EFFECTIVE USE OF LECTURE CAPTURE IN LARGE LECTURE HALLS

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Abstract

This paper will report on the results of an iterative project that has been taking place at the School of Communication and Information (SC&I) at Rutgers University in the area of integrating lecture capture technology into a large lecture hall course. One gap that has been identified in the literature is that students are rarely trained in how to successfully use lecture recordings for learning; they often apply surface instead of deeper, more strategic approaches. Based on this understanding, a study was conducted focusing on the incorporation of a learning strategies training activity that utilizes self-explanation with recorded lectures viewing.

Introduction

Lecture is a highly used instructional approach in higher education, (Benson, 1989; Dunkel & Davis, 1994) and can be considered "a defining element of most university courses" (Bell, Cockburn, McKenzie & Vargo, 2001). While lecture may be a highly utilized instructional tool, it may not be as effective as many would like to think. In a study conducted by Mulligan and Kirkpatrick (2000), only nine percent of non-English speaking (NNES) background students indicated that they 'understood very well' the content and intent of a set of eight university lectures. Further, 22% of students overall (English speaking and NNES) indicated that they "did not understand a lot" (Mulligan & Kirkpatrick, 2000, p. 316). For instructors who use the lecture segment of their course to emphasize conceptual issues, inspire students and review problem solving approaches, these are potentially troubling numbers.

One approach to help students learn more from lecture has been to record them so that students can review content covered as part of learning and study strategies. Methods of recording include lecture capture, screencasting, vodcasting, podcasting, and creation of e-lectures or voice-over-PowerPoints (VOPP). While the process of recording and delivering lectures to students for both primary and supplementary viewing is not new, research articles using these terms began to appear in 2002, and the amount of academic articles written on the topic of video podcasts in education has increased dramatically since 2006 (Kay, 2012).

Bransford, Brown and Cocking (2000) accurately summarize the challenge for recorded lectures in higher education; "Technology-based tools can enhance student performance when they are integrated into the curriculum and used in accordance with knowledge about learning. But the mere existence of these tools … provides no guarantee that student learning will improve" (p.216).

Therefore, what we are facing in 2015 is similar to the findings of Bates and the Audio-Visual Media Research Group at the UK Open University in 1981 when they concluded, "Students do not automatically know how to use instructional television (video) to best advantage" (p. 10). At present, we have the ability to record and distribute lectures and the general belief that making recorded lectures available will improve learning. However, we need to find out more about if and how students use lecture recordings, what effects the use of recorded lectures has (and for whom), and if training on effective use of recorded lectures makes a difference in their use and level of effect.

A review of the literature and results of student surveys conducted over the last three semesters, reveal that students appreciate having lecture recordings available and believe that using the recordings helps them with course assessments. Yet, results on assessments are mixed other than for non-native English students where the results are overwhelmingly positive (Leadbeater, Shuttleworth, Couperthwaite, & Nightingale, 2012; Molnar, 2011; Pearce & Scutter, 2010). Although many instructors/schools capture recordings and make them available to students, very few train students on how to effectively use them for studying and learning. This study's hypothesis is that if training on how to use lecture recordings for studying is delivered to students (self-explanation method), it will make a significant difference in their learning strategies and assessment scores.

Self-explanation involves generating explanations to oneself that facilitates the process of integrating new knowledge with existing knowledge (Chi, Bassok, Lewis, Reimann, & Glaser, 1989). Self-explanation has shown to be an effective method for learning and studying (Bielaczyc, Pirolli, & Brown, 1995; Chi et al., 1989; Chi, Leeuw, Chiu, & LaVancher 1994; VanLehn, Jones, & Chi, 1992), is easy to implement with a brief training intervention (Bielaczyc et al., 1995; Chi et al., 1994; Hodds, 2014), and is presently being researched vis-a-vis multimedia learning (Roy & Chi, 2005), under which lecture recording applies. The combination of effectiveness, easy implementation, and connection to multimedia learning raised this method above others that were explored for a potential learning and study strategies intervention.

Research Questions

Since the Spring 2013 semester, multiple facets of lecture recording and use have been studied. In former research efforts, the focus has been on whether students in higher education have utilized lecture recordings and, if so, how and why. The most recent study, conducted in the Fall 2014 semester, continued this approach but also expanded to assess the impact of training students to utilize a learning strategy, self-explanation, so that they can make more effective use of recordings for studying and learning. This paper will specifically address the effects of the learning strategies training and these specific research questions.

If students are trained to utilize self-explanation with lecture recordings:

   1. How will the training affect how they utilize lecture recordings?

2. Will the training have an impact on their level of achievement as evidenced by course assessment scores?

Literature Review

This literature review explores two primary areas that relate to this study. The first area covers the impact on learning outcomes when students use lecture recordings. The second area covers the literature of self-explanation and explores more of what self-explanation is, validates its effectiveness, and indicates methods for effective training.

Utilization of Recorded Lectures and Impact on Learning Outcomes
Availability and use of recorded lectures resulted in a positive impact, with a 9% increase in two midterm exam scores, in an Introduction to Psychology course (Cramer, Collins, Snider & Fawcett, 2006). This quasi-experimental study of 884 students reviewed use of a *Virtual Lecture Hall* (VLH) in which recorded lectures were made available. Unique in this study is that recordings were used as supplementary (review) content for in-class students and primary content for an online section. While online students used the VLH more heavily, moderate use gains were seen across both groups. Vajoczki, Watt, Marquis, Liao, and Vine (2011) also found a positive correlation between the use of lecture recordings and student learning outcomes. In their study of first and second year students in large Economics and Sociology courses (n=1675), they found that both deep and surface learners reported on surveys and focus groups that they were more satisfied with their courses and retained more knowledge when they utilized the recordings. Finally, use of lecture recordings resulted in significantly higher student test scores, 6% higher than previous year, in a graduate biochemistry course (Molnar, 2011). These gains and reported knowledge happened across social science and science disciplines for undergraduate and graduate students.

While promising, this type of positive correlation between recorded lecture viewing and gains in student learning was not seen across all studies. Other articles indicated no significant difference in outcomes when students had access to recorded lectures. (Euzent, Martin, Moskal & Moskal, 2011; Owston, Lupshenyuk, D., & Wideman, 2011; Traphagan, Kucsera &, Kishi, 2009). While the findings of 'no significant difference' on learning outcomes for students who utilized captured lectures may not seem like a positive outcome, it does suggest that if a course is heavily lecture based that students would be able to obtain a certain level of proficiency without the requirement of being present. Indeed, the long held concern of increased absenteeism due to recorded lectures, though accurate, seems to have little effect on student outcomes provided students had access to and used the recordings (Euzent et al., 2011; Owston et al., 2011; Traphagan et al., 2009; Vajoczki et al., 2011). Indeed, the findings of Owston et al. (2011) in his study of large undergraduate health courses indicated that those students who stopped attending often achieved the highest grades. The results of this study however should be mitigated by the fact that only 19% of those students in his sample allowed for access to course grades, and only the highest achievers may have granted access.

Finally, in a quasi-experimental study Le, Joordens, Chrysostomou and Grinell found that students who "augmented their class attendance with online viewing were actually the students who performed the most poorly" (2010). Much of this was attributed to student reports that they used surface level learning strategies with the lecture recording by using the pause feature in their attempt to memorize content. Further this course was in the subject was mathematics, and the authors indicated that the viewing of recorded lectures was perhaps not well suited for learning tasks in this area. In comparison, the studies reviewed that indicated no significant difference or a positive correlation were in the domains of biochemistry, psychology, geology, sociology, and economics.

In regards to Bransford et al. (2000) on the integration of the technology of lecture capture into the curriculum, there appears to be no evidence that students were significantly trained, technically or pedagogically, on the use of the lecture recordings. Instead recordings were made available and students were left to their own means to figure out how to best use them. Given this void, students seemed to generally treat lecture recordings in the same way that they treated face-to-face lectures and merely passively viewed them.

Self-explanation
As a result of the depth of research in the specific area, self-explanation was chosen as the method to train students to use when studying and learning with recorded lectures. Self-explanation involves generating explanations to oneself, which facilitates the process of integrating new knowledge with existing knowledge (Chi et al., 1989). In the education literature, the concept of self-explanation theory traces back to 1989 and Chi, Bassok, Lewis, Reimann, and Glaser's seminal work in which they review the behaviors of "good" and "poor" students and how good students differed in their action of explaining to themselves particular concepts and examples were presented to them. Since then, there have been many studies which have affirmed self-explaining as an effective learning strategy and there have also been several studies which have examined the attributes of effective training approaches for the use of self-explanation.

The process of self-explaining has been shown to be an effective technique for learning in math (Atkinson, Renkl, & Merrill, 2003; Berthold, Eysink, & Renkl, 2009; Hodds, Alcock, & Inglis, 2014; Rittle-Johnson, 2006), science (Chi et al., 1989; Chi, Leeuw, Chiu, & LaVancher, 1994; Ionas, Cemusca, & Collier, 2012; O'Reilly, Symons, MacLatchy-Gaudet, 1998), and language arts (Huang & Reiser, 2012). Beneficial to our study is that of the studies reviewed on effectiveness, all but three, Chi et al., 1994; Huang & Reiser, 2012; and Rittle-Johnson, 2006, were conducted with college age students.

Some of the particular approaches needed to ensure that self-explanation is effective is that it is frequent (Chi et al., 1989; VanLehn, Jones, & Chi, 1992), helps students fill-in gaps in explanations and/or examples (Atkinson et al., 2003), and incorporates past knowledge and/or experience (Chi et al., 1994; Kiewra, 2002; King, 1994). Additionally, self-explanation is effective whether students are highly prompted (Atkinson et al. 2003; Berthold et al. 2009; Chi

et al., 2009; Huang et al. 2012), receive low level prompts (Huang & Reiser, 2012), or training to prompt themselves (Kiewra, 2002; O'Reilly et al., 1998).

Effective training on self-explanation needs to meet several criteria: (a) it must indicate to students that self-explanation is a highly effective learning and study strategy (Kiewra, 2002; O'Reilly et al., 1998), (b) should be simple and brief (Hodds, 2014; Huang et al., 2012; Kiewra, 2002) and (c) should include practice time (Bielaczyc et al., 1995; Kiewra, 2002; O'Reilly et al., 1998) so that students can effectively incorporate self-explanation. In our Fall 2014 study we built all three of these elements into our training intervention and thus enabled students to more effectively incorporate self-explanation into their study and learning strategies.

At present, members in the educational community have the ability to record and distribute lectures and the belief that making recorded lectures available will improve learning. Further research is needed about if and how students use lecture recordings, what effects the use of recorded lectures have (and for whom), and if training on learning strategies, for this study self-explanation, to use with recorded lectures makes a difference in use and level of effect. By ascertaining more in these areas students can be effectively engaged with those resources and not look at the recordings simply as a video to watch but rather as a learning tool they can use to become competent in a subject.

Research Design and Method

Setting

This study took place in one section of the Introduction to Communication (Comm 101) course at Rutgers University in the Fall 2014 semester with a final enrollment of 227 students. Comm 101 is required for anyone who wants to major in Communication and fulfills several general education requirements at Rutgers University. The course was delivered over 15 weeks in a face-to-face format for two 80-minute sessions per week. Each 80-minute session was recorded. Recordings consisted of the instructor's voice, his PowerPoint presentation, and anything else he projected through his laptop's screen. Recordings were released to students via a link in the course management system (CMS) and all students were given a Panopto viewer-only account using their university credentials to access the recordings. In addition to the lecture, each class session also incorporated the use of a classroom response system (iClicker - http://www1.iclicker.com/) for both attendance and engagement.

Students were assessed through attendance/participation (determined via iClicker responses), three objective question exams given in weeks 5, 10, and 14, and a brief three page essay. Exam #2 was the assessment most aligned to explanation and analysis, and thus it was selected to be the one used to determine the efficacy of the self-explanation training intervention. Further, two questions on exam #2 on the Shannon and Weaver Model of Communication that were aligned with the treatment and control activities were selected for further analysis.

As confirmed by past surveys and comparison to Rutgers institutional planning data, students in the Comm 101 course are representative of the population of undergraduate students at the University (Rutgers University, 2013). For the Fall 2014 semester the demographics of students in the Comm 101 course who participated in the study were:

- Gender - 58.3% female, 40.7% male
- Race/ethnicity - 36.1%, Caucasian (non-Hispanic), 27.8% Asian/Pacific Islander, 16% African-American (non-Hispanic), 12.4% Latino or Hispanic, 7.2% Other

Method
After the add/drop period at the beginning of the semester each student in the Comm 101 course was asked to participate in a study on instructional methodology and learning strategies and to allow access to their student records. Any student who declined participation in the study was able to take part in the course, but no data were collected on or about the student. A total of 204 students opted to participate and completed the consent form, a demographic survey, and the brief version of the Approaches and Study Skills Inventory for Students (ASSIST). ASSIST indicated whether students utilize surface, strategic, or deep approaches when studying and learning (Entwistle, Tait & McCune, 2000). The results of ASSIST were utilized in the analysis of lecture recording use, adoption of self-explanation, and impact on assessment scores. This mixed-methods study was conducted in two phases. Phase 1 addressed traditional questions focusing on overall use, overall impact, and impacts based on student demographics. Phase 2 focused on the self-explanation intervention.

Phase 1 of the study began at the end of week #2 of the course with the instructor recording each lecture and making the recording available via the course management system (CMS). Links to lecture recordings were posted on a page within the CMS with a brief "How to Use Recordings" tutorial on how to use the lecture viewing system. Each recording was captioned and these captions were then indexed within the Panopto system to allow for a higher level of searching for students. Students were thus able to view a list of all the recordings over the semester, view individual recordings, search individual recordings and search across all recordings for lecture content. The Panopto system enabled students to start/stop/pause the recordings, search, and, as we had captioning done, read along with the lecture.

Phase 2 of the study began in week #8 of the semester with the students in the course being invited to a lesson and activity based on whether they were assigned to the treatment or control group. To help control for issues of compensatory demoralization, compensatory rivalry and diffusion of treatment (Creswell, 2009), both groups received training and were required to complete an assignment. Successful completion of the assignment resulted in a very small amount of extra credit. While both groups continued to have access to lecture recordings and the "How to …" screencast, the treatment group received training on self-explanation and how it could be incorporated with the lecture recordings. The control group received training on the lecture

capture system's features (e.g., navigation, search, captions). Training for each group was delivered as embedded lessons in the CMS utilizing an e-learning object for content and a follow-up assessment, which allowed us to have students practice and verify how well those in the treatment group were able to use self-explanation.

In phase 2, students were randomly assigned to either treatment or control groups. At final analysis, 58 students who were engaged in the study fully participated in the treatment activities, while 57 students fully participated in the control activity. Table 1 indicates the demographic characteristics of each group and shows the homogeneity between each group.

Table 1

Demographic Characteristics of Students in Treatment and Control Groups

	Gender	Credits earned prior to course	Major or intended major in Comm	Prior Interest in course or subject	ASSIST Approach to studying & learning
Control group n=57	M: 21 F: 36	0-12: 25 13-30: 11 31-60: 13 61+: 8	Y: 10 N: 27 U: 19	SD: 2 D: 2 N: 28 A: 21 SA: 4	Deep: 18 Strategic: 32 Surface: 6
Treatment group n=58	M: 21 F: 37	0-12: 27 13-30: 12 31-60: 13 61+: 6	Y: 16 N: 28 U: 14	SD: 2 D: 3 N: 19 A: 27 SA: 7	Deep: 35 Strategic: 20 Surface: 1

Note: Where data is missing the number for each criteria will not match the n.

Throughout the study multiple types of data were captured at multiple points in time. The most applicable items for the research questions addressed in this article come from the initial demographic survey and ASSIST questionnaire, exam #2 scores, scores on the Shannon and Weaver Model of Communication questions from exam #2, exam preparation surveys, final course grades (1000pt and 4pt scales), and Panopto server log-files. The results on exam 2, Shannon and Weaver questions, and final course grade focused on the effects of student use associated with the lecture recordings and the intervention. The exam preparation survey simply asked students how they studied, if they used the recordings, and, if yes, how they used the recordings. The survey results provided valuable feedback not just on if students used the recordings but how they used them. Further, the results revealed if students indicated the incorporation of self-explanation into their study strategy. Finally, the Panopto server log-files confirmed student use of lecture recordings offering another data point on student use and timing of that use.

Results

Overview

The analysis and review of the end-of-semester survey, shows that:

- Students spent a combined total of 18,261 minutes viewing the recordings.
- Students watched an average of four recordings and about 20% watched every single recording that was made available.
- Use of the recordings peaked 3-5 days before the three principal exams.
- Overall, the students who used the recordings as part of their preparation for the exams used a combined approach of searching for specific content to review, pausing when needed to take notes or complete their study guide, and/or viewing entire recordings for class sessions they missed.
- A large majority of the students (79%) believe that the availability of the lecture recordings helped them meet the learning objectives of the course, allowed them to do better in the exams, and should continue in future terms.

Effectiveness of Use of Lecture Recordings

Table 2 shows the mean scores and standard deviations on three outcomes.

Table 2

Effect of Use of Lecture Capture Recordings on Select Course Outcomes

	Overall n=204	Overall (No-LC) n=47	Overall (LC) n=148
Exam #2	mean=16.78 sd=3.35	mean=15.28 sd=3.53	mean=17.24 sd=3.17
Final Grade (1000pt scale)	mean=852.27 sd=88.62	mean=837.49 sd=78.36	mean=862.89 sd=74.64
Final Grade (4pt scale)	mean=3.16 sd=.72	mean=2.98 sd=.722	mean=3.26 sd=.67

Note: Six students did not indicate whether they used LC or not; LC use determined from Exam #2 - Exam Preparation Survey.

Significance of these results was determined by independent samples t-tests on each dependent variable and use of the lecture capture recordings. These results indicate significance for exam #2 scores ($p=.001$) and the final grade on a 4pt scale ($p=.021$). Results for the final grade on a 1000pt scale were not significant ($p=.054$). Therefore, those students who utilized the lecture recordings did achieve a higher level of results in the course.

Self-explanation intervention results. The study attempted to determine if the training intervention on the use of self-intervention would have an effect on how students use lecture recordings and if there would be further learning gains.

Effect on lecture recording use. Upon comparing the results of the Exam Prep Survey from exam #2 to exam #1 for the treatment group, ~~we found~~ no specific mention of self-explanation or indication of a rise in deep learning or studying behaviors was found. There was a slightly increased indication of lecture capture use, which correlates to what was seen from the Panopto log-files, but overall *how* the system was used was less affected than *that* it was used.

Impact on course assessment scores. Table 3 provides results on multiple assessments and outcomes for treatment and control groups. Table 3 also shows the results for those who did not participate in either activity for comparison.

Table 3

Effect of training on self-explanation on select course outcomes

	Non-participants or incomplete n=86	Control (How to…) n=57	Treatment (Self-explanation) n=58
Exam #2	mean=15.83 sd=3.49	mean=17.7 sd=3.16	mean=17.28 sd=2.98
S&W Q.1	correct=33 incorrect=56	correct=32 incorrect=25	correct=30 incorrect=28
S&W Q.2	correct=59 incorrect=30	correct=45 incorrect=12	correct=46 incorrect=12
Final Grade (1000pt scale)	mean=830.00 sd=105.66	mean=875.88 sd=63.13	mean=863.24 sd=73.24
Final Grade (4pt scale)	mean=2.972 sd=.81	mean=3.421 sd=.52	mean=3.198 sd=.65

Note: 6 of 57 control participants indicated that they did NOT use the lecture recordings for exam #2; 2 of 58 treatment participants indicated that they did NOT use the lecture recordings for exam #2, 1 of 58 did not indicate use.

To compare results one-way analysis of variance (ANOVA) tests were conducted. Results of these tests are indicated in Table 4 below. For the dependent variables - Exam #2, Final Grade (1000) and Final Grade(4) there is no violation of variance as per Levene's test as the tests of significance indicate results of: .212, .226, and .369 respectively. For each of these variables no significant results between the treatment and control groups are observed. However, the results are significant between the control group and

the no/incomplete group for all outcomes and, for exam #2 results, between the treatment group and the no/incomplete group.

Table 4

ANOVA Results for Treatment, Control, and Non-Participatory Groups

	Treatment vs. Control	Treatment vs. No/Incomplete	Control vs. No/Incomplete
Exam #2	.763	.025*	.003*
Final Grade (1000pt)	.715	.062	.006*
Final Grade (4pt)	.202	.135	.001*

Conclusion

Based on the analysis above it can be concluded that:

- Students will use lecture recordings if made available and they highly value having them available for studying and learning.
- Students who utilized the lecture recordings achieved higher assessment scores and overall outcomes than those who did not.
- Students who received training in self-explanation did not indicate a change in their approaches to learning/studying, nor did they achieve higher assessment scores or overall outcomes than those who did not.
- Students who received further training on how to use the lecture recording system did achieve higher assessment scores and overall course outcomes.

In light of the above conclusions, the issue that Bates (1982) determined regarding students uncertainty of how to use multimedia recordings is still relevant and transferable to recorded lectures. In our hypothesis we believed that training students in a study/learning technique, self-explanation, would help them to utilize the lecture recordings more effectively and that would result in an increase in student learning outcomes. Instead, it seems that it was more beneficial to train students to effectively use the lecture recording system.

There are three plausible reasons based on which the results of the study can be explained. First, training in how to use the system allowed students to better incorporate the lecture recordings into the study and learning techniques that they already utilized. Second, and related to the first explanation, student perceptions of the best study techniques for the types of assessments in the course (objective exams) were not aligned to self-explanation but more directed to memorization. Therefore being able to find, play, pause, replay, etc., in the lecture recording system seemed more valuable to students than trying to have a deep understanding of content. Third, by focusing on self-explanation, either the process was not thoroughly explained or did not

effectively enough incorporate system based training. It seems that students in this study were not ready for the self-explanation approach, a topic area that warrants further research.

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