

Web-based Lecture Technologies and their Effects on Student Performance

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BACKGROUND

Pressure to use Web-Based Learning Technologies lecture recordings (WBLT) has been placed on lecturers (Chang 2007) with the assumption that WBLT is beneficial to student learning. Prior to 2007, most available research into the use of WBLT relied on student surveys. Little research had been conducted into the impact of using WBLT on student performance.

PURPOSE

What is the effect of WBLT availability on the exam results of telecommunication engineering students?

DESIGN/METHOD

Between semester 2, 2007 and semester 1, 2009 audio of lectures was recorded and made available throughout alternate semesters to 842 on-campus students in a number of undergraduate and postgraduate units. All other aspects of the curriculum remained constant. Student exam results were collated and statistically analysed. Student exam performance for a parallel control unit was also collated and analysed in order to identify any variance in the different cohorts of students.

RESULTS

Our results showed that whenever WBLT was available there were no positive effects on the overall exam performance. For some groups of students, negative effects were observable. These results are similar to the findings of subsequent research by others (Williams, et al. 2012; McNulty, 2011; Figlio, 2010).

CONCLUSIONS

Our results suggest that just simply making WBLT available, alone with no other strategies, is not guaranteed to have a positive effect on student outcomes. In some cases, the availability of WBLT resulted in worse student outcomes.

More research on the ways WBLT could be more effectively incorporated in teaching strategies is suggested.

KEYWORDS

Lecture recordings, student performance

Introduction

Web-based lecture recording technologies (WBLT) are used to record the audio and/or video of lectures for students to access at a later time. WBLT is growing in popularity amongst students (Woo et al. 2008) and some academic staff are experiencing pressure from departments and students to use WBLT (Chang 2007).

Prior to 2007 much of the literature into WBLT use focussed on student and staff perceptions (Williams & Fardon 2005), (Phillips et al. 2007). This data tended to be based on self-reporting questionnaires and interviews (Williams & Fardon 2007), and showed a strong student preference for having WBLT available (Gosper et al. 2007, p.2).

In this study we examine student performances in their final exam paper in two Telecommunications Engineering subjects taught at Swinburne University of Technology, Australia. Access to recorded lectures was occasionally restricted over a number of semesters. Student exam paper results are analysed for impact of the availability of online lectures.

Our work will show that, contrary to strong student perceptions, the availability of recorded lectures to students is not always beneficial for student learning. In our survey of two different subjects and a control subject, our results indicate that availability of recorded lectures has not had any observable positive effect in their exam performance.

Prior Work

A body of literature has been produced in regards to lecture recording systems, particularly in Australia where Lectopia is the predominant WBLT system in most of the Universities (Williams & Fardon 2005). These systems typically provide for digital recording of audio, audio/video or audio/slide-presentation during the Lecture and later making the content available for offline viewing by students

Web-based Lecture Technologies

Students have recently become more vocal in their expectations of what a University education should deliver, most likely due to increasing costs and a shift away from government funded education (McElroy & Blount 2006). Part of this shift is an expectation of increased flexibility in how courses are delivered. These expectations are reinforced by the recent advent of ICT technologies and an Internet aware generation (Skene, Cluett & Hogan 2007). Use of these technologies by academic staff can help deliver this flexibility (Evans 2008; Gosper et al. 2007).

Williams and Fardon (2007) and McElroy and Blount(2006) highlight that the expectation from academic staff is that students will still endeavour to attend classes in person, using technological tools as a means to address issues such as: Missed classes due to unavoidable circumstances; Further review of work after the lecture has been attended; Make use of lost time such as time spent on public transport

Student Use of Web-based Lecture Resources

Many studies have been performed into how WBLT are used by students. McElroy and Blount (2006) performed a study of the use of WBLT in a large (828 students) 2nd year accounting subject taught at Macquarie University. The perception of students was overwhelmingly positive in that the provision of online lectures improved the quality of their education (73.15%), enhanced the learning experience (78.39%), and that it was an effective learning tool (84.26%). (McElroy & Blount) also noted that being from a non-English speaking background was a major factor contributing to student usage of WBLT.

Phillips et al. (2007) surveyed 700 students and 136 staff across four Universities. The study found that the students reported positive experiences in using WBLT. Interestingly, a large proportion of the student population (68.3%) agreed that they could learn just as well using

WBLT as compared to being present at lectures. Kurtz, James B. Fenwick and Ellsworth (2007) however observed that students who were required to listen to WBLT felt they had been forced to work harder as a result.

Bond, Holland and Wells (2008) examined outcomes of 574 students in a 2nd year subject in a Business Faculty at the University of Technology, Sydney. They found that students mainly accessed online recordings immediately prior to assessment tasks. von Kinsky, Ivins and Gribble (2009) looked at student use of WBLT in a 3rd year software engineering subject of 148 students taught at Curtin University. The results confirm that online recordings are predominately accessed immediately prior to assessment tasks and that most students make use of both lecture attendance and the recording facilities.

von Kinsky, Ivins and Gribble (2009) also found that usage of WBLT was not a predictor on student results, with passing students just as likely to use the online facilities as failing students. von Kinsky, Ivins and Gribble (2009) also suggested that their data suggested that there was no impact on lecture attendance by the introduction of WBLT. However Scutter et al. (2010) found that 75% of students feel that they would be more likely to skip a lecture if they knew it was going to be available via WBLT. This data supports the findings of Naber and Kohle (2002) who concluded that the main reason why students skip lectures is the availability of lecture materials.

Academic Perception of Online Lecture Resources

In Phillips et al. (2007) paper, academic staff were surveyed along with students. While staff experiences were generally positive, and they believed that WBLT was beneficial to their students, they were neutral on the issue of whether the provision of WBLT enhanced their ability to teach their students.

A majority (55%) felt that access to online recordings had resulted in decreased lecture attendance. A large proportion of respondents reported changing their style in lectures, confirming Fardon's (2003) assumptions that certain lecture styles are more predisposed to online delivery than others. Respondents also noted being more careful about what was said.

Chang (2007) performed a detailed survey of a number of subjects taught across different faculties at the University of Melbourne. He found that while a number of academics worried about the impact on lecture attendance and that many had felt compelled to provide the facility by their students, the academics perceived a number of benefits to its availability. These primarily included issues of equity for students and benefits to student revision. Chang (2007) also asked academic staff whether the use of WBLT resulted in changes in student performance. The respondents either perceived no change or declined to respond to this question. Either way, no numbers were presented to confirm or deny any change in student outcomes.

Effects on Student Outcomes

Little work has been done on objectively exploring student outcomes due to the deployment of WBLT. Most existing research essentially surveys user acceptance or perceptions, rather than detailed studies looking at effects on students' learning (McGarr 2009)

von Kinsky, Ivins and Gribble (2009) performed some basic analysis of students' results in a semester where WBLT was deployed. They concluded that whether a student chose to use the online recordings was not an indicator as to that student's academic performance. The report also highlighted a good student attendance rate at lectures. However, von Kinsky's work does not evaluate how students may have performed had WBLT not been made available, as it does not compare these results to students from prior semesters.

Bond, Holland and Wells (2008) is one paper that attempts to evaluate the effect of the use of recorded lectures on student academic performance. The authors looked at student performance of 574 students in the written components of the final exam. Data available to these authors included when recorded lectures were accessed and by whom. They also

made use of each student's weighted mark across all subjects previously studied by this student and whether or not each student is a native English speaker. Bond, Holland and Wells (2008) found no evidence to support the hypothesis "*There is a positive association between the utilisation of lecture recordings and student performance*".

While the outcomes of the studies into student use of WBLT that relied on self-reported data overwhelmingly show that students perceive that provision of lecture recordings online assist in their learning and help them achieve better results, there is limited quantitative evidence based on objective data to demonstrate this one way or the other.

Web-based Lectures at Swinburne University

The WBLT system deployed at Swinburne University is Lectopia. Its use is actively encouraged and strongly marketed by the University. The available literature on WBLT systems is positive and so some time ago we decided that, where possible, Lectopia would be enabled on two of our subjects.

After use in one semester, it became apparent that the provision of WBLT was having an observably negative effect on student performance. Following this observation, Lectopia was disabled for certain semesters to try to gauge the impact. As compared to the studies cited above, we are looking at different data. von Konsky, Ivins and Gribble (2009) only analysed performances between students groups at different grade boundaries based on whether they used online recordings or not. Alternatively, Bond, Holland and Wells (2008) compared student results with their individual historical performances.

In this study we attempted to view the effect of WBLT availability (audio recordings only) on student performance. The way that WBLT is implemented at Swinburne University provided a number of hurdles to this study. The first was that the servers hosting the recorded lectures did not provide details on which students accessed the recordings and when. A second problem faced was that there was no record of which of the student's previous subjects had utilised WBLT, thus we cannot compare an individual student's past performance in those units that do or don't utilise WBLT.

The subjects selected for analysis were taught by the same lecturer, with a long-standing team of tutors. The curriculum in these units remained consistent over the semesters of analysis. In order to identify any variability in the student cohort, a third subject was selected as a control subject. Many students took this subject simultaneously with the first subject we will analyse.

Student Populations

The student population in the subjects under consideration are on-campus students who come from a mixed background. These students may enter University study via a range of pathways, including post-High School, vocational education (eg. TAFE), or mature age entry. A significant proportion of students are foreign born, while a non-negligible number work full-time while studying part-time.

Lecture Content

The subjects being examined fall under the Telecommunications Engineering banner and can be described as highly technical with a high level of online and digital skills required to be demonstrated by students. Lecture delivery for each subject is face-to-face, consisting of a two hour lecture every week for the duration of the 12 week semester with a ten minute break in the middle of the lecture. To aid engagement, the lectures are structured to require some form of interaction by students including exercises, answering questions, extensive whiteboard use and live demonstrations.

The lecture content has not been tailored for online and recorded listening. Students were advised that these recordings were provided as a supplement to lectures, and not a replacement. This is in accordance with the findings of von Konsky, Ivins and Gribble

(2009), McElroy and Blount (2006) and Phillips et al. (2007) that students would generally use the online recordings as an adjunct rather than as a replacement to lecture attendance.

Results - Student Outcomes

As in Bond, Holland and Wells (2008), we use student exam paper performance as a measure of academic outcomes. Other assessments, conducted throughout the semester, are typically used to assess the more practical components of the subject, which are primarily taught in the laboratory classes. Theory, as taught in the lectures, is assessed in the exam. Data was collected and is presented for two subjects, and the control subject that was undertaken simultaneously by many students.

Table 1: Descriptive Statistics of Exam Results in All Subjects (Bold = WBLT available)

	Subject 1			Concurrent Subject			Subject 2				
	Sem2 '08	Sem 1 '09	Sem 2 '09	Sem2 '08	Sem 1 '09	Sem 2 '09	Sem2 '07	Sem2 '08	Sem 1 '09	Sem 2 '09	
Count	200	205	189	82	87	100	80	54	66	49	
Mean	45.1	55.7	54.7	52.6	50.1	50.8	58.9	52.6	62.5	55.5	
Mode	33.0	56.0	59.0	38.3	45.4	51.3	57.0	57.5	69.5	64.5	
St.Dev	19.2	17.0	15.9	15.3	18.0	15.7	13.2	15.8	15.4	12.4	
Quartiles	1	32.0	43.0	42.5	42.7	39.6	42.9	50.4	49.5	49.6	48.5
	2	45.5	56.0	54.0	52.5	48.3	51.5	59.5	57.5	65.0	57.0
	3	58.0	68.0	67.5	63.1	61.3	61.7	69.0	68.0	73.8	63.5

Subject 1

The first subject under consideration is an introductory IP networking subject that covers both theory and practical work in configuring physical networks. This subject is taken by a range of students at various stages of their degree. Pure networking students typically undertake it in their first year, while engineering students within the last half of their 4 year degree. This subject is also an elective in various other degrees offered and may be taken by other students at varying stages of their study.

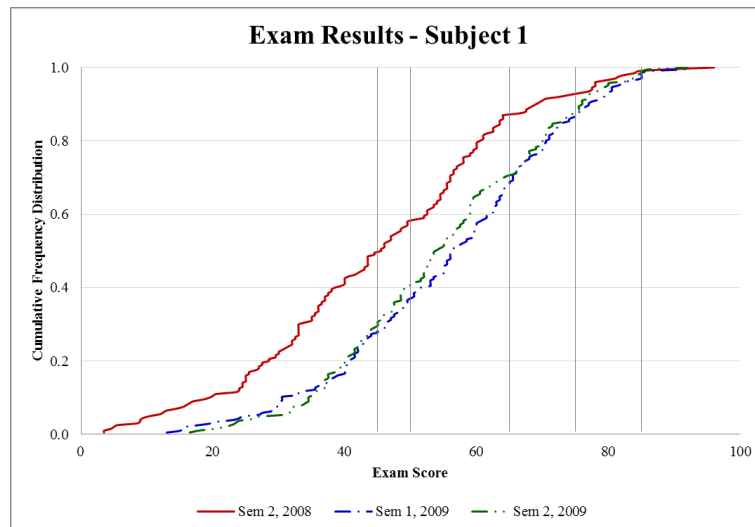
The subject runs in both semesters every year, enrolment numbers are presented in **Table 1**. Results prior to Semester 2, 2008 cannot be compared with later outcomes as there was a major change in the content of the curriculum beginning in that semester. For the three semesters under consideration, recorded lectures were made available to students in Semester 2, 2008 only.

The exam paper results are summarised in **Table 1** and plotted as a cumulative distribution in **Figure 1**. Exam results are displayed on the horizontal axis while the vertical axis measures the percentage of students who scored no more than the given result. Better student performance is indicated by curves which are further to the right, indicating fewer students achieving lower scores. Vertical lines are plotted at 45 (the minimum hurdle requirement to pass the examination component of the subject) and at 50, 65, 75 and 85 (grade boundaries used at Swinburne University). Semesters where WBLT was available are indicated as a solid line, whereas dashed lines means WBLT was not available.

Table 2: Kolmogorov-Smirnov *p* Value Statistics for Subject 1 Exam Results
(Bold = the hypothesis that distributions are the same is rejected at 95% confidence)

	Sem. 2, 2008	Sem. 1 2009	Sem. 2 2009
Sem. 2, 2008	-	<0.0001	0.0015
Sem. 1 2009	-	-	0.0876
Sem. 2 2009	-	-	-

Figure 1: Cumulative Frequency Distribution of Exam Results – Subject 1



From the descriptive statistics for this subject (**Table 1**) it is observable that the exam results in those semesters where WBLT was not available outperform the exams results for the semester where WBLT was available in each statistic presented. The Kolmogorov-Smirnov p values confirms what we can see in **Figure 1**, that the distributions for Semester 1, 2009 and Semester 2, 2009 are relatively similar, but the Semester 2, 2008 distribution is sufficiently different from the distributions of the other two semesters that the hypothesis that the distributions are the same is rejected at a confidence level of 95%.

Comparing Subject 1 with a Control Subject

One explanation for the observed variability in student performance is cohort variability. In other words, the calibre of students and/or their group culture in one semester may be weaker or stronger than another semester.

In order to determine cohort variability a unit that many students studied concurrently was also analysed. This unit also had the same lecturer for all of the semesters analysed, as well as having a stable curriculum that was not significantly varied throughout the duration of the research. This concurrent subject did not utilize WBLT in any of the semesters sampled. Similar to Subject 1 each semester had the same lecturer and the lectures were interactive in nature insofar as students were asked to address questions, discussions were conducted and numerous demonstrations were presented.

If the drop in performance in any semester is due to the variability of the student cohort, then we would expect to see a drop in performance in a unit students are studying concurrently.

The number of students that were studying subject 1 simultaneously with the concurrent subject is shown in **Table 1**. Comparing the means of each semester with the means of the equivalent semesters in Subject 1 shows that students generally did worse in the concurrent subject than in Subject 1, with students having lower average exam scores in the concurrent subject for all but the semester when Subject 1 was using WBLT.

Figure 2: Cumulative Frequency Distribution of Exam Results – Concurrent Subject

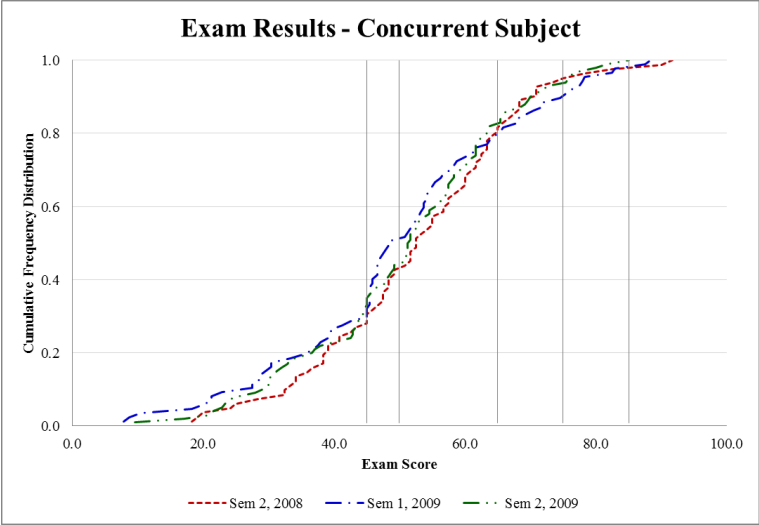


Table 3: Kolmogorov-Smirnov p Value Statistics for the Concurrent Subject Exam Results

	Sem. 2, 2008	Sem. 1 2009	Sem. 2 2009
Sem. 2, 2008	-	0.99720	0.32690
Sem. 1 2009	-	-	0.46470
Sem. 2 2009	-	-	-

Our data, **Figure 2**, shows that the distribution of exam results did not vary much between the semesters sampled. It is observable that in Semester 2, 2008 those students in the bottom three quartiles performed slightly better than the other two semesters. These are the same students who in Subject 1 had a significantly lower distribution. However the Kolmogorov-Smirnov statistics for these distributions (see **Table 3**) show that this latter observation is not statistically significant, as the rejection of any hypothesis that these distributions were different failed.

Subject 2

The second subject under consideration is a highly practical subject in IP networking that covers the construction and deployment of Unix-based systems in a Telecommunications environment. Unlike Subject 1, this is typically taken in the last year of the degree structure for all enrolled students. As such, students studying this subject have already completed a large portion of their degree. For this type of subject we would expect an increased pass rate when compared to an introductory subject.

Like the previous subject, this subject also runs in both semesters every year, with enrolments outlined in **Table 1**. Results for Semester 2, 2009 are not included due to a major change in the structure and form of the exam paper. In this subject it is also important to note the following variables: As the subject is relatively new, other subject activities (laboratories and tutorials) have been modified and improved over time. This should have improved learning outcomes for students undertaking these activities; Student workload has decreased and been more evenly distributed across the semester as enrolment numbers increased beyond the originally projected 30 students per year. This should have improved academic performance; Students were informed in Semester 1, 2009 of prior outcomes when recorded lectures were available, and warned not to fall into the same trap. For the four semesters under consideration, WBLT was made available to students in Semesters 1 of 2008 and 2009.

Basic statistics for all students are tabulated in **Table 1**. As with outcomes witnessed for Subject 1, student outcomes are markedly reduced when online recordings are available. The results also indicate a slight improvement in comparable semesters (with/without WBLT)

as time progresses, evidence of the impact of other changes made to improve the Unit. It is also relevant to note that both the mean and quartile results are better than for Subject 1, we assume that this indicates the increased capability of students towards the latter part of their degree.

Student Exam Paper results are plotted in **Figure 3**. As expected, there are a significantly lower proportion of students failing the exam paper hurdle than for Subject 1. As in Subject 1, student outcomes improve when WBLT was not available.

It is also apparent that student performance has increased as time progressed, likely due to other improvements and modifications to the subject over time, but is markedly decreased when recorded lectures are made available. Taking into account this slight variability, the curves indicate that student exam paper results increase by $\approx 7\%$ when online recordings are not available.

Table 4: Kolmogorov-Smirnov p Value Statistics for the Subject 2 Exam Results

	Sem. 2, 2007	Sem. 1, 2008	Sem. 2, 2008	Sem. 1 2009
Sem. 2, 2007	-	0.0528	0.1090	0.0486
Sem. 1, 2008	-	-	0.0044	0.4554
Sem. 2, 2008	-	-	-	0.0007

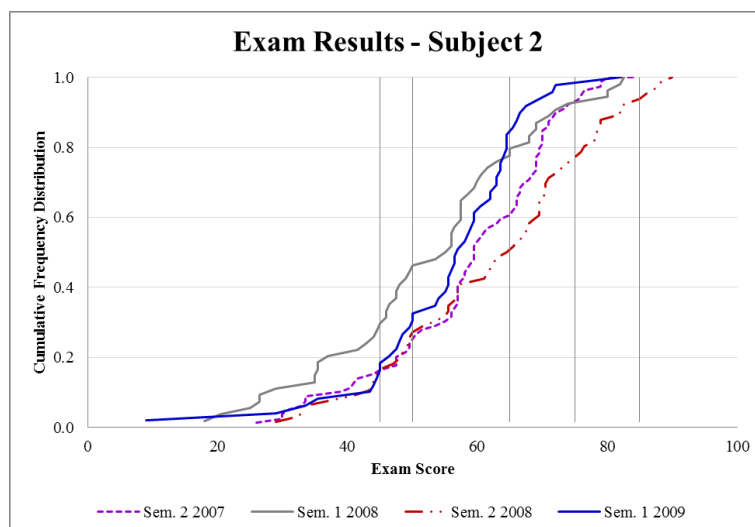
Table 4: Kolmogorov-Smirnov p Value Statistics for the Subject 2 Exam Results lists the results of the Kolmogorov-Smirnov significance tests on the data sets. In general, the data suggests that student results come from the same distribution in semesters where access to online recordings is the same and from different distributions otherwise. The value comparing Semester 2, 2007 with Semester 1, 2008 is also very close to the trigger value (0.05) to indicate this response.

Discussion

Our data did not show any observable improvement in student results when WBLT was available. This is in contrast to the perceptions of the students reported by McElroy and Blount (2006) and Phillips et al. (2007), who felt they learnt better when WBLT was available. Instead the data showed that student performance was at best unaffected or negatively affected when WBLT was available.

While the methodology used was rudimentary, and hence these results should be weighted accordingly, the results do raise questions on the role that WBLT should play in our curriculum. The assumption that students learn better with WBLT because students self-report that they learn better with WBLT should be challenged. It is unfortunate that Swinburne's current set up did not allow us to identify which students were accessing WBLT, and then analyse this against their learning outcomes.

Figure 3: Cumulative Frequency Distribution of Exam Results – Subject 2



Subsequent to this paper's data collection a number of authors have attempted to undertake objective research into the effect of WBLT on student outcomes.

Similar to von Kinsky, Ivins and Gribble (2009), Solomon et al. (2004) found that there was no benefit, nor disadvantage, to using live or recorded lectures. Stain et al. (2005) also found no significant difference. Schreiber, Fukuta and Gordon (2010), using randomised controls observed that the learning outcomes were slightly better for those attending a live lecture.

More worrying are the findings of McNulty et al. (2011), who found an inverse trend between the frequency of viewing recordings and medical student performance. Figlio, Rush and Yin (2010) also identified that some groups of students are disadvantaged when using on-line recordings of lectures.

Preston et al. (2010) suggests some characteristics of lectures that are suitable for use with WBLT. One of those characteristics *"the lecture is delivered in a traditional format based largely on one-way communication"*. They also suggest that when a lecture is *"used for problem solving, discussions and other small group activities"* WBLT is less applicable. This latter point was certainly the case with the three subjects analysed in this paper. This also helps us identify one aspect that is missing from most research into WBLT and that is the nature of the lectures that are being recorded. Some are more suitable than others, and this point means it is difficult to compare research into WBLT that does not address the nature of the lecture being recorded.

Some researchers have partially considered this issue. Jensen (2011) found that there was no advantage between face-to-face lectures and lecture recordings when lectures are based on the delivery of declarative knowledge. Similarly Ross and Bell (2007) also found that there was no difference for surface learning; however the learning performance dropped for on-line learners when work progressed to higher orders of abstraction.

Conclusion

Our results suggest that just simply making WBLT available, alone with no other strategies, is not guaranteed to have a positive effect on student outcomes. In some cases, the availability of WBLT resulted in worse student outcomes.

More research on the ways WBLT could be more effectively incorporated in teaching strategies, such as 'What styles of lectures are suited to use in WBLT?' is suggested.

References

- Bond, D, Holland, T & Wells, P 2008, 'Podcasting and its Relation with Student Performance,' *3rd International Conference on e-Learning*, Academic Publishing Ltd, Reading UK, 33-42.
- Chang, S 2007, in *ascilite 2007* Singapore, pp. 135-144.
- Evans, C 2008, 'The effectiveness of m-learning in the form of podcast revision lectures in higher education', *Computers & Education*, vol. 50, no. 2, pp. 491-498.
- Fardon, M 2003, 'Internet Streaming of Lectures: A Matter of Style,' *Educause In Australasia 03*,
- Figlio, DN, Rush, M & Yin, L 2010, *IS IT LIVE OR IS IT INTERNET? EXPERIMENTAL ESTIMATES OF THE EFFECTS OF ONLINE INSTRUCTION ON STUDENT LEARNING*, Working Paper 16089, viewed 12/07/2012.
- Gosper, M, McNeill, M, Woo, K, Phillips, R, Preston, G & Green, D 2007, 'Web-based Lecture Recording Technologies: Do Students Learn From Them?,' *Educause Australasia 2007*,
- Jensen, SA 2011, 'In-Class versus Online Video Lectures: Similar Learning Outcomes, but a Preference for In-Class', *Teaching of Psychology*, vol. 38, no. 4, pp. 298-302.
- Kurtz, BL, James B. Fenwick, J & Ellsworth, CC 2007, in *Proceedings of the 45th annual southeast regional conference* ACM, Winston-Salem, North Carolina, pp. 484-489.
- McElroy, J & Blount, Y 2006, 'You, me and iLecture,' *ascilite 2006 - Who's Learning? Whose Technology?*,
- McGarr, O 2009, 'A review of podcasting in higher education: Its influence on the traditional lecture', *Australasian Journal of Educational Technology*, vol. 25, no. 3, pp. 309-321.
- McNulty, JA, Hoyt, A, Chandrasekhar, AJ, Espritu, B, Gruener, G, Price, RJ & Naheedy, R 2011, 'A Three-year Study of Lecture Multimedia Utilization in the Medical Curriculum: Associations with Performances in the Basic Sciences', *MEDICAL SCIENCE EDUCATOR* vol. 21, no. 1, pp. 29-36.
- Naber, L & Kohle, M 2002, 'If E-Learning Is The Answer, What Was The Problem?,' *AusWeb02*,
- Phillips, R, Gosper, M, McNeill, M, Woo, K, Preston, G & Green, D 2007, 'Staff and student perspectives on web based lecture technologies: Insights into the great divide,' *Proceedings ascilite Singapore 2007*, 854-864.
- Preston, G, Phillips, R, Gosper, M, McNeill, M, Woo, K & Green, D 2010, 'Web-based lecture technologies: Highlighting the changing nature of teaching and learning', *Australasian Journal of Educational Technology*, vol. 26, no. 6, pp. 717-728.
- Ross, TK & Bell, PD 2007, "'No Significant Difference" Only on the Surface', *International Journal of Instructional Technology and Distance Learning*, vol. 4, no. 7
- Schreiber, B, Fukuta, J & Gordon, F 2010, 'Live lecture versus video podcast in undergraduate medical education: A randomised controlled trial', *BMC Medical Education*, vol. 10, no. 1, p. 68.
- Scutter, S, Stupans, I, Sawyer, T & King, S 2010, 'How do students use poscasts to support learning?,' *Australasian Journal of Educational Technology*, vol. 26, no. 2, pp. 180-191.
- Skene, J, Cluett, L & Hogan, J 2007, 'Engaging Gen Y students at university: what web tools do they have, how do they use them and what do they want?,' *10th Pacific Rim First Year in Higher Education Conference 2007*, QUT Web Solutions,
- Solomon, D, Ferenchick, G, Laird-Fick, H & Kavanaugh, K 2004, 'A randomized trial comparing digital and live lecture formats [ISRCTN40455708]', *BMC Medical Education*, vol. 4, no. 1, p. 27.
- Stain, SC, Mitchell, M, Belue, R, Mosley, V, Wherry, S, Adams, CZ, Lomis, K & Williams, PC 2005, 'Objective assessment of videoconferenced lectures in a surgical clerkship', *The American Journal of Surgery*, vol. 189, no. 1, pp. 81-84.
- von Kinsky, BR, Ivins, J & Gribble, SJ 2009, 'Lecture attendance and web based lecture technologies: A comparison of student perceptions and usage patterns', *Australian Journal of Educational Technology*, vol. 25, no. 4, pp. 581-595.
- Williams, J & Fardon, M 2005, 'On-Demand Internet-Transmitted Lecture Recordings: Attempting to Enhance and Support the Lecture Experience,' *ALT-C 2005: exploring the frontiers of e-learning - borders, outposts and migration*,
- Williams, J & Fardon, M 2007, 'Perpetual connectivity: Lecture recordings and portable media players,' *ICT: Providing choices for learners and learning*
Proceedings ascilite Singapore 2007,

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*, vol. 16, no. 2, pp. 81-93.

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