ascilite
ascilite 2012
FUTURE CHALLENGES | SUSTAINABLE FUTURES
25 - 28 November 2012 | Wellington | New Zealand

Promoting asynchronous interactivity of recorded lectures in blended learning environments

Bernadette K McCabe
Faculty of Sciences
University of Southern Queensland

Carola Hobohm
Faculty of Sciences
University of Southern Queensland

Recorded lectures have become one of the most popular methods of delivery in a blended learning environment (Greenberg & Nilssen, 2009). While there are many advantages to using recorded lectures they are limited in their ability to capture the interactive atmosphere experienced by students in the face-to-face environment. This paper examines how the use of audience response systems (ARS) and digital inking, when incorporated into live lecture recordings, can be used to facilitate asynchronous interaction of recorded lectures in bioscience lectures for nursing students. Key findings show that the three most valuable improvements that ARS and digital ink made to face-to-face lectures and recorded lectures relate to the ability to see other students' responses, immediate feedback and reinforcing material covered in class. Students who used recorded lectures more frequently particularly valued the ability to pause recorded lectures to consider the questions and then view collective results with immediate feedback. Moreover, students who viewed recorded lectures more frequently performed equally well with those students who did not.

Keywords: Audience response systems, clickers, active learning, digital inking, nursing bioscience

Introduction

A little over a decade ago Collis and Moonen (2001) posited that blended learning is a hybrid of traditional face-to-face and online learning, where the online component becomes a natural extension of traditional classroom learning. Now, blended learning has become an expectation for higher education students. A well designed blended learning approach of delivery is able to enhance the face-to-face interaction between teachers and students with online opportunities in the form of flexible, self-directed activities (Garrison & Kanuka, 2004) and is perceived to have many advantages for the learner, including anytime, anywhere access, self-paced learning, enquiry led learning and collaborative learning (Ruiz, Mintzer & Leipzip, 2006). There are many blended learning models which combine on-line material and traditional face-to-face teaching. They commonly use a central learning management system (LMS) as a platform to provide content such as online video, quizzes and other activities. The provision of electronic lecture recordings within the LMS has become an effective tool in the flexible delivery of lecture material (Woo, Gosper, McNeill, Preston, Green, & Phillips, 2008). Wieling and Hofman (2010) emphasize that offering recordings of face-to-face lectures is an easy extension of a traditional course and is of practical importance, because it enables students who are absent from the regular face-to-face lectures to be able to improve their course grade by viewing the lectures online.

It has been documented that the success of blended learning can, in part, be attributed to the interactive capabilities of online communication technologies (Swan, 2001). Literature in the field of lecture capture identifies many benefits that can be gained from recorded lectures, such as: reviewing material to complement in-class interactions; improving test scores; improving retention of class material; flexibility of schedule; making up for missed class; and the ability to clarify misunderstandings (Deal, 2007; McElroy & Blount, 2006; Nagel, 2008). One major shortcoming of recorded lectures, however, is that they are limited in their ability to capture the interactive atmosphere experienced by students in the face-to-face environment (Larkin, 2010).The potential drawbacks focus mainly on elements that students miss if they do not attend face-to-face lectures, including: lack of opportunity to ask questions and ability to obtain immediate feedback; lack of interaction with peers and/or lecturer; reduced motivation; and inability to pay attention/focus and distraction (Panther, Mosse & Wright, 2011). Chang (2007) highlights the concern that student engagement is reduced through using lecture capture hence encouraging students to become passive learners.

Whilst there is evidence that lecture capture generally supports student learning positively, there is a need to explore new ways to support active learning using recorded lectures. This perhaps represents one of the major

challenges facing the effective use of lecture capture. The greatest increase in the effectiveness of lecture capture systems will come from the application of pedagogical techniques that integrate engagement and interactivity and will ultimately drive the success of this form of learning into the future.

Background

The University of Southern Queensland (USQ) supports high levels of flexibility in its programs of study by ensuring that students have equitable learning opportunities, no matter where or when they are studying. Lecture recording technology at USQ began 10 years ago and forms a central component to support flexible learning options for both on-campus and distance students.

The biological and physical sciences are an important component of USQ's Bachelor of Nursing (Pre-Registration) program. The learning and teaching of science subjects in undergraduate nursing programs can be difficult and a number of issues which contribute to this have been documented (McVicar & Clancy, 2001). An obvious disparity in science background exists amongst USQ's cohort with 60% of the enrolment comprising mature age students who either have never studied science at senior school level or may have left secondary school some 15 or 20 years ago.

Lectures have been recorded live in the course NSC1500 Biophysical Science Foundations in Nursing since 2002 to accommodate the diverse on-campus student cohort and tablet PC technology has been used on-going since 2007. Digital inking, using tablet PCs or pen-enabled screens is a technology that has been adopted increasingly within lecture recordings, both pre-recorded and live, since the ability to draw spontaneous annotation to support explanation in lectures greatly enhances communication and assists in creating close reproductions of the live lectures (Yoon & Sneddon, 2011; Ambikairajah, Epps, Sheng, Celler & Chen, 2005; Subhlok, Johnson, Subramaniam, Vilalta & Yun, 2007).

On-campus nursing students enrolled in NSC1500 can be categorised as: (1) those that usually attend lectures, but may occasionally be unable to attend; (2) those who attend face-to-face lectures about 50% of the time; and (3) those that rarely attend lectures and only attend compulsory tutorials. For many of the students who rarely attend lectures, reasons are predominantly related to travel time, work and family commitments. USQ is a regional university and many of the students are from remote areas where they may have to travel 1 to 2 hours to attend classes. Many thus rely on recorded lectures. Pilot research has revealed that 30% of students (n=97) never or only attended lectures 20% of the time and that these students use recorded lectures both as a supplement and replacement to the traditional lecture (McCabe, 2010). This provides an interesting contrast given that many studies show that students use recorded lectures to support and supplement learning rather than to replace face-to-face teaching (Brotherton & Abowd, 2004; Griffen, Mitchell & Thompson, 2009; Buchanan, Macfarlane & Ludviniak, 2010; Larkin, 2010).

Purpose of the current study

There appears to be scant information regarding how lecture capture can support active learning, particularly for those cohorts which use recorded lectures as a replacement of face-to-face lectures. Thus the challenge remains for educators to incorporate technologies which create an interactive learning experience that stimulate active learning. The relatively large percentage of NSC1500 students who rely on recorded lectures indicates that there is a necessity to enhance lectures to cater for students who are present as well as those relying solely on recorded lectures. This is perhaps especially important to support students using blended learning environments so that they can feel part of the same learning environment as campus-based students.

One strategy is to facilitate interactions during the live lecture and embed them in the subsequent lecture recording. A number of technologies have been used to promote interaction and active learning in live lectures, including audience response systems (ARS). ARS technology or 'clickers' have been used in higher education for over a decade, and a number of studies support its potential to transform classroom participation and learning, especially in science disciplines (Crossgrove & Curran, 2008; MacArthur & Jones, 2008). The technology has been used to improve student interaction, engagement and attention, increase attendance, stimulate peer and class discussion, provide feedback for both students and instructor in order to improve instruction, and improve learning performance. Kay & LeSage (2009) provide a comprehensive literature review examining the benefits and challenges of using ARS.

This study proposes to integrate ARS and digital inking within live lecture recordings as a simple approach to increase active learning whilst students view recorded lectures. The main motivating factor was firstly to

provide a more interactive face-to-face learning environment for students attending live lectures and secondly, to enhance the blended learning environment by promoting student engagement and active learning using the subsequent recorded lectures. The adoption of the ARS in this study is therefore pedagogy-led (rather than technology-led) and the emphasis on teaching needs in technology-enhanced teaching is consistent with e-learning trends (for example Draper, 2009).

The aim of the study was to firstly explore how the use of ARS and digital inking in lecture recordings stimulate student active learning in asynchronous learning environments. Secondly, the study evaluated student perceptions of the combined technologies and quiz performance in relation to frequency of lecture recording use.

Methodology

Participants

The participants in this study were on-campus students who were enrolled in NSC1500 Biophysical Sciences in Nursing during the first semester of 2011. Of the 218 students enrolled in the course, 136 (62.4%) voluntarily took the survey, which was approved by the University of Southern Queensland Human Research Ethics Committee. The majority of students experienced ARS in live lectures for the first time, and none of them had used recorded lectures combined with ARS questions and digital inking. The average number of students participating in the live lecture was between 50 and 70.

Course delivery

The on campus NSC1500 course was designed as a blended learning model incorporating face-to-face, online and self-directed learning experiences over 13 weeks. Two modules of NSC1500 were included in the present study, namely chemistry and biochemistry, since these were delivered by the same instructor. The face-to-face component consisted of three 50-minute lectures and one compulsory 50-minute face-to-face tutorial each week. In addition, weekly online self-directed learning activities integrating lecture and tutorial material was provided for students to complete. A secondary teaching supplement was also provided to students in the form of a pre-study DVD which they can access both at the start of semester and throughout (McCabe, Kek and Turner, 2011). This support material was developed in response to the many nursing students who are apprehensive of their ability to understand biological and physical science concepts.

Integration of ARS and digital inking in live and recorded lectures

Audience response systems (clickers) are hand-held, pocket-size remote control-like devices that use infra-red or radio frequency signals to transmit and record audience responses to questions. The response system used in this study was TurningPoint™ software. This was used to present questions about 4 or 5 times throughout the face-to-face lecture and was tailored to hone in on specific points in the lecture. They were used for various purposes, for example: to assess students' background knowledge; to highlight known misconceptions; to review material; or to apply new knowledge to solve a problem. During the lecture sessions the software program recoded the student entries and response data was instantly aggregated and displayed. After the graphed responses were displayed the lecturer provided detailed feedback through verbal explanations and annotations on the PowerPoint slides to support the explanations.

The live lectures were captured using Camtasia Relay software (http: www.techsmith.com/camtasiarelay), which recorded the instructors voice and PowerPoint™ slides containing ARS activity and digital inking. The recorded lectures were made available soon after class in the Moodle learning management system. Figure 1 illustrates a typical slide containing an ARS question with the responses provided by on-campus students and annotations made by the lecturer using digital ink in response to the students' answers.

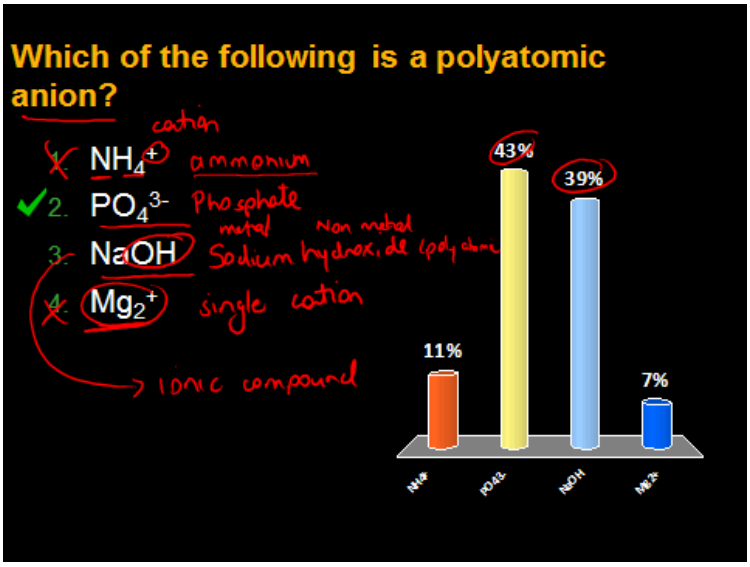

Figure 1: Screenshot example of recorded ARS question including graphed student responses and annotations to provide feedback

Student evaluation and analysis

An anonymous paper-based survey was provided during the last week of semester to the students attending tutorials. The questionnaire was designed with both quantitative and qualitative questions to evaluate the effectiveness of the combined technologies in the different learning environments, that is, live lectures, recorded lectures or a mixture of both. A concurrent triangulation research design was employed (Creswell, Plano Clark, Gutman & Hanson, 2003) where both quantitative and qualitative data were collected simultaneously, and the results of the analyses of both data sets were merged for a better understanding of the research aims. The quantitative questions related to students' perceptions of the use of the combined technologies and effects on their learning. Qualitative data was obtained through open ended questions asking students to provide their comments.

Findings

This section presents the analysis of the evaluation data. Students were firstly asked to rate their frequency of face-to-face lecture attendance and use of recorded lectures. A close correlation exists between students who view recorded lectures versus those that attend live lectures (Table 1; highlighted data). As a summary, 30% of students attend lectures while over 25% seldom or never view recorded lectures. Approximately 25% of students seldom or never attend lectures; the same percentage of students always or usually viewed recorded lectures.

Table 1: Summary of frequency of lecture attendance and recorded lecture use.

Live lecture attendance*	**Use of recorded lectures***					
	Always or usually	Most times	Sometimes	Seldom	Never	Total
Always or usually	5	5	7	16	8	41 **(30.15%)**
Most times	4	9	14	5	0	32 (23.53%)
Sometimes	6	11	8	1	1	27 (19.85%)
Seldom	12	8	2	2	0	24 **(17.65%)**
Never	8	2	1	1	0	12 **(8.82%)**
Total	35 **(25.74%)**	35 (25.74%)	32 (23.53%)	25 **(18.38%)**	9 **(6.62%)**	136

*Always or usually (>80%); most times (50-80%); Sometimes (20-50%); Seldom (<20%)

Secondly, students were asked a series of questions in order to assess their perception of the use of clickers in recorded lectures. The results of the attitudinal survey are reported in Table 2. Students indicated their responses to the first 6 survey questions shown in Table 2 using a 5-point Likert scale: (1) strongly disagree; (2) disagree;

(3) neutral; (4) agree; (5) strongly agree. The next 2 questions used a 4-point Likert scale: (1) not important; (2) neutral; (3) reasonably important; (4) most important. The 8 questions express the students' responses as % agree and % disagree, or % important and % not important, calculated from the sum of students who responded in each category. The mean and standard deviation of the students' responses are also given; indicating the larger the mean value, the more positive the students response.

The first aim of the study was to explore how the use of ARS and digital inking in lecture recordings stimulate student active learning in asynchronous learning environments. The survey data in Table 2 show that the majority of students agreed that clicker activities included in the lecture recordings enabled them to (1) revise the questions multiple times (69.9%); (2) helped them focus when replaying long lectures (64.5%); (3) helped reinforce the material covered in class (76.1%); and (4) enabled them to 'stop-think-answer' (69.9%). The most positive responses were regarding the ability to see responses of other students' answers to gauge levels of understanding (82.6%) and immediate feedback (81.9%), while incentive to play/replay all the lecture recordings and encouraged better grades were rated to a lesser extent (49.3% and 57.9% respectively).

Table 2: Student perception of use of ARS in recorded lectures

Question	**Agree (%)**	**Disagree (%)**	**Mean ± SD**
1. The clicker questions included in the lecture recordings enabled me to revise the questions multiple times which is important for the way I study	69.6	5.0	3.88 ± 1.05
2. Having the clicker questions included in the lecture recording has helped me keep my focus when replaying long lectures	64.5	7.9	3.83 ± 1.11
3. Having clicker questions included in the lecture recording has given me incentive to play/replay all the lecture recordings better	49.3	15.2	3.44 ± 1.09
4. Being able to go through recorded clicker activities has helped me as it reinforces the material covered in class	76.1	5.0	4.04 ± 0.94
5. Seeing responses of other students' answers helped me gauge my level of knowledge	82.6	3.6	4.01 ± 0.78
6. The clicker questions encouraged me to get better grades	57.9	14.5	3.62 ± 0.86
	Important (%)	**Not important (%)**	**Mean ± SD**
7. When viewing the lecture recording, you can stop the recording at the clicker questions, think about the answer and then play the recording to reveal and cross check the answers. How useful do you rate this capability of 'stop-think-answer' for your studies	69.6	5.8	3.00 ± 0.99
8. How important do you rate the immediate answer and feedback provided with the clicker questions?	81.9	3.6	3.24 ± 0.90

The qualitative findings also broadly support the quantitative results. Themes emerged around increasing focus and the ability to revise/reinforce lecture material. Students reported that:

> They encouraged me to actively think rather than sit passively in the lectures – very good for learning.
>
> It was a good exercise because I enjoyed being attentive - it minimized boredom and daydreaming.
>
> I really enjoyed them; it helped me focus overall on the material as a question might have been coming.
>
> Overall I found the clickers to be an AWESOME idea. Helps keep me going when listening to the lectures.
>
> Introduced throughout the lecture definitely breaks it up and ensures you are on the right track and understanding it all. Made the lecture more interesting and engaging.
>
> Even though I attended the live versions I found clicker questions good for rewatching, as I do often get sidetracked in thought.

The combined use of digital inking and clicker feedback in providing effective feedback was another theme that emerged from the qualitative comments. The ability to obtain immediate feedback from both the teacher and other students (i.e. ability to see peers' responses) proved equally important. Students reported that:

> Recorded lectures with clicker questions and interactive slides e.g. writing on slides as we go is the best way for me to learn in an online environment.
>
> I found the clicker feedback with the red pen allowed me to make connections in the work we had to learn.
>
> I found this a great help as I would pause the lecture and write the questions and answers down.
>
> I felt that I definitely enjoyed the lectures that used clickers and it was really good to see where my level of understanding was in comparison to my peers.

The second aim of the study evaluated student's perception of the combined technologies and quiz performance in relation to lecture recording use. A t-test was used to compare students' who attended lectures more than 80% of the time with those that never or seldom attended. Table 4 shows that there was only a significant difference in students' perception of the use of clickers for the stop-think-answer method (question 7). Students who never or seldom (<20%) attended lectures found this function particularly useful compared to students who preferred to attend the live lecture.

Table 3: Student perception of ARS in recorded lectures depending on lecture attendance

	Lecture Attendance				t-test (cf >80%-(20% - Never)
Question	**>80%**	**50-80%**	**20-50%**	**<20% - never**	
1.	3.68 (1.31)	4.25 (0.72)	3.67 (0.92)	3.94 (1.01)	0.328
2.	3.63 (1.16)	4.00 (0.98)	3.78 (1.01)	3.94 (1.22)	0.257
3.	3.27 (1.14)	3.56 (0.98)	3.41 (1.01)	3.56 (1.21)	0.288
4.	4.15 (0.99)	4.09 (0.78)	3.78 (0.85)	4.08 (1.08)	0.791
5.	4.05 (0.92)	4.03 (0.59)	3.81 (0.88)	4.00 (0.96)	0.821
6.	3.54 (0.87)	3.72 (0.77)	3.44 (0.80)	3.75 (0.97)	0.315
7.	***3.71 (1.10)***	***4.16 (0.88)***	***3.85 (1.03)***	***4.25 (1.05)***	***0.030***
8.	4.22 (1.15)	4.34 (0.83)	4.04 (0.90)	4.25 (0.91)	0.897

One student who attended less than 20% of the time reports that:

> Recorded lectures can cause your mind to drift – the clickers have made the lectures interesting and have helped me stay alert. I was also able to pause the lecture think about my answer, then see if I was correct or not.

Figures 2(a) and (b) show results from an online quiz given to students at the completion of the chemistry and biochemistry modules. Apart from two outliers at 8 and 18 lecture views in Figures 2a and 2b respectively, it appears that students who view lectures more frequently perform equally well, if not better, compared to those students who used them to a lesser extent if at all.

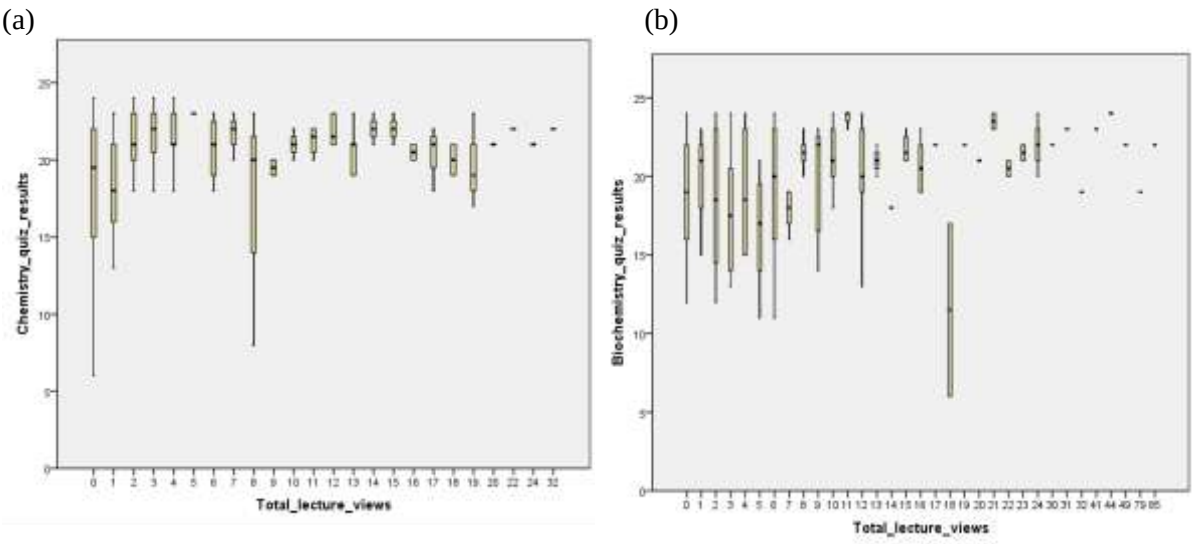

Figure 2: Online quiz performance (/24) for (a) chemistry and (b) biochemistry modules against lecture views

Discussion and Conclusion

Many higher education institutions support the policy that blended learning encompasses the obligation to provide equitable learning and assessment experiences between and across different cohorts. The pedagogic issue therefore is ensuring equal treatment for all students. Brandt (cited in Russo & Campbell 2004) suggests that many students expect online courses to mirror face-to-face classes in providing opportunities for interaction, idea generation and confirmation associated with constructivist learning. Such expectations were promoted through the provision of ARS and inking enhanced lecture recordings in this study. Both quantitative and qualitative findings provided support that the three most valuable improvements that clickers and digital ink made to face-to-face lectures and recorded lectures relate to: (1) the ability to see other students' responses; (2) the ability to obtain immediate feedback and (3) the ability to revise/reinforce material covered in class.

Seeing responses of other students' answers rated the highest positive student experience in this study. Maintaining a sense of community and interaction amongst students is critical to the success of online delivery (Rovai & Jordan, 2004). This is particularly important when considering the use of recorded lectures as part of the blended learning experience, especially in light of the relatively high percentage of students who rely on recorded lectures in this current study. Collaborative learning implies a more dynamic communication among learners that brings about knowledge sharing. Capturing students' responses in the recorded lecture via the use of embedded clicker questions has created a form of peer review activity not normally afforded by traditional lecture recordings by allowing students to see each other's responses. Race (2006) suggests that peer instruction/feedback can itself allow students to learn from each other's weaknesses and the ability of students to compare their knowledge against their peers is particularly important especially in regard to confidence levels. A previous study has found that strategies which increase nursing students' confidence in studying the biosciences are central to their success in these courses (McCabe, Kek and Turner, 2011). As one student comments

> Clicker question helped me think more about the material and helped me gain confidence.

The high percentage of students who positively rated that the technology enabled provision of immediate feedback facilitates active learning through the inclusion of clickers in the recorded lectures. Generally, formative feedback during the learning process helps students to correct misunderstandings, gain clarification, identify gaps in knowledge, and flaws in logic (Beatty, 2004). Feedback from students to the instructor allows on-the-spot adjustments to instruction, such as trying a different explanation, providing amplification with discussion, or using additional learning exhibits. Likewise, the feedback obtained from the clicker questions in the current study provided a dual purpose, allowing both students and teacher to benefit. The additional use of digital inking in the feedback process provided another dimension to the teaching process which can be absent from other methods of clicker instruction and lecture recording.

Recorded lectures enable students to be strategic in their use of recordings for review and repetition of key or difficult concepts. However, it is important that students are able to navigate to sections of the online lecture they felt were the most relevant to them. Davis, Connolly & Linfield (2009) found that students were actively choosing specific sections of the content to review rather than passively revisiting entire lectures. However, finding the critical concepts can be difficult for the less advanced students. It has been found that students can spend a copious amount of time listening to recorded lectures without understanding key concepts. Owston, Lupshenyuk and Wideman (2011) found that highest achieving students fast-forwarded to sections and watched them once, whereas the lower achieving watch the whole video for each class multiple times or watched the entire recording once and sections multiple times. The current study has shown that embedding clicker questions can potentially enable the viewer to identify the key learning concepts and thus aid in the revision process. This is supported by the use of the 'stop-think-answer' method which was valued more highly by those students who used recorded lectures frequently. Moreover, an analysis of viewing patterns of recorded lectures show that those students who viewed lectures more frequently performed equally well in quizzes compared to those students who accessed them less frequently. Interestingly, Le, Joordens, Chrysostomou, & Grinnell (2010) found that students who used the pause and seek features in a maths course performed more poorly than students who used lecture recordings for a concept based course in psychology. Like maths courses, the disciplines presented in the current study differ to the teaching of a concepts based course in their emphasis on the teaching of cognitive skills that are enhanced with practice. This study has shown that, recorded lecture strategies which embed activities that apply knowledge through the application of problems, such as clicker questions, has the potential to enable students to become more proficient in disciplines such as maths and science.

Bennett and Maniar (2007) questioned the value of lecture capture arguing that it could prevent some students becoming independent learners. The survey results demonstrate that independent and self-regulated learning has been encouraged through the integration of clicker questions in the recording. The approach taken in this study aids to transform traditional lecture recording into a form more suitable for blended learning environments by engaging students in a 'pseudo-synchronous' environment, thereby allowing them to feel part of the live lectures without participating synchronously or being physically present. Thus, the ability to pause recorded lectures to consider the content (such as unanswered clicker questions), continue to view collective results with immediate feedback, and repeat this process as desired, affords flexibility to students' individual patterns of engagement (De George-Walker & Keeffe, 2010). This context also implies that the pseudo-synchronous environment provides teacher, content, student and interface interactivity, thus augmenting interaction and cohesion through measures of mediated presence (Russo & Campbell, 2004). Student engagement through stop-think-answer activities are bi-directional - albeit self-determined - and thus offer students the autonomy to learn at a pace and in the manner that suited their needs (De George-Walker & Keeffe, 2010). The present study demonstrated that the heightened asynchronous interactivity afforded by the use if ARS and digital ink in recorded lectures was especially beneficial to those on campus students who choose to use recorded lectures more, and possibly "facilitated a simultaneous independent and collaborative learning experience…where learners are independent of space and time – yet together" (Garrison & Kanuka, 2004, p. 97).

In conclusion, this study has revealed that lecture recordings with embedded clicker and annotation using digital ink create a pseudo-synchronous learning environment where students manipulate the recordings to suit their learning whilst experiencing levels of social connectivity. The use of ARS and digital ink provides dual support for both the face-to-face environment and the online environment without any extra effort on the part of the instructor, and has therefore improved both efficiency and consistency of delivery. The contextual immediacy of audio-visual activity in lecture recordings has the potential to create a sense of reality for online students. The findings of this study give support to the increase active learning provided by clicker questions and annotation within recorded lectures in a blended environment. Further evaluation of the combined technologies in a fully online environment and direct comparisons with an on campus counterpart would provide interesting insights.

Acknowledgements

The use of the TurningPoint™ audience response devices and software was provided by the University of Southern Queensland. The contributions of Joanna Turner (USQ Department of Biological and Physical Sciences) for her assistance in data analysis and Megan Kek (USQ Learning and Teaching Support) for her useful comments on the paper are also gratefully acknowledged.

References

Ambikairajah, E., Epps, J., Sheng, M., Celler, B., & Chen, P. (2005). Experiences with an Electronic Whiteboard Teaching Laboratory and Tablet PC-based Lecture Presentations. *Proceedings ICASSP 05 IEEE International Conference on Acoustics Speech and Signal Processing*, (5), 565-568.

Beatty, I.D. (2004). Transforming student learning with classroom communication systems. *Educause Center for Applied Research (ECAR) Research Bulletin ERBO403*. Retrieved August, 13, 2011 from http://www.educause.edu/LibraryDetailPage/666?ID=ERB0403

Bennett, E. and Maniar, N. (2007). Are videoed lectures an effective teaching tool? Accessed October, 10, 2011 from http://podcastingforpp.pbworks.com/f/Bennett%20plymouth.pdf

Brotherton, J.A., & Abowd, G.D. (2004). Lessons learned from eClass: Assessing automated lecture capture and access in the classroom. *ACM Transactions on Computer-Human Interaction*, *11*(2), 121–155.

Buchanan, W.J., Macfarlane, R., & Ludviniak, R. (2010). Student perception of online lectures with a blended learning environment. Paper presented at *The 4th International Conference on Cybercrime Forensics Education & Training*, 2nd-3rd September 2010, Canterbury Christ Church University, United Kingdom.

Chang, S. (2007). Academic perceptions of the use of Lectopia: A University of Melbourne example. In: *ICT: providing choices for learners and learning*. Proceedings ascilite Singapore 2007. http://www.ascilite.org.au/conferences/singapore07/procs/chang.pdf

Collis, B., & Moonen, J. (2001). *Flexible learning in the digital world: Experiences and expectations.* London: Kogan Page.

Creswell, J.W., Plano Clark, V.L., Gutman, M.L., & Hanson, W.E. (2003). Advanced mixed methods research designs. In: A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209–240). Thousand Oaks, CA: Sage.

Crossgrove, K., & Curran, K.L. (2008). Using clickers in nonmajors- and majors-level biology courses: Student opinion, learning, and long-term retention of course material. *CBE-Life Sciences Education*, *7*(1), 146-154.

Davis, S., Connolly, A., & Linfield, E. (2009). Lecture capture: making the most of face-to-face learning. *Engineering Education: Journal of the Higher Education Academy Engineering Subject Centre, 4*(2), 4-13.

De George-Walker, L., & Keeffe, M. (2010). Self determined blended learning: a case study of blended learning design. *Higher Education Research & Development, 29*(1), 1-13.

Deal, A. (2007). Carnegie Mellon teaching with technology white paper: Lecture webcasting. Retrieved August, 18, 2011, from http://www.cmu.edu/teaching/resources/PublicationsArchives/StudiesWhitepapers/LectureWebcasting_Jan07.pdf.

Draper, S.W. (2009). Catalytic assessment: understanding how MCQs and EVS can foster deep learning. *British Journal of Educational Technology, 40*(2), 285-293.

Garrison, D.R., & Kanuka, H. (2004). Blended learning: uncovering its transformative potential in higher education. *The Internet and Higher Education, 7*(2), 95-105.

Gosper, M., McNeill, M., Phillips, R., Preston, G., Woo, K., G. & Green, D. (2010). Web-based lecture technologies and learning and teaching: a study of change in four Australian universities. *ALT-J, Research in Learning and Technology, 18*(3), 251-263.

Greenberg, A., & Nilssen, A.H. (2009). The New Imperative for Lecture Capture Systems in Higher Education. Wainhouse Research White Paper. Retrieved 30 September 2011. http://download.techsmith.com/relay/docs/wainhouse_relay_whitepaper.pdf.

Griffin, D.K., Mitchell, D., & Thompson, S. (2009). Podcasting by synchronising PowerPoint and voice: What are the pedagogical benefits? *Computers & Education, 53*(2), 532-539.

Kay, R., & LeSage, A. (2009). A strategic assessment of audience response systems used in higher education. *Australasian Journal of Educational Technology, 25*(2), 235-249

Lancaster, J.W., McQueeney, M.L., & Van Amburgh, J.A. (2011). Online lecture delivery paired with in class problem-based learning…Does it enhance student learning? *Currents in Pharmacy Teaching and Learning, 3*(1), 23-29.

Larkin, H.E. (2010). "But they won't come to lectures…" The impact of audio recorded lectures on student experience and attendance. *Australasian Journal of Educational Technology, 26*(2), 238-249.

Le, A., Joordens, S., Chrysostomou, S., & Grinnell, R. (2010). Online lecture accessibility and its influence on performance in skills-based courses. *Computers & Education, 55*(1), 313-319.

MacArthur, J.R., & Jones, L.L. (2008). A review of literature reports of clickers applicable to college chemistry classrooms. *Chemistry Education Research and Practice, 9*, 187-195.

McCabe, B.K. (2010). Questionnaire administered in NSC1500 at USQ on June 2-3, 2010. Unpublished raw data.

McCabe, B.K., Kek, M., & Turner, J. (2011). Creating confidence: exploring the effectiveness of a pre-study resource as a 'front loading' strategy in a foundation nursing science course. In: *14th Pacific Rim First Year in Higher Education Conference: Design for Student Success*, 29 June - 1 July 2011, Perth, Australia.
McElroy, J., & Blount, Y. (2006). You, me and ilecture. In: Who's Learning? Whose Technology? *Proceedings ascilite Sydney 2006*. http://www.ascilite.org.au/conferences/sydney06/proceeding/pdf_papers/p87.pdf
McVicar, A., & Clancy, J. (2001). The biosciences and fitness for practice: a time for review? *British Journal of Nursing, 10*(12), 1415-1420.
Nagel, D. (2008). Lecture capture: No longer optional? *Campus Technology*. Retrieved September, 9, 2011, from http://campustechnology.com/Articles/2008/09/Lecture-Capture-No-Longer-Optional.aspx?Page=2
O'Donoghue, M., Hollis, J., & Hoskin, A. (2007). Lecture recording: help or hinder in developing a stimulating learning environment? *Proceedings ascilite Singapore 2007*. http://www.ascilite.org.au/conferences/singapore07/procs/odonoghue-poster.pdf
Owston, R., Lupshenyuk, D., & Wideman, H. (2011). Lecture capture in large undergraduate classes: Student perceptions and academic performance. *Internet and Higher Education*, http://www.yorku.ca/rowston/AERA2011final.pdf
Panther, B.C., Mosse, J.A., & Wright, W. (2011). Recorded lectures don't replace the 'real thing': what the students say. *Proceedings of the Australian Conference on Science and Mathematics Education, University of Melbourne, 28 Sept to 30 Sept 2011*, pages 127-132.
Race, P. (2006). *The lecturer's tool kit: 3rd Edition*. London: Routledge.
Rovai, A.P., & Jordan, H.M. (2004). Blended learning and sense of community: A comparative analysis with traditional and fully online graduate courses. *International Review of Research in Open and Distance Learning, 5*(2).
Ruiz, J.G., Mintzer, M.J., & Leipzig, R.M. (2006). The impact of E-learning in medical education. *Academic Medicine, 81*(3), 207-212.
Russo, T.C., & Campbell, S. (2004). Perceptions of mediated presence in an asynchronous online course: Interplay of communication behaviors and medium. *Distance Education, 25*(2), 215-32.
Stephenson, J.E., Brown, C., & Griffin, D. (2008). Electronic delivery of lectures in the university environment: An empirical comparison of three delivery styles. *Computers & Education, 50*(3), 640-651.
Subhlok, J., Johnson, O., Subramaniam, V., Vilalta, R., & Yun, C. (2007). Tablet PC Video based Hybrid Coursework in Computer Science: Report from a Pilot Project. *SIGCSE Bulletin, 39*(1), 74-78
Swan, K. (2001). Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance Education, 22*(2), 306-331.
Wieling, M.B. & Hofman, W.H.A. (2010). The impact of online video lecture recordings and automated feedback on student performance. *Computers & Education, 54*(4), 992-998.
Woo, K., Gosper, M., McNeill, M., Preston, G., Green, D., Phillips, R. (2008). Web-based lecture technologies: Blurring the boundaries between face to face and distance learning. *ALT-J, Research in Learning Technology, 16*(2), 81-93.
Yoon, C., & Sneddon, J. (2011). Student perceptions of effective use of Tablet PC recorded lectures in undergraduate mathematics courses. *International Journal of Mathematical Education in Science and Technology, 42*(4), 425-445.

Author contact details:

Bernadette McCabe Bernadette.McCabe@usq.edu.au

Please cite as: McCabe, B. K. & Hobohm, C. (2012). Promoting asynchronous interactivity of recorded lectures in blended learning environments. In M. Brown, M. Hartnett & T. Stewart (Eds.), Future challenges, sustainable futures. Proceedings ascilite Wellington 2012. (pp.612-621).