rather than continually for the two-day course, as they found looking at the screen for long periods of time physically demanding. Government guidelines state that workers should be encouraged to take short, frequent breaks from their computers to do other tasks (Health and Safety Executive, no date), but no national guidelines exist for students using computers to support their study although many UK universities have guidelines that address this. It would seem sensible therefore to advise that LectureTools should be limited to classes where they will have the most positive impact on learning and teaching, rather than arguing for its wholesale integration into teaching.

The results of the survey and focus group suggest that LectureTools was a distraction for some students, although interestingly, this was not mentioned by their teachers in the interviews. In the observation of the one-hour session, students were seen accessing up to four different websites. Empirical evidence suggests that the distracting capability of laptops may be minimised if educators think carefully about how they may be best used in terms of the proposed learning design (Zhu et al., 2011). Suggestions for minimising the disruptive effect of laptops include establishing a laptop policy for students in class, and identifying a laptop-free zone for students who do not wish to be immediately surrounded by laptop users; however, this means that alternative mechanisms for engaging students are also required so as not to exclude students who choose not to bring mobile devices or laptops into the classroom (Zhu et al., 2011).

The university infrastructure needs to be designed to support mobile use in classrooms (Zhu et al., 2011). With respect to LectureTools, in addition to providing extra desk space for laptops and power sockets, this means having two display monitors in lecture theatres, or providing the facilities for educators to connect their laptops to project the classroom display via the data projector while being able to monitor the dashboard on their laptop. With the increasing use of technology in the classroom, universities are being encouraged to reconsider the physical design of their teaching and learning spaces (JISC, 2006). As part of a

review of audio-visual requirements, those responsible for redesigning learning spaces should consider the technical requirements of interactive classroom-based technologies.

In this institution, LectureTools has yet to be trialled on a larger scale. While its touted advantages include the ability to engage students in large cohorts (van der Pluijm, 2008; Samson and van der Pluijm, 2009; Samson, 2010), students and teachers in this study questioned the logistics of using open text questions with more than the relatively small number in these classes, given their time-consuming nature and the difficulty reviewing a large number of text entries on screen. One solution to this problem might be to use one of the elements of Mazur's (1997) peer instruction in that the teacher could ask students to discuss the answer in a small group before agreeing on an answer which is typed in by one student on behalf of the group. An alternative solution is to use only closed questions; multiple choice questions may be designed to support thinking at different cognitive levels, as illustrated by Bruff's (2009) taxonomy. In their interviews, teachers also commented on the potential difficulty of knowing what all the students in a large class might be doing (although they do not know this in a traditional lecture) and how they might best support a larger number of students from the technical perspective. This could be one of the tasks of a teaching assistant, as well as monitoring the dashboard.

Limitations of the study included the fact that this was a pilot evaluation of LectureTools in a two-day course with only 17 students, of which 15 participated in the survey, one provided additional information and six participated in the focus group discussion. Although LectureTools was used throughout the two days of the course, the observation was of just one hour of teaching, and only two educators participated in the interviews. Acknowledging these limitations, this study suggests that LectureTools does offer the potential for increased interactivity, engagement and learning in lectures. The success of its use appears to be dependent on teachers having some familiarity with LectureTools, being confident in delivering interactive sessions and providing explicit signposting throughout sessions and designing appropriate activities. Bringing laptops and mobile devices into the classroom provides opportunities for distractions which need to be carefully managed. Future research will be required to explore changing attitudes to LectureTools as it becomes more embedded in learning and teaching; this includes ascertaining the extent to which LectureTools might actually *change* the way that students approach their studies, with respect to note-taking, thinking about their learning and engaging with their discipline, and how it impacts on teaching approaches.

Acknowledgements

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