LECTURE CAPTURE AND LEARNING STRATEGIES

By

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ABSTRACT OF THE DISSERTATION
LECTURE CAPTURE AND LEARNING STRATEGIES

By Steven Garwood

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William Firestone

Lecture is a highly utilized instructional approach in higher education, but is not always the most effective method for student learning. One approach utilized to help students learn in their face-to-face courses has been to record lectures so that students can review the content covered as part of their approach to studying and learning. This mixed-methods study with approximately 200 college students in a face-to-face introductory level communication course utilized multiple surveys, log-files, and student demographic and study strategies data to identify if, how, and why students use recorded lectures. Further, this study reviewed the impact of lecture recording use on student assessment scores and overall grades. Besides studying the broad use and benefits of lecture recording, this dissertation also reports on the impact of training students on the application of self-explanation to effectively study and learn from lecture recordings and student use of captions which were available with the lecture recordings. Findings of this study will be utilized to expand the current knowledge on the process and use of lecture recording, the application of training methods to lecture recording use, and the use of captions to improve student learning and studying, especially in relation to student note-taking. Findings will also inform the literature on self-explanation in respect to how students can be trained to use this technique to help improve their approaches to studying and learning and will also inform the literature on note-taking as captioning potentially addresses challenges that exist with the quality of student notes.

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needed to be more productive than I thought I could be.

Dedication

To John and Mary
my parents, who both inspired me to learn in their own unique ways

To Jill
my partner, who believes in me and helps me through when times are tough

LECTURE CAPTURE AND LEARNING STRATEGIES

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Chapter 1: Introduction

One approach to help students learn more from lectures has been to record them so that students can review the content covered as part of their learning and study strategies. The methods of recording include lecture capture, screencasting, vodcasting, podcasting, and the 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, the number of academic articles written on the topic of video podcasts in education has increased dramatically since 2006 (Kay, 2012).

Recordings of class lectures can help to alleviate multiple problems that students experience with lecture-based courses. For example, students do not take effective or sufficient notes, often recording less than 50% of important lecture points (Kiewra, 1985; Kiewra & Kieuwra, 1987; Kiewra, DuBois, Christian, & McShane, 1988; Titsworth & Kiewra, 2004). Having lecture recordings available can help students mitigate challenges they encounter when trying to take notes such as lecture rate, organization of the presentation, lack of verbal or visual cues to help discern what information is important, and manipulation of information in working memory (Kiewra & Kieuwra, 1987). This can be especially important for non-native English speaking (NNES) students who face even greater challenges than their English speaking peers (Flowerdew, 1994; Huang, 2004; Mulligan & Kirkpatrick, 2000).

Since the Spring 2013 semester, multiple facets of lecture recording and use have been studied in the Introduction to Communication and Information Processes (Communication 101) course at the School of Communication and Information (SC&I) at Rutgers University. At the conclusion of each semester, I administered a survey to students to determine how and why they

used the lecture recordings and also to see what could be done to improve access and use of the recordings.

Results from these student surveys and reviews of the literature on lecture capture revealed that students appreciated having lecture recordings available and believe that using the recordings helps them with course assessments (Euzent, Martin, Moskal & Moskal, 2011; Owston, Lupshenyuk, & Wideman 2011; Traphagan, Kucsera & Kishi, 2009). However, the literature indicated that 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). Further analysis of the literature highlighted two areas that I wanted to explore further and address with a more comprehensive study. First, many studies relied on student self-report data to determine use of lecture recordings and/or impact on learning outcomes. Second, there was no evidence indicated in the literature that students were 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.

This dissertation study, conducted in the Fall 2014 semester, sought to address these two areas. In the study, I explored student use, impact of use, and the impact of training students to use lecture recordings using a systematic and methodological approach. This mixed-methods study with approximately 200 college students utilized multiple surveys, log-files, and student demographic and course assessment data to identify if, how, and why students use recorded lectures and if that use had an impact on student learning and assessment scores. Further, it explored the impact of training students on the application of self-explanation to effectively study and learn from lecture recordings.

As part of a portfolio (alternative format) method, this dissertation comprises three distinct articles which indicate my findings. The three articles (i.e. Chapters 2, 3, and 4 in this document) are complementary to each other, and each focuses on a particular facet of my dissertation study. Chapter 2 looks broadly at whether students used lecture capture if made available to them and, if they did, whether or not that use has an impact on learning and assessment scores. Chapter 3 specifically focuses on an intervention we conducted which utilized self-explanation as a possible approach to help students effectively incorporate the lecture recordings into their study and learning practices. Chapter 4 focuses on students' attitudes toward and use of captions that were incorporated into the lecture recordings.

I outline each chapter in the following section:

Chapter 2 - Lecture Capture and Student Learning

Chapter 2 focuses on student use of lecture recordings and impact on course assessment scores.

Audience - Instructors, Educational Technologists

Rationale - While this type of research is represented in the literature, much of that research relies on student self-report data rather than log-files or assessment scores, or does not contain the level of data that was collected in this dissertation study. This article reinforces and provides a greater level of detail to the body of literature on lecture capture than currently exists.

Research Questions -

- Use - Do students use recorded lectures if made available to them? How do students utilize recorded lectures?

- Impact - Do students report that there is an impact on their learning outcomes if they utilize recorded lectures? Do students who use recorded lectures have a higher level of

achievement on course assessments and overall grades? Do non-native English speaking students benefit from the use of recorded lecture?

Methods/Analysis - For this study I collected data from multiple sources to determine use (i.e. multiple surveys and log-files), impact (i.e. surveys, assessment scores and final grades) and also collected student demographic data (i.e. entering GPA, interest in the course, English proficiency). By combining descriptive statistics, t-tests, ANOVA tests, and inductive coding of open survey questions, I provide a high level of detail on who used the lecture recordings, how and why they were used, and the benefits the lecture recordings had for students in general and NNES students in particular.

Chapter 3 - Training Students to Effectively use Lecture Recordings

Chapter 3 focuses on the results of my intervention activity which trained students on the use of self-explanation as a study technique to use with the lecture recordings.

Audience - Instructors, Educational Technologists, Instructional Designers, Learning Theory Researchers

Rationale - The gap identified in my literature review on lecture capture is that while students are provided with lecture recordings they are not trained to use them for studying and learning. The intervention which took place in this study attempted to train students to use a study technique, self-explanation, with lecture recordings to determine if that would result in higher assessment scores. This article expands the body of literature on the use of lecture capture for student learning and also contributes to the literature on self-explanation as a technique for studying and learning.

Research Questions - If students in the treatment group are trained to utilize self-explanation with recorded lectures:

- How will the training affect how they utilize lecture recordings?

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

Methods/Analysis - In this study, I had a treatment group (n=58), control group (n=57), and a group of students who did not participate in the intervention aspect of the study but who still used the recordings (n=86). The treatment group received training on self-explanation and the control group received general training on how to use the lecture recording system to help with studying. The non-participant group was able to utilize the recordings but received no training. Utilizing a combination of descriptive statistics, t-tests, ANOVA tests, and inductive coding of student comments on exam study strategies surveys which asked about lecture recording use for studying, I determined if training on self-explanation resulted in statistically significant improvements in student assessment scores. I also compared that to results of general training on how to incorporate lecture recordings into study approaches.

Chapter 4 - Student Use of Captions when Using Lecture Recordings for Studying and Learning

Chapter 4 focuses on student attitudes toward and use of captions available with the lecture recordings.

Audience - Instructors, Educational Technologists, Universal Design for Learning Developers, Educational Researchers

Rationale - Captioning lecture recordings was something the course instructor and I decided to do to improve search results with the lecture capture system. We considered that some students might use the captions (especially non-native English speakers) when studying, but did not initially focus on this in detail as an area of study. However, students frequently mentioned

utilizing the captions, which suggested that making captions available was received very positively. This article focused on student use of and attitudes towards the captions, especially as incorporated into study strategies. It also looked at whether there was an impact on assessment scores and course grades for those who used captions.

  The use of captioning is not something which has been covered in the literature on lecture capture. With an increasing focus on universal design for learning, and the strong connection that students made to the captions and their processes of studying, especially in relation to their course notes, this article expands the literature on the use of lecture capture.

Methods/Analysis - Utilizing results from descriptive statistics on Likert style questions on the end-of-course survey and inductive coding of open ended questions on the three exam study strategies surveys, we determined if and how students utilized the captions that were created for the lecture recordings. Further we determined the value that students placed on the captions, especially for studying and learning.

Each of these chapters help to solve problems of practice and improve instructional practice. The literature indicates that students appreciate having lecture recordings available to them and believe them to be beneficial, especially for studying and preparing for examinations. Each of these articles provide instructors, educational technologists, and instructional designers with information to help them implement an effective program of lecture recording.

Chapters 2, 3, and 4 are written as articles in first person plural. This was done to prepare each article for publication with two authors, myself and Dr. Nick Linardopoulos, the instructor whose course was utilized for this study. I performed all data collection, analysis, and writing. As per the language of the consent form for the study, results were shared with Dr. Linardopoulos only after the completion of the course.

Chapter 2: Lecture Capture and Student Learning

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 & 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 the content covered as part of their learning and study strategies. The methods of recording include lecture capture, screencasting, vodcasting, podcasting, and the 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 utilizing these terms began to appear in 2002, and the number 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 summarized the present 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). Thus, 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 that "students do not automatically know how to use instructional television (video) to

best advantage" (p. 10). At present, we have the technical 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 and what effects the

use of recorded lectures has (and for whom).

A review of the literature and results of student surveys that we[1] have 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. However, the literature

indicates that 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). This study seeks to continue the research in this

area and explores the issues of use and impact in greater detail by looking at both topics from

several lenses.

Research Questions

Since the Spring 2013 semester, multiple facets of lecture recording and use have been

studied in the Introduction to Communication and Information Processes (Communication 101)

course at the School of Communication and Information (SC&I) at Rutgers University. In former

research efforts, the focus has been on whether students have utilized lecture recordings and, if

so, how and why. For this project we continued this research and also explored the impact of

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[1] Chapters 2, 3, and 4 are written as articles in first person plural. This was done to prepare the
article for publication with two authors, myself and Dr. Nick Linardopoulos, the instructor whose
course was utilized for this study.

student use of lecture recordings on course assessments and overall grades. This paper will

specifically address:

- Use

    1. Do students use recorded lectures if made available to them?

    2. How do students utilize recorded lectures?

- Impact

    3. Do students report that there is an impact on their learning outcomes if they utilize

    recorded lectures?

    4. Do students who use recorded lectures have a higher level of achievement on

    course assessments and overall grades?

    5. Do non-native English speaking students benefit from the use of recorded lecture?

Literature Review

Use of lecture recordings

Multiple studies have focused on the recording of lectures or presentations for optional or

supplementary purposes (e.g. reviewing notes, studying). These recordings may have been

created, like those in this study, from a lecture conducted in a classroom or may have been

conducted in an instructor's office using some type of voice-over-PowerPoint (VOPP) approach.

In each of the studies students had the opportunity to attend face-to-face class sessions where the

content was presented, thus the recordings were optional or supplementary in nature. In these

studies, usage of recordings was tracked using methods such as server downloads and course

management system access logs. Results from these studies indicated that all possible students in

a course (or as part of the target audience) did not view the recordings (Copley, 2007; Evans,

2011; Shantikumar, 2009).

In all, where viewing was not enforced in some way, use tended to be driven by some type of intrinsic motivation. In a study by Copley (2007), students in two different courses had access to recordings that they could use for review but did not necessarily need to utilize. Only about 61% of students downloaded video recordings (though 80% downloaded an audio version). Of those who downloaded, more students in the higher level course downloaded/viewed than did students in the lower level course. This could be attributed to better learning strategies on part of the more senior students or perhaps the difficulty of the content at the higher level which required further need for review. In a study of the use of recordings for medical students preparing for their final exams, only 46% viewed recordings (Shantikumar, 2009). The author does explain, however, that usage was measured three weeks prior to the exam and done as students entered into a period of face-to-face review lectures. His surveys indicated a high level of intended use for the time between the survey and the actual exams, but this was not measured. Lastly, when supplementary recordings were made available for an embryology course, the authors indicated that the total number of students downloading recordings ranged from 42-85% of the cohort (Evans, 2011). Again, in this example, recordings were made available as a resource, but not necessarily tied to a specific activity or assessment. One unique note from the discussion section in this article was that the most downloaded recordings were on the traditionally most difficult topic and the exam review; thus, when students were presented with a specific need, they used the recordings.

To explore student motivations for use a bit further, the main reasons why students indicated that they used recordings were to: make-up for a missed class due to illness or other event that kept them from attending (Copley, 2007; Evans, 2011); a sense of control – they could interact with the lecture content at their own pace and in their own way and deal with difficult

material (Evans, 2011; Lents & Cifuentes, 2009; McMinn, n.d.); review content, especially

before exams (Copley, 2007; Evans, 2011; Shantikumar, 2009); and for backup so they would

have the content "in case" they needed it if they discovered a gap in their notes or a question as

they were studying (Copley, 2007). These findings do correspond with the results from Kay's

(2012) literature review on video podcasts, where she writes that student use appears to happen

for three principal reasons: (1) to improve learning, (2) to obtain a level of control over the

learning experience, and (3) to make up for missed classes.

In further review of student comments from surveys, reasons for not accessing recordings

included: being unaware of their availability (Demetriadis & Pombortsis, 2007; Evans, 2011);

the lack of need to view based on confidence with the subject matter (Copley, 2007; Evans,

2011); preference for face-to-face interaction or other course materials (e.g. handouts) (Copley,

2007; Evans, 2011); difficulty with the technology (Copley, 2007; Demetriadis & Pombortsis,

2007; Griffin, Mitchell, & Thompson, 2009; Lents & Cifuentes, 2009); and even "home being

too comfortable to be productive" (Demetriadis & Pombortsis, 2007). These findings as well

reflect Kay's (2012) review which found that students did not access recordings because of: (1)

lack of awareness, (2) technical issues, and, (3) lack of comfort with video lectures as compared

to live, face-to-face lectures.

Impact on learning outcomes

This section focuses specifically on the measured impact on learning outcomes from the

availability and use of recorded lectures. The following studies are all based on large lecture hall

courses and all measured the impact on learning outcomes based on student surveys, course

assessments such as exam scores, homework problems, and/or the end-of-term grade. Each study

was unique in subject area, study methodology, and interpretation of factors that determined

impact. Overall, results on student learning outcomes are mixed.

The availability and use of lecture recordings has been shown to improve student achievement on course assessments (Cramer, Collins, Snider & Fawcett, 2006; Molnar, 2011; Vajoczki, Watt, Marquis, Liao, & Vine, 2011). In an Introduction to Psychology course, researchers found a 9% increase in two midterm exam scores (Cramer, et al., 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 utilized the VLH more heavily, the moderate use gains were seen across both groups. Vajoczki, et al. (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 in scores and reported knowledge happened across social science and science disciplines and for both 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 that there was no significant difference in outcomes when students had access to recorded lectures. (Euzent, Martin, Moskal & Moskal, 2011; Owston, et al., 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, although 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.

Benefits for non-native English speaking students.

Across multiple studies, students indicate that recorded lectures enhance their learning and help them to improve their grades (Cramer, et al., 2006; Euzent et al., 2011; Traphagan et al. 2010; Vajoczki et al. 2011), but we cannot proceed from student self-reports alone. As we aim to educate many types of students with differing motivations, backgrounds, abilities, life situations, etc. we need to better understand how different types of students can benefit from access to, and use of, recorded lectures. While current research has been focused on student perceptions of

recorded lectures, overall use of recordings, and impacts across the entirety of the population of a course, the literature reviewed in this section focuses on those studies that have teased out particular audiences that may benefit the most, particularly non-native English speakers (NNES).

Four specific groups of students who have shown to benefit from the availability of recorded lectures are non-native English speaking students (NNES) (Leadbeater, et al., 2012; Molnar, 2011; Pearce & Scutter, 2010), students who need more flexible access to learning materials, such as online or blended students with full-time employment (Euzent et al, 2011), low-achieving students (Owston, et al., 2011) and students with learning disabilities (Leadbeater, et al. 2012). Each of these groups has different needs, but each of their needs can still be addressed by the same recording(s). As the Communication 101 course is an on-campus course, and we have limited access to student achievement data (many new and transfer students take the Communication 101 course), we will focus on NNES in the rest of this section.

NNES students find many social and academic challenges as they enter the higher education setting. The ability to communicate academically in English is one of those challenges. And, while we may think this occurs mostly as speaking and writing in courses, we also need to consider a student's ability to academically *listen,* a critical skill for academic success.

As was indicated in the introduction, as students enter university settings, one of the primary instructional methods they experience is the lecture (Benson, 1989). Lectures are usually conducted for 45 minutes or longer and present a multitude of challenges to listening comprehension. NNES students face myriad problems with live lectures that recordings can help mitigate. Beyond problems of language, NNES students often face challenges discerning the organization of lectures (Allison & Tauroza, 1995; Dudley-Evans, 1994; Dunkel & Davis, 1994; Miller, 2007; Olsen & Huckin, 1990; Tauroza & Allison, 1994) so they are unsure of what is

important and what is not. Additionally, they are often challenged by the delivery style of the lecturer who speaks too fast, has a heavy accent or speaks in too informal a manner (Arden-Close, 1993; Flowerdew, 1994; Flowerdew & Miller, 1992; Flowerdew & Miller, 1996; Huang 2004; Miller, 2007).

Both Molnar (2011) and Pearce & Scutter (2010) found significant gains for those NNES students who utilized lecture recordings. In Molnar's quasi-experimental study of students in a podiatric medical program, he found that NNES students who utilized lecture recordings performed three standard deviations or 10 points higher than NNES students in the previous semester that did not have access to lecture recordings. While this was a study of only 60 students and the comparison was not made between students in the same semester of the course, the course materials and instructor were held constant and the only alteration was the inclusion of the lecture recordings. Pearce & Scutter (2010) indicate a somewhat counterintuitive finding that seems quite significant in relation to lecture recordings. In their study of Health Science students which included 400 NNES, 59% of NNES students indicated taking fewer notes when lecture recordings were available. When asked why, they indicated that "they could concentrate on what was being taught and discussed in the lecture rather than focus on note taking…this allowed them to understand the context of what was being said in the lecture…and clarify difficult concepts later" (Pearce & Scutter, 2010, p. 1034).

In this study we will seek to further explore the issues raised in this literature review. Specifically our research questions will focus on use:

1. Do students use recorded lectures if made available to them?

2. How do students utilize recorded lectures?

And impact:

3. Do students report that there is an impact on their learning outcomes if they utilize recorded lectures?

4. Do students who use recorded lectures have a higher level of achievement on course assessments and overall grades?

5. Do non-native English speaking students benefit from the use of recorded lecture?

Research Design and Method

Setting

This study took place in one section of the Introduction to Communication and Information Processes (Communication 101) course at Rutgers University in the Fall 2014 semester with a final enrollment of 227 students. Communication 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 within 24 hours of the conclusion of the class session via a link in the course management system (CMS) and all students were given a viewer-only account to the Panopto (Panopto - http://www.panopto.com) lecture capture system 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. This study focused on the results of the three exams and overall grades on a 4 point (A,

B…) scale. For each exam there was a review session, which was recorded and made available,

and students were provided with a study guide to use for exam preparation.

As confirmed by past surveys and comparison to Rutgers institutional planning data,

students in the Communication 101 course are representative of the population students at

Rutgers University (Rutgers University, 2015). Table 1 indicates a comparison of the

demographics of Communication 101 to Rutgers University students.

Table 1.

Demographic comparison of Communication 101 students to Rutgers University students

	Gender	**Race/ethnicity**
Communication 101 Students	Male - 40.7% Female - 58.3%	Caucasian (non-Hispanic) - 36.1% Asian/Pacific Islander - 27.8% African American (non-Hispanic) - 16% Latino/Hispanic - 12.4% Other - 7.2%
Rutgers University Students	Male - 47.2% Female - 52.8%	White - 42% Asian - 20% Latino - 13% African American - 10% Foreign - 9% Other - 6%

Note: Race/Ethnicity categories were different between our demographic survey and the approach that Rutgers University uses

Method

In the third week of the semester each student in the Communication 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). The ASSIST was

conducted to determine whether students utilize surface, strategic, or deep approaches when

studying and learning (Entwistle, Tait & McCune, 2000). Table 2 provides further details about

the Communication 101 students and indicates results from the demographic survey and

Approaches and Study Skills (ASSIST) inventory.

Table 2.
Demographic characteristics of students in Communication 101 course.

Credits earned prior to course	0-12	99
	13-30	38
	31-60	41
	61+	25
Major or intended major in Communication	Yes	50
	No	93
	Undecided	60
Prior Interest in course or subject	Strongly Disagree	6
	Disagree	12
	Neutral	83
	Agree	82
	Strongly Agree	20
English Proficiency	English 1st Language:	164
	English 2nd Language, but as strong as 1st	26
	English 2nd Language	14
ASSIST Approach to studying & learning	Deep	95
	Strategic	94
	Surface	10

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

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 captions created-read along with the lecture.

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, exam #1 and exam #2 scores, exam preparation surveys, final course grades(1000pt and 4pt scales), and Panopto server log-files. The results on exam #1, exam #2 and final course grade focused on the impact of student use associated with the lecture recordings. Exam #3 was not used as it was conducted using an irregular format where students were able to collaborate on answers. The exam preparation survey 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 also how they used them. Finally, the Panopto server log-files confirmed student use of lecture recordings offering another data point on student use and timing of that use.

<div align="center">**Results**</div>

Use of lecture recordings

To address research question #1 and determine whether students in the Communication 101 course utilized the lecture recordings during the Fall 2014 semester, we reviewed student responses from the three exam study strategies surveys and the end-of-course survey. We also reviewed the log-files of the Panopto lecture recording system. Finally, we also looked specifically at the NNES students' use of lecture recording.

Exam Study Strategies surveys. At the conclusion of each exam, students were asked to complete a survey indicating how they studied, if they used the lecture recordings and if so, how they used them. This data was collected, comments from students who consented to participating

in the study were transcribed into excel and the data was analyzed. Based on student self-reports

on the use of the lecture recordings:

- Exam 1 - 123 students (60.3%) indicated use

- Exam 2 - 160 students (78.43%) indicated use

- Exam 3 - 156 students (76.47%) indicated use

As students could indicate use of the lecture recordings for one or more exams (or none)

we also coded indications of use to Never (no use), Sometimes (use on 1-2 exam surveys), or

Always (use on all 3 exam surveys) to determine the consistency of use throughout the semester.

Table 3 below indicates those results.

Table 3.
Exam Study Strategies Surveys - Aggregate use of recordings

Never	Sometimes	Always
16% (32)	27% (54)	49% (101)

Note.

End of course survey on lecture recordings and learning strategies. Multiple questions on the

end of course survey sought information about student use. Responses to two of the Likert-style

questions are indicated in the tables below. The end of course survey was conducted from

12.10.14 through 12.15.14. A total of 177 (78% completion rate) students responded to the

survey. Table 4 below indicates student responses to the amount of recordings they used, and

Table 5 indicates the percentage of any individual recording that a student indicated viewing.

Table 4.
End of course survey - Question #11 - Quantity of Recordings Used

	0	1-5	6-9	10-15	16-20	All
How many recordings (either fully or partially)	4% (7)	33% (58)	17% (30)	14% (24)	14% (24)	19% (34)

of our class sessions did you end up watching this term (in total)?					

Table 5.

End-of-course survey - Question #14 - Percentage of recording viewed

	No viewing	< 24%	25-49%	50-74%	75-100%
For the class session recordings that you did watch, approximately what percentage of each recording did you end up viewing?	5% (9)	8% (14)	20% (36)	38% (68)	8% (14)

       The end of course survey questions indicate that the majority of students utilized a subset of the recordings and most viewed somewhere between 25% and 74% of the recordings that they did view. So as to not rely solely on student self-reports of use, we also reviewed student actions in the Panopto lecture capture system by analyzing system log-files.

Log files of Panopto server. The Panopto lecture capture system provides analytics in three forms: a) a visual overview (Appendix A) including a chart that indicates the highest level of views, minutes viewed, and unique users, b) a chart (Appendix B) that ranks recordings by their level of use, and c) log-files available in a comma-separated value, .csv, format. There were two log-files available - views and breakout. Views is a listing of each recording with an indication of when it was viewed, who viewed it, and the duration of the view. Breakout is a listing by viewer (student) of amount of views, minutes viewed, and average viewing time. Both types of log files from the Panopto server were downloaded and analyzed. Log files indicate that the recordings were heavily utilized, especially on the days immediately preceding the exam. There were 227 students on the final roster for the course. In total these students account for 5,854 views totaling 52,354 minutes of viewing of lecture recordings.

Fifty seven percent of total viewing clustered around course examinations. Exams for the

course were held on 10.2.14, 11.6.14, and 12.2.14. Table 6 below indicates the usage of lecture

recordings for the two days prior to the exam and up to 5:00 PM the day of the exam.

Breakdowns of views and unique viewers is below. Exam #2 is considered the most difficult in

the course as it focuses on application of theories and concepts and is also the exam in which we

applied a training intervention using either self-explanation or more detailed system training.

Exam #3 is conducted in an alternative format where students answer questions using an iClicker

audience response device and students have 45 seconds in class to collaborate on potential

answers before answering. While students have this time to debate answers/choices, exam scores

are still individually assessed.

Table 6.
Viewing totals for two days prior to exams till beginning of exam.

Exam	Viewing Dates	Total Views	Unique Viewers
1 - 10.2.14	9.30.14 - 10.2.14	922	101
2 - 11.6.14	11.4.14 - 11.6.14	1858	126
3 - 12.2.14	11.30.14 - 12.2.14	585	78

Note. Views of <10 seconds and views by course instructor and systems administrators removed.

To better define use we also categorized students by levels of viewing (quantity of unique

views) and level of minutes viewed as indicated in the Panopto log-files. See Table 7 and Table 8

for breakdown.

Table 7.
Level of viewing (quantity of unique views)

	no views or no record	v. rarely (1-10)	rarely (11-24)	occasional (25-49)	frequent (50-99)	v. frequent (100+)
# of students	23% (46)	17% (35)	21% (43)	23% (47)	14% (29)	2% (4)

Note: Student must have at least 1 view to be indicated in log files.

Table 8.
Level of minutes viewed (to the tenth of a minute)

	no minutes or no record	v. low (.01-74.9)	below avg (75-149.9)	average (150-299.9)	above avg (300-749.9)	v. high (750+)
# of students	24% (48)	16% (32)	15% (31)	22% (45)	18% (36)	6% (12)

Note: Student record indicating less than 1/10 minute view counted as 0 minutes viewed.

When comparing student self-reports of use and log-file data we see that these are generally in agreement. Student tended not to view entire recordings nor all recordings. Instead they selectively utilized them based on their perceived needs. Where difference occurs is the level of use where students tended to indicate a higher level of use than the log-files indicate. For example, 160 students indicated on the exam study strategies surveys that they used the lecture recordings to prepare, but log files indicate that only 126 utilized them (at least within 48 hours of the exam time).

Use of lecture recordings by non-native English speaking students. When looking specifically at surveys and log-files from the 14 students who indicated English as a 2nd language (NNES), their use of the lecture recordings overall (Table 9) is similar to the students in the course as a whole as seen in Table 6, 7, and 8 above, but with some increased use in minutes viewed as discussed below.

Table 9.
NNES use of lecture recordings

Exam Study Strategies Surveys - Aggregate use of recordings					
Never	**Sometimes**	**Always**			
0	36% (5)	64% (9)			
Level of Viewing (quantity of unique views) (log-files)					

no views / no record	v. rarely (1-10)	rarely (11-24)	occasional (25-49)	frequent (50-99)	v.frequent (100+)
7% (1)	20% (3)	20% (3)	29% (4)	14% (2)	7% (1)
Level of Minutes Viewed (to the tenth of a minute) (log-files)					
no minutes / no record	v. low (.01-74.9)	below avg (75-149.9)	average (150-299.9)	above avg (300-749.9)	v.high (750+)
1% (1)	14% (2)	14% (2)	20% (3)	29% (4)	14% (2)

Notes.

While the use of lecture recordings between NNES students and the general student population of the course is similar, there are three differences. First, all the NNES students indicated using the lecture recordings on the exam study strategies surveys. Second, their amount of views is higher, and, third, their amount of minutes viewed is higher.

From the analysis of the exam study strategies surveys we found two items of particular interest. First, while not all NNES students used the lecture recordings for Exam #1, they did for Exam #2 and Exam #3. Second, although we see an indication that a NNES student did not use the lecture recordings from the Panopto log-files, the exam study strategies indicate that at least one student reported studying with friends.

According to Panopto log-files, in both amount of views and amount of minutes of viewed, NNES students utilized the lecture recordings to a higher degree than other students. While the difference in overall views was not significantly higher, the difference in minutes viewed was. 63% of NNES students viewed 150+ minutes of the recordings vs. 46% for the course as a whole.

How students utilize recorded lectures

While we know from student reports and log-file analysis that students did utilize the lecture recordings, the focus of research question #2 is how they were utilized. To better determine this we looked at a question from the end-of-course survey and the responses on the three study strategies surveys.

End-of-course survey. On the end-of-course survey we specifically asked how students used the lecture capture system in a Likert style question. We focused here on whether students viewed entire recordings, searched recordings, or did some combination of the two. Results are indicated in Table 10 below, but indicate that students searched for content or did a combination of searching and viewing full recordings.

Table 10.
End-of-course survey - If you viewed the recordings as part of your preparation for the exams, how did you use them?

Entire	Searched	Combination	n/a
13% (23)	38% (67)	39% (69)	6% (11)

Notes. Choices: Viewed the entire recording or recordings, Searched a recording or recordings for specific content to review, Combination of viewing the entire recording and searching for specific content, Not applicable - I did not view any of the recordings

Analysis from Student study strategies surveys. In addition to the Likert style question above we also asked students the question - "How did you use the lecture recordings?" on the three exam study strategies surveys. We received a total of 417 responses across the three surveys (Exam 1 - 135, Exam 2 - 138, Exam 3 - 144). We conducted a text analysis of terms that students used in their comments and found that students used the term: Search(ed) 168 times, Caption(s, ing) 102 times; Pause 97 times; Note(s) 87 times; and, Guide, in relation to the study guide 69 times. After the text analysis, we reviewed their responses multiple times, conducted an initial round of inductive coding, refined the code set and then did a final round of coding.

We categorized the code set we used into two main areas: features - comments specific to features of the lecture capture system such as search and pause, and study strategies - ways in which students incorporated the lecture recordings into their approaches to studying. In the area of study strategies we coded for terms/approaches such as use of the exam study guides, notes or note taking, or level of learning such as understanding or clarification.

Search was by far the feature most mentioned by students. The most common approach to this feature was to use it in conjunction with the study guide for the exam. For example - "I went through the study guide and answered the questions. When I could not get something, I searched the keyword on Panopto and listened till my question was explained." The search feature was also utilized for general knowledge development as well, "I used the search feature to fill in some gaps and questions I had about certain topics…" and, "I searched all the topics I was not sure with and used the recordings to address these topics."

Pause was also highly used and indicated for multiple purposes. Foremost was the use of the pause feature to enable notetaking - "I also paused the videos while writing down notes" and "I paused and took notes when I felt something was important or new to me." Pause also was indicated as a feature which would allow a student to control the demands on their cognitive process -"...pause always, he talks too fast" and "I would pause it a lot because that would allow myself time to process the information that I needed." Pause was also indicated as a feature which would help a student switch processing modes, in this case from audio to textual - "(I) paused and read associated captions." Finally, some students used the pause feature in novel ways such as "I would pause the recordings whenever a clicker question appeared and try to answer it."

While captioning was something we originally did to improve searching (Panopto indexes captions for search purposes), students commented heavily on the captions. They indicated using them for navigation purposes - "I would skim through looking for specific parts using the caption feature…," "...to get through the lecture recordings faster, I scrolled through the captions to the key points and definitions." Some also expressed a preference for the captions in comparison to the audio - "I sometimes remember better by reading so captions were helpful," "sometimes I would mute it, listen to music, and read the captions. Professor … had an annoying voice," and "reading the captions if I could not catch everything that was said by listening." The caption text also considered helpful when the text on the PowerPoint presentation was perceived as lacking - "captions are great for definitions he didn't post on the slides," and "to understand and emphasize key points I used the captions a lot, especially for definitions."

Use of an exam study guide was indicated 69 times in the exam study strategies surveys. Much of this use was direct where students took the study guide and searched - "Searched for key terms of study guide" and, "I used the recordings to help me find the answers to the study guide questions." Students also indicated using the lecture recordings as a backup when their notes were insufficient to answer study guide questions - "Whenever I couldn't find an answer to one of the study guide questions … .I would look up the key phrases through Panopto," and "Searched keywords in Panopto when I couldn't answer the study guide using notes."

As per our text analysis, the term Notes appeared almost 90 times in the exam study strategies surveys. Students used the lecture recordings for a variety of notes related purposes. They utilized them to review their notes, fill gaps, and/or to take original notes on the lecture or subject of the lecture.

Reviewing notes and filling gaps was a very popular use of the lecture recordings. Types of behaviors within this review were to double check notes - "I watched the entire recordings while looking at my notes" and "paused to ensure good notes"; fill identifiable gaps - "I used the recordings to complete missing notes," "I watched parts I couldn't find in the book or in my notes"; and clarify notes that were unclear - "When there was something ... in my notes that I didn't understand, I searched for an explanation on Panopto." Further, since we captioned each of the recordings, possibilities like this were enabled - "I used the recordings to go along with my notes, a very helpful feature was typing in the keyword on the left and the exact moment the Prof said that word, popped up!"

Students also used the lecture recordings to take original notes. Students took notes from lecture recordings when they missed a class session - "Since I missed a class, I watched the recording of it and then took notes"; utilized the pause feature to stop the recording to take notes - "(I) paused the lectures to review & take notes on the slides" and "... then pause, take notes ...," and, utilized the lecture recordings to supplement their notes - "Watched the entire recordings and took extra notes."

Besides the strategic uses of lecture recordings to complete the exam study guides and fill gaps in notes to prepare for exams, many students also indicated the use of lecture recordings for deep approaches to learning. Our text analysis identified the use of such terms as Understand (43), Know (19), Clarify (12) and Comprehend (3). Students indicated a desire to understand or comprehend course materials in comments such as - "I used Panopto for the info I didn't understand or needed clarification for," "(I) watched the entire recordings and followed them with the notes I took in class so I could get a deeper understanding of the material," and "I used

the lecture recording to get a better understanding of the information on the slides. A more in

depth understanding."

How non-native English speaking students use lecture recordings. To determine if there was

a difference in how NNES students utilized the recordings we isolated and analyzed their

comments from the exam study strategies surveys. In general the comments from NNES students

were very similar to the student population as a whole with two noticeable differences. These

differences were the amount of times that students mentioned Notes (19) and Guide (12).

In the exam study strategies surveys collected from 204 students, the term Notes was

used 87 times. As the NNES students are a subset of this group, 14 students (7%) accounted for

22% of the use of the term. Further, NNES students accounted for 18% of the use of the term

Guide. Indications of these terms were far higher than Search, where NNES students accounted

for 7% of use, and Pause, where NNES students account for 4% of use. In further analysis of

student comments it appears that they heavily relied on the study guide to determine what they

would study, their notes to review material, and the lecture recordings to confirm or fill-in gaps

in their notes.

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Impact of use of lecture recordings

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While we know that students used the lecture recordings and how they used the lecture

recordings, we also wanted to determine whether or not the use of lecture recordings would have

an impact on student learning. To determine this we looked at a question from the end-of-course

survey, the scores from Exam #1 and Exam #2 and the final course grades. Further we reviewed

results based on various criteria to determine not only if there was an impact but if there were

particular characteristics of lecture recording use that determined impact.

Student self-reports on learning outcomes impact.

In response to research question #3, regarding student reports of impact, students do

indicate that there is a positive impact on their learning outcomes when they utilize recorded

lectures. One hundred and seventy seven students out of 227 (78%) responded to the end-of-

semester survey which asked, among other things, if students felt there was an impact on their

learning outcomes if they utilized recorded lectures. Results on the two questions focused on

student learning are indicated in Table 11 below and demonstrate strong agreement on the

positive impact of lecture recordings.

Table 11.
Student survey responses on impact of use of lecture recordings

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Overall, I feel that the availability of the lecture recordings facilitated the learning process and helped me meet the objectives of the course.	1% (2)	1% (2)	15% (27)	34% (60)	44% (78)
Overall, I feel the availability of the lecture recordings helped me do better in the exams for this course.	1% (2)	1% (2)	14% (25)	37% (66)	42% (72)

In addition to the Likert style questions above we also asked students for their general

comments on the end-of-semester survey. Ninety-eight students responded and we reviewed and

inductively coded their responses multiple times. We attempted to focus on comments that were

direct to their assessment scores or grades or that focused on their overall feeling of learning.

Students frequently commented on how useful the recordings were for studying and exam

preparation, specifically mentioning exam preparation or studying 21 times. While broader in

nature, the word *help* or *helpful* was used 34 times in the student comments. Lastly, eighteen of

the student responses specifically indicated that lecture recordings and/or Panopto should be

available in future and other courses.

Throughout the comments students indicated the broad-based benefits of having the

lecture recordings available. Repeatedly we saw comments that indicated that the lecture

recordings "really benefited and helped me," "were overall very effective," and "were effective

and helped me succeed in the course." While not directly tied to achievement on course

assessments and overall grades, it can be inferred from surrounding comments that many of these

statements were related to course assessment scores and grades. Several students also speculated

about the benefits of the system if they had used them, for example - "I did not see the benefit of

re-watching the lectures but I do wonder what the effect would have been if I did...I think that it

could have a benefit" or indicated that they believed that overall the students in the course

benefitted from them - "great resource in order for students to pass with good grades."

Assessment score indications of impact on learning outcomes.

While the level of student confidence that the use of lecture recordings improved their

learning outcomes is positive, this section addresses research question #4 and reviews impact

based on scores of individual assessments and overall course grades to determine actual effect.

Table 12.
Effect of use of lecture capture recordings on select course assessments.

	Overall	**Overall (No-LC)**	**Overall (LC)**
Exam #1	n=204 mean=17.03 sd=2.81	n=72 mean=16.85 sd=2.86	n=120 mean=17.20 sd=2.84
Exam #2	n=201 mean=16.78 sd=3.35	n=47 mean=15.28 sd=3.53	n=148 mean=17.24 sd=3.17

Note: Differences in overall n and n of No-LC and LC exist as some students did not indicate
whether they used LC or not; Exam #3 was not used given its alternative format

To determine if the difference in exam scores was statistically significant we conducted

separate independent samples t-tests on each exam score for those who indicated use and those

who did not. For exam #1 there was homogeneity of variances, as assessed by Levene's test for

equality of variances ($p = .908$). While those who used lecture recordings scored higher ($17.2 \pm$

2.8) than those who did not (16.85 ± 2.86), the difference $t(190) = .832$, $p = .41$ was not

statistically significant. For exam #2 there was homogeneity of variances, as assessed by

Levene's test for equality of variances ($p = .984$). Those who used lecture recordings scored

higher (17.24 ± 3.17) than those who did not (15.28 ± 3.53); the difference $t(192) = 3.26$, $p =$

$.001$ was statistically significant.

To determine the effect of the use of lecture recordings on overall course grades, we

compared course grades to a variable we created based on students' comments on the exam study

strategies surveys. Three variables were created – never, sometimes, and always. Never indicates

that students did not make use of the lecture recordings for any of the three exams, sometimes

indicates that students indicated use on one or more study strategies surveys but not across all

three, and always indicates that the student used lecture recordings as part of their study process

for all of the exams. Results are in Table 13 below.

Table 13.
Overall use of lecture recordings and final course grades on a 4.0pt scale

	Never	**Sometimes**	**Always**
Overall Course Grade (4.0pt)	n=32 mean=2.97 sd=.84	n=53 mean=3.05 sd=.76	n=101 mean=3.35 sd=.57

Note: Students who did not complete all three exam study strategies surveys were not included

Our overall hypothesis is that if students always used the lecture recordings to prepare for

exams that there would be a positive effect on their overall course grades. To determine this we

conducted a one-way ANOVA on the overall course grade scores (4.0pt scale) and whether

students always used the recordings to study, never used them, or responded that they used them

for at least one exam, but not for all three (sometimes). Data are presented as mean ± standard

deviation, unless otherwise stated. There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .502$), and differences in scores between groups was statistically significant $F(2, 184) = 5.71$, $p < .004$, $\eta^2 = .06$.

Tukey post hoc analysis revealed the difference between the always group, 3.35 $\pm$ .57, and sometimes group, 3.05 $\pm$ .76, was .3 (95% CI, .03 to .57) and was statistically significant ($p = .024$). Additionally, the difference between the always group, 3.35 $\pm$ .57, and never group, 2.97 $\pm$ .84, was .38 (95% CI, .057 to .71) and was statistically significant ($p = .017$). Thus our hypothesis is accepted with an indication of a moderate effect size (Cohen, 1988).

While we are indicating a correlation between use of the recordings and improved assessment scores, there are other factors that may have impacted student performance. For example, students who were highly motivated to achieve high assessment scores may have used the recordings in a further attempt to do so, but lecture recording use may have been incidental to their success rather than fundamental. While they used the lecture recordings, they may have achieved similar assessment scores without them.

As the analysis with viewing behaviors above relies on student self-report data we also wanted to review impacts on course grades with log-file data from Panopto. Table 14 below utilizes a variable we created based on the amount of viewing of lecture recordings through the Fall 2014 semester and course grades on a 4pt scale.

Table 14.
Effect of view amount rankings of lecture capture recordings on course final grades - 4pt scale.

no views (0) or no record	v. rarely (1-10)	rarely (11-24)	occasional (25-49)	frequent (50-99)	v. frequent (100+)
n=46 mean=2.79 sd=.66	n=34 mean=3.13 sd=.75	n=43 mean=3.10 sd=.91	n=47 mean=3.35 sd=.51	n=29 mean=3.52 sd=.47	n=4 mean=3.5 sd=.41

To determine if there was a statistically significant effect, we conducted a one-way ANOVA on the overall course grade scores (4pt scale) and the view amount rankings. Data are mean ± standard deviation, unless otherwise stated. There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .187$) and differences in scores between groups was statistically significant $F(5, 197) = 5.236$, $p < .000$. The effect size score, $\eta^2 = .12$, indicates a moderate to strong effect.

Tukey post hoc analysis revealed the difference between the occasional viewing group, 3.35 ± .51, and no views group, 2.79 ± .66, was .56 (95% CI, .15 to .96) and was statistically significant ($p = .002$). Additionally, the difference between the frequent viewing group, 3.52 ± .47, and no views group, 2.79 ± .66, was .72 (95% CI, .26 to 1.2) and was statistically significant ($p = .000$).

To follow this we also looked at if there would be an impact based on the amount of minutes of lecture recordings viewed. Table 15 below utilizes a variable we created based on levels of viewing minutes through the Fall 2014 semester and course grades on a 4pt scale.

Table 15.
Level of minutes viewed (to the tenth of a minute)

no minutes or no record	v. low (.01-74.9)	below avg (75-149.9)	average (150-299.9)	above avg (300-749.9)	v. high (750+)
n=48 mean=2.82 sd=.67	n=32 mean=3.3 sd=.58	n=30 mean=3.2 sd=.65	n=45 mean=3.2 sd=.86	n=36 mean=3.4 sd=.65	n=12 mean=3.25 sd=.62

Note: Student record indicating less than 1/10 minute view counted as 0 minutes viewed.

Data are mean ± standard deviation, unless otherwise stated. There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .904$) and differences in scores between groups was statistically significant $F(5, 197) = 3.438$, $p < .005$. The effect size score, $\eta^2 = .08$ indicates a moderate effect.

Tukey post hoc analysis revealed the difference between the very low viewing group, 3.3 ± .58, and no minutes/no record group, 2.82 ± .67, was .47 (95% CI, .016 to .932) and was statistically significant ($p = .038$). Additionally, the difference between the above average viewing group, 3.4 ± .65, and no minutes/no record group, 2.82 ± .67, was .58 (95% CI, .14 to 1.02) and was statistically significant ($p = .003$).

When viewing the results in Table 14 and Table 15 we found it important that there are improvements in course grades between the no minutes/no record group and all other groups that used lecture capture at any level. Furthermore, especially in terms of minutes viewed, there is minimal, if any gain, from higher levels of viewing. Thus, viewing the recordings more or using them for more time does not necessarily correlate with increased improvements in assessment scores. This aligns well with the idea of strategic use that students used with the lecture recordings as they focused on searching, using their study guides, clarifying notes, etc.

Indications of impact on learning outcomes for NNES students.

Research question #5 focused on the potential benefits of lecture recordings for non-native English speaking students. As the end-of-semester survey was anonymous, we do not have data to indicate how NNES students felt about the use of lecture recordings in regards to their ability to do well on course assessments and learning goals. Further, because all NNES students indicated using the lecture recordings we cannot compare use and nonuse among NNES students. However, we can indicate how well they did on course assessments. Table 16 below indicates how NNES students did in comparison to their peers on each exam and on their overall course grade.

Table 16.
English proficiency and course assessments and grades.

	Exam #1 (25pt)	Exam #2 (25pt)	Exam #3 (25pt)	Overall Course Grade (4.0pt)

English 1st Language	n=164 mean=17.12 sd=2.83	n=161 mean=16.88 sd=3.11	n=162 mean=21.34 sd=1.53	n=163 mean=3.18 sd=.66
English 2nd Language, but as strong as 1st	n=26 mean=17.08 sd=2.64	n=25 mean=16.64 sd=4.15	n=26 mean=21.35 sd=1.74	n=26 mean=3.00 sd=1.02
English 2nd Language	n=14 mean=15.93 sd=2.89	n=14 mean=16.57 sd=3.52	n=14 mean=21.36 sd=1.15	n=14 mean=3.21 sd=.67

Notes. All NNES students reported using lecture recordings, but log files indicate that two students did not use the lecture recordings in preparation for Exam #1; Use of lecture recordings was based on an indication of use for at least one exam, not necessarily for all exams.

While NNES students did not do better on course exams, they were able to achieve very similar results, especially on exams #2 and #3, to their native English speaking peers. This despite known issues with language comprehension, confusion over organization of the lecture and style of the lecturer (Allison & Tauroza, 1995; Dudley-Evans, 1994; Dunkel & Davis, 1994; Flowerdew & Miller, 1992; Flowerdew, 1994; Huang 2004; Miller, 2007; Olsen & Huckin, 1990; Tauroza & Allison, 1994). Thus we can speculate that the use of lecture recordings by NNES students, based on their responses on the exam study strategies surveys and Panopto log-files, that the recordings had a positive effect. This is perhaps best summed up by one student's comment - "Panopto is the most useful thing when preparing for an exam. When I have some questions about the study guide, I go to Panopto to find the answer."

Conclusion

Based on the results above it can be concluded that:

- Students will use lecture recordings if made available and they see relevance in their use (e.g. using the recordings = higher exam scores).

- Students feel that the lecture recordings help them to do better on course assessments and with learning course material.

- Students who utilized the lecture recordings achieved higher assessment scores and overall outcomes than those who did not.

- Students use the lecture recordings strategically to study and learn. Specifically, they do not view entire recordings, but use features such as search to locate what they need, pause to take or clarify notes, and captions to read and navigate.

- NNES students utilize lecture recordings to a slightly higher degree, but generally in the same way as their peers who are native English speakers. They value having the lecture recordings and are able to use them to do well on course assessments.

While many previous studies have explored if and how students use lecture recordings, this study attempted to create as comprehensive picture as possible of use and impact in this particular course. Our results generally aligned with the literature we reviewed. The number of students who used recordings and the reasons they used recordings were similar although we found a higher percentage of overall student use. Further, the positive impact of lecture recording use that we found aligned most closely with the impact indicated in studies where course content was in the social science disciplines.

One particular finding in our study that we believe is important in understanding the use and benefit of lecture recordings is *how* students utilize the recordings. While some may believe that more use (in terms of views or duration of viewing) is important, we found that strategic student use of the lecture recordings was the most impactful. Very few students "binge" viewed recordings, instead most used the recordings as needed. They employed search strategies to discover content they needed to learn or review, paused to clarify their notes, etc. Their study and learning strategies were generally not of a surface nature of frequent viewing of entire recordings, but rather strategic use of parts of the recordings. Overall, it appears that they heavily

relied on the study guide to determine what they would study, their notes to review material, and the lecture recordings to confirm or fill-in gaps in their notes.

This understanding of student use will help us in the future as we continue to refine our methods of recording and distributing lecture content. It will also help us as we develop approaches to train students to make impactful use of the recordings. For example, we need to ensure that the recordings are searchable, both individually and across all the recordings so that students can find what they need. We also need to ensure that they are aware that they can search and show them how to most effectively do so.

Finally, in the literature review students indicated that the lecture recordings provided them with a sense of control over how they learned. They were aware that the lecture recordings were available so they knew they could focus on paying attention in class or could go back to the recordings to affirm or modify content in their notes. We saw this sense of control as well both in the use of the lecture recordings by the students and from their survey comments. Thus, while we see direct evidence that recordings helped students, there also seems to be an effect on student self-efficacy to succeed in the course because of the availability of the lecture recordings. While we have some anecdotal evidence of this from student reports, it is a potential area for future research to confirm and gauge the impact.

While we believe the results from this study are generalizable to other large lecture hall courses, we also know that courses are conducted using multiple methods and that not all the lessons learned from this study will be applicable to other situations. Therefore, we hope to continue this research and focus on several areas including: 1. Courses with lower enrollment numbers that still have a significant lecture component; 2. Courses that use recordings for

primary delivery of content such as in online or "flipped classroom" hybrid model courses; and,

3. Student use of recordings in mobile setting such as through tablet or mobile phones.

Chapter 3: Training Students to Effectively Use Lecture Recordings

Lecture is frequently used 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 (Flowerdew, 1994; Huang, 2004). In a study conducted by Mulligan & 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 the content presented as part of their learning and study strategies. The methods of recording include lecture capture, screencasting, podcasting, and the creation of e-lectures or voice-over-PowerPoints (VOPP). While recording and delivering lectures to students for both primary and supplementary viewing is not new, research articles utilizing 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 present 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). Thus, what we are facing is similar to the findings of Bates and the

Audio-Visual Media Research Group at the UK Open University in 1981 when they concluded

that "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 in 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 reveals that students appreciate having lecture recordings available and believe that

using the recordings helps them with course assessments. However, 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). A review of the literature also indicates that although many instructors/schools capture

recordings and make them available to students, very few train students on how to effectively

utilize them for studying and learning.

For this study we trained students to use a technique, self-explanation, to utilize with the

lecture recordings when preparing for course assessments. Self-explanation involves generating

explanations to oneself which facilitates the process of integrating new knowledge with existing

knowledge (Chi, Bassok, Lewis, Reimann, & Glaser, 1989). Self-explanation has been 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 at the School of Communication and Information (SC&I) at Rutgers University. In past 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 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 improve 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

This section focuses specifically on the measured impact on learning outcomes from the availability and use of recorded lectures. The following studies are all based on large lecture hall courses and all measured the impact on learning outcomes based on student surveys, course

assessments such as exam scores, homework problems, and/or the end-of-term grade. Each study was unique in subject area, study methodology, and interpretation of factors that determined impact. Overall, results on student learning outcomes are mixed.

The availability and use of lecture recordings has been shown to improve student achievement on course assessments (Cramer, Collins, Snider & Fawcett, 2006; Molnar, 2011; Vajoczki, Watt, Marquis, Liao, & Vine, 2011). A positive impact, with a 9% increase in two midterm exam scores, was indicated in an Introduction to Psychology course (Cramer, et al., 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 utilized the VLH more heavily moderate use gains were seen across both groups. Vajoczki, et al. (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 in scores and reported knowledge happened across social science and science disciplines and for both 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 that there was no significant difference in outcomes when students had access to recorded lectures. (Euzent,

Martin, Moskal & Moskal, 2011; Owston, Lupshenyuk, & 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, students can obtain a certain level of proficiency without being present. This speaks to the long held concern of increased absenteeism due to recorded lectures, which, although accurate, seems to have little effect on student outcomes provided students have access to and use 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 was a mathematics course, and the authors indicated that the viewing of recorded lectures was perhaps not well suited for learning skills 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 the research literature, 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). Self-explanation theory traces back to 1989 and Chi, Bassok, Lewis, Reimann, & 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 that were presented to them. Since then, many studies 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: a) math (Atkinson, Renkl, & Merrill, 2003; Berthold, Eysink, & Renkl, 2009; Hodds, Alcock, & Inglis, 2014; Rittle-Johnson, 2006); b) science (Chi, et al., 1989; Chi, Leeuw, Chiu, & LaVancher, 1994; Ionas, Cemusca, & Collier, 2012; O'Reilly, Symons, MacLatchy-Gaudet, 1998); and, c) 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.

While the primary areas of research on self-explanation have focused on the math and science subject areas, most, including Huang & Reiser's (2012) work in language arts, have utilized self-explanation to enable students to more deeply learn and apply skills, techniques, and concepts to a situation or problem. In our study in the Communication 101 course, we hypothesized that self-explanation would enable students to internalize theories and concepts and then apply them to examples of real-world situations on course assessments.

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; Huang, et al. 2012), receive low-level prompts (Huang & Reiser, 2012), or receive 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 to determine 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 this 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 (Communication 101) course at Rutgers University in the Fall 2014 semester with a final enrollment of 227 students. Communication 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 within 24 hours of the conclusion of the class session via a link in the course management system (CMS) and all students were given a viewer-only account to the Panopto (Panopto - http://www.panopto.com) lecture capture system 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.

As confirmed by past surveys and comparison to Rutgers institutional planning data, students in the Communication 101 course are representative of the population students at

Rutgers University (Rutgers University, 2015). Table 17 indicates a comparison of the

demographics of Communication 101 to Rutgers University students:

Table 17.

Demographic comparison of Communication 101 students to Rutgers University students

	Gender	**Race/ethnicity**
Communication 101 Students	Male - 40.7% Female - 58.3%	Caucasian (non-Hispanic) - 36.1% Asian/Pacific Islander - 27.8% African American (non-Hispanic) - 16% Latino/Hispanic - 12.4% Other - 7.2%
Rutgers University Students	Male - 47.2% Female - 52.8%	White - 42% Asian - 20% Latino - 13% African American - 10% Foreign - 9% Other - 6%

Note: Race/Ethnicity categories were different between our demographic survey and the approach that Rutgers University uses

Method

In the third week of the semester each student in the Communication 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 a learning

strategies survey - the brief version of Entwistle's (2000) Approaches and Study Skills Inventory

for Students (ASSIST).

This mixed-methods study was conducted in two phases. Phase 1 addressed traditional

questions focusing on overall lecture recording 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 captioned each recording, read along with the lecture.

In phase 2, beginning in week #8 of the semester, two weeks prior to exam #2, students were randomly assigned to either a treatment or control group and were invited to complete a brief lesson and activity. At final analysis, 58 students who were participating in the study fully participated in the treatment activities, while 57 students fully participated in the control activity. Table 18 indicates demographic characteristics and shows the homogeneity between each group. For comparison, the table also indicates the characteristics of those who participated in the study but did not participate in the intervention activities.

Table 18.
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**
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
Control group	M: 20 F: 36	0-12: 25 13-30: 11	Y: 10 N: 27	SD: 2 D: 2	Deep: 18 Strategic: 32

n=57	Prefer no answer: 1	31-60: 13 61+: 8	U: 19	N: 28 A: 21 SA: 4	Surface: 6
Non-participant group n=89	M: 42 F: 46 Prefer no answer: 1	0-12: 47 13-30: 15 31-60: 15 61+: 11	Y: 24 N: 38 U: 27	SD: 2 D: 7 N: 36 A: 34 SA: 9	Deep: 42 Strategic: 42 Surface: 3

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

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 into study approaches with lecture recordings. The control group received training on features of the lecture capture system (e.g. navigation, search, captions). We provided each group with training and an activity to help control for issues of compensatory demoralization, compensatory rivalry and diffusion of treatment (Creswell, 2009). Training for each group was delivered as an embedded lesson in the CMS utilizing an e-learning object for content delivery and a follow-up activity which allowed for student practice and to verify how well those in the treatment group were able to use self-explanation. Appendix C contains screenshots of what students in the treatment group viewed in the CMS. The content of both the treatment and control activities was based on the Shannon & Weaver Model of Communication which is a fundamental theory in the field of Communication. Successful completion of the treatment or control activity resulted in a very small amount of extra credit.

Throughout the study multiple types of data were captured at multiple points in time. The most applicable items for the research questions addressed here come from the exam #2 scores, scores on the Shannon & Weaver Model of Communication questions (Appendix D) from exam #2, exam preparation surveys, and Panopto server log-files. Exam #2 was the assessment most aligned to explanation and analysis and was conducted shortly after the intervention activities.

Thus, it was selected to be used to determine the efficacy of our self-explanation training intervention. To explore impact in further detail, results of two questions on exam #2 on the Shannon & Weaver Model of Communication that were aligned with the treatment and control activities were also analyzed.

Results

Overall Effectiveness of the Use of Lecture Recordings

To contextualize the results from the intervention activities, this section indicates the impacts of the overall use of lecture capture on Exam #2 results. Table 19 below shows student's self-reported use of the lecture recordings from the exam #2 preparation survey and the mean scores and standard deviations for the exam. Exam #2 was scored on a 25pt scale.

Table 19.
Effect of reported use of lecture capture recordings on Exam #2 outcomes.

	Overall n=200	**Overall** **(No-LC)** n=46	**Overall** **(LC)** n=148
Exam #2	mean=16.83 sd=3.3	mean=15.48 sd=3.3	mean=17.24 sd=3.2

Note: Five students did not indicate whether or not they used LC; one outlier was removed from the No-LC area.

We conducted an independent samples t-test on the reported use of the lecture capture recordings and the student's score on exam #2. There was one outlier in the data as determined by inspection of a boxplot. The outlier was removed as the student worked with the instructor to drop the exam grade from the final grade. There was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .984$) and there was a statistically significant difference in mean exam #2 scores between those who reported use of lecture recordings and those who did not, $t(192) = 3.258$, $p = .001$, $d = .55$. To assess the size of the effect of using the

lecture recordings, we calculated a *d* score. The value of .55 is generally considered to indicate a

moderate sized effect (Cohen, 2013).

Self-explanation Intervention Results

While we see that use of lecture recordings had a moderate impact on exam scores, this

study attempted to determine if the training intervention on the use of self-explanation would

have an effect on how students utilize lecture recordings and if there would be further

improvements in student learning as evidenced by assessment scores.

Effect on Lecture Recording Use. Upon comparing the results of the exam preparation

surveys of exam #2 to exam #1, no specific mention of self-explanation or indication of a rise in

deep learning or studying behaviors was found. There was an increased indication of lecture

capture use as indicated by the Panopto log-files (Table 20), but overall *how* the system was used

was less affected than *that* it was used.

Table 20.
Viewing totals for 48 hours prior to exam till beginning of exam.

Exam	Viewing Dates	Total Views	Unique Viewers
1 - 10.2.14	9.30.14 - 10.2.14	922	101
2 - 11.6.14	11.4.14 - 11.6.14	1858	126

Note. Views of <10 seconds and views by course instructor and systems administrators removed.

Impact on Course Assessment Scores. Table 21 below indicates the results for the

treatment and control groups for the overall score on exam #2 and for the two exam questions

specific to the Shannon & Weaver Model of Communication. For comparison, the table also

indicates the results for those who participated in the study but did not participate in the

intervention activities.

Table 21.
Effect of training on self-explanation on select course outcomes.

	Non-participants or incomplete n=85	Control (How to…) n=57	Treatment (Self-explanation) n=58
Exam #2	mean=15.94 sd=3.3	mean=17.7 sd=3.2	mean=17.28 sd=3
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

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 outlier was removed in the non-participants group and 3 other students in the non-participant category did not take or had no score for exam #2.

Our original hypothesis was that students who completed training on self-explanation would achieve higher exam scores than those who did not receive the training. A visual comparison of mean scores of the treatment group (17.28 ±3) and the control group (17.7 ±3.2) indicate a rejection of this hypothesis. Comparing the results of student correct responses to the two exam questions on the Shannon & Weaver model of communication also indicate a rejection of the original hypothesis.

While our original hypothesis appears to be rejected, we do see what appears to be significant differences between the non-participant group and the control and treatment groups. To verify the rejection of our original hypothesis and to determine if there are statistically significant differences between the non-participant and control and treatment groups, we conducted a one-way ANOVA on the exam #2 scores and the three groups of students. There was one outlier in the data as determined by inspection of a boxplot. The outlier was removed as the student worked with the instructor to drop the exam grade from the final grade. Data are mean ± standard deviation, unless otherwise stated. There was homogeneity of variances, as

assessed by Levene's test for equality of variances ($p = .298$) and differences in scores between

groups was statistically significant $F(2, 197) = 6.002$, $p < .003$, $\eta^2 = .057$.

Tukey post hoc analysis revealed the difference between the treatment group, 17.28 $\pm$ 3,

and control group, 17.7 $\pm$ 3.2, was -.43 (95% CI, -1.83 to .98) and was not statistically significant

($p = .754$). Thus our hypothesis is rejected. In viewing relationships between the other groups,

there was an increase in the exam #2 score from 15.94 $\pm$ 3.3 in the non-participant group to

17.28 $\pm$ 3 in the treatment group, 1.4 (95% CI, .05 to 2.6) but this was not statistically

significant ($p= .039$). However, there was an increase in exam #2 scores from 15.94 $\pm$ 3.3 in the

non-participant group to 17.7 $\pm$ 3.2 in the control group, an increase of 1.8 (95% CI, .47 to 3.1),

which was statistically significant ($p = .004$).

To evaluate if the students in the control group were predisposed to achieve higher

assessment scores based on their choice to participate in the intervention activities, we reviewed

the results for Exam #1 across the non-participant, control, and treatment groups. Results are

available in Table 22 below. The results indicate that the control group was not more likely to

score higher on course assessments.

Table 22.
Results of Exam #1 for intervention and non-participant groups

	Non-participants or incomplete n=89	**Control (How to…)** n=57	**Treatment (Self-explanation)** n=58
Exam #1	mean=17.11 sd=3	mean=16.91 sd=2.6	mean=17.03 sd=2.8

Looking at the demographic characteristics from Table 2 *Demographic characteristics of*

students in treatment and control groups. in the Setting section above, the only difference that

stands out between the control group and non-participant (and treatment) group is that those in

the control group scored more as those who took a strategic (vs. deep or surface) approach to

studying and learning on the brief version of Entwistle's (2000) Approaches and Study Skills Inventory for Students (ASSIST).

Finally, we decided to look at whether participating in the intervention (regardless of treatment or control group) would have a statistically significant impact on Exam #2 scores when compared to those who did not participate. A linear regression established that participating in the intervention could statistically significantly predict scores on exam #2, $F(1,198) = 11.52$, $p <$ .001. However, as indicated by the adjusted R^2, participation in the intervention accounted for 5% of the effect on exam #2 scores.

Conclusion

Based on the analysis above it can be concluded that:

- Students who utilized the lecture recordings achieved higher assessment scores than those who did not.

- Students who received training in self-explanation did not indicate a change in their approaches to learning/studying and did not achieve higher assessment scores.

- Students who received training in self-explanation did not achieve improved assessment scores in comparison to those who received training on how to effectively use the lecture recording system.

- Students who received further training on how to use the lecture recording system to study/learn achieved higher, but not statistically significant, assessment scores than those who received training in self-explanation. However, these students did achieve statistically significantly higher results than the non-participant group who received no training whatsoever.

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 improved outcomes. Instead, it seems that it was more beneficial to train students to effectively use the lecture recording system.

While we are encouraged that students can achieve improved outcomes by using lecture recordings, and that training in how to utilize the lecture recording system can have a significant effect, we also want to explore possible explanations as to why the training on self-explanation did not result in improved outcomes. While there are several possible explanations for our findings, two in particular are explored here in more detail: (a) the effectiveness of our training on self-explanation; and, (b) student perceptions of the best way to study for course assessments.

While we attempted to create an effective training approach by indicating to students that self-explanation is a highly effective study strategy and by providing students with a practice exercise on self-explanation (Appendix C), the training may not have been sufficient to convince students of its effectiveness and to incorporate the practice of self-explanation into their study and learning strategies. The training may have been more effective if we had repeated it over a period of time using multiple examples or if we had added self-explanation prompts to resources such as the exam study guide.

Additionally, upon review of the training approaches used in the literature, especially those approaches indicated in the research by Bielaczyc, et al. (1995), Hoods, et al. (2014), and Huang and Reiser (2012), we've determined that one element of our training may have been insufficient. In our analysis of the literature, we identified three elements of effective training on

self-explanation: (a) it must indicate to students that self-explanation is a highly effective

learning and study strategy; (b) it should be simple and brief, and (c) it should include practice

time so that students can effectively incorporate self-explanation. While we built all three of

these elements into our training intervention, one criterion we missed was the use of repeated

examples within the training intervention. In each of the studies indicated, there were multiple

examples of self-explanation in the training. For example, in Hodds, et al. (2014) a mathematical

proof was used as an example and self-explanation was used as each line in the proof was

reviewed. Thus, students had reinforcement of how self-explanation was applied. In our

intervention, we instead used one example before directing students to the practice exercise.

   In addition to the limitations of our training approach, student perceptions of the best

study techniques for the types of assessments in the course (objective exams) were perhaps not

aligned to their judgement of the benefits of self-explanation. They may have considered self-

explanation to be something more useful for deeper, analytical approaches to learning, perhaps

something they would need for an essay exam, instead of memorization which they determined

necessary for the objective exams. While self-explanation promotes memory, it appears that

students did not make the connection between self-explanation and memory and instead returned

to their traditional approaches to studying. Therefore, being able to search, find, play, pause,

replay, etc. in the lecture recording system may have seemed a more valuable approach to

students than trying to have a deep understanding of content. With this explanation it is

understandable that those students who received training on how to effectively utilize the lecture

recording systems were able to achieve higher assessment scores than those who did not receive

training. Essentially, these students were able to better incorporate the lecture recordings into the

study and learning techniques that they already utilized to prepare for objective exams.

      Based on the findings of this study, further research is needed to determine applicable

training techniques to enable students to effectively utilize lecture recordings to study and learn.

The results of this study tend to indicate that one approach may be to train students to

incorporate the lecture recordings into their present approaches. However, given the identified

limitations with the self-explanation training technique, it would be worth revising the training

and trying it again. If either or both approaches to training prove effective, it would then be

helpful to confirm these results by utilizing training in various types of courses that utilize

lecture recording.

Chapter 4: Student Use of Captions when Using Lecture Recordings for Studying and Learning

Lecture is a frequently 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 (Flowerdew, 1994; Huang, 2004). In a study conducted by Mulligan & 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. More broadly, 22% of students overall (English speaking and NNES) indicated that they "did not understand a lot" (Mulligan & Kirkpatrick, 2000, p. 316).

Why do students have a difficult time learning from lectures? The literature on NNES students provides a good overview of the problems and reasons to consider a student's ability to academically *listen,* a critical skill for academic success. Lectures are usually conducted for 45 minutes or longer and present a multitude of challenges to listening comprehension. Beyond problems of language, NNES students often face challenges: 1) discerning the organization of lectures (Miller, 2007; Olsen & Huckin, 1990) or the cues (discourse markers) that instructors use (Allison & Tauroza, 1995; Dudley-Evans, 1994; Dunkel & Davis, 1994; Flowerdew & Tauroza, 1995), so they are unsure of what is important and what is not, and, 2) they are often challenged by the delivery style of the lecturer who speaks too fast, has a heavy accent or speaks in too informal a manner (Arden-Close, 1993; Flowerdew, 1994; Flowerdew & Miller, 1992; Flowerdew & Miller, 1996; Huang 2004; Miller, 2007).

Many of the problems of learning from lectures faced by NNES students are shared by students in general as reflected in the literature on student note-taking. While note-taking is an important skill for academic success, and students acknowledge the need for good notes to recall

the lecture and do well on examinations (Badger, White, Sutherland & Haggis, 2001; Hartley &

Marshall, 1974), students do not take effective or sufficient notes (Kiewra & Kieuwra, 1987;

Titsworth & Kiewra, 2004). Multiple studies indicate that students record less than 50% of

important lecture points (Kiewra, 1985; Kiewra, DuBois, Christian, & McShane, 1988). Some

identified reasons for this include lecture rate, organization of the presentation, lack of verbal or

visual cues to help discern what information is important, inattentiveness, and manipulation of

information in working memory (Kiewra & Kieuwra, 1987).

One approach that institutions are adopting to help students learn more from lecture has

been to record lectures so that students can review the content presented as part of their learning

and study strategies. The methods of recording include lecture capture, screencasting,

podcasting, and the creation of e-lectures or voice-over-PowerPoints (VOPP). While recording

and delivering lectures to students for both primary and supplementary viewing is not new,

research articles utilizing 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).

Since Spring 2013, multiple facets of lecture recording and use have been studied at the

School of Communication and Information (SC&I) at Rutgers University. At the conclusion of

each semester we have administered a survey to students to determine how and why they used

the lecture recordings and also to see what we could do to improve access and use of the

recordings. Examples of changes we have made over the semesters:

1. The course instructor switched from the Prezi presentation software to PowerPoint as

   Panopto indexes PowerPoint slide content and uses slides and slide titles for navigation

   (See Appendix E. for visual of the navigation within a Panopto recording).

2. Modified our approach to presenting recordings to students via the class' site in our course management system to provide easier or more direct access.

3. Established a method so that all students receive viewer accounts that require them to log-in. This enables us to track and analyze their use of recordings so that we do not have to rely solely on student self-reports of use.

In a comprehensive study, conducted in the Fall 2014 semester, we expanded our usual approach and explored student use, impact of use, and the impact of training students to use lecture recordings. We knew from previously collected student surveys that Search was a commonly used feature in the lecture recording system. In order to ensure the best possible results when students searched the lecture recordings, we decided to caption the recordings as captions would be indexed and would thus render the recordings more searchable. In this study we did not set out to study how students used captions. Instead we focused on overall use of lecture recordings, effectiveness of lecture recordings for studying and learning, and to determine if we could train students to more effectively use recordings. In other papers we have reported on these results; here we focus on an unintended finding of how students utilized captions with the lecture recordings as we witnessed uses of the captions that were beyond, in scale and scope, the use that we had expected. While our findings are promising, more research is needed to both confirm our results and to further explore student use of captions with lecture recordings.

Study

Setting

This study took place in one section of the Introduction to Communication (Communication 101) course at Rutgers University in the Fall 2014 semester with a final enrollment of 227 students. Communication 101 is required for anyone who wants to major in Communication and fulfills several general education requirements at Rutgers University. As

confirmed by past surveys and comparison to Rutgers institutional planning data, students in the

Communication 101 course were representative of the population students at Rutgers University

(Rutgers University, 2015). Table 23 indicates a comparison of the demographics of

Communication 101 to Rutgers University students:

Table 23.
Demographic comparison of Communication 101 students to Rutgers University students

	Gender	**Race/ethnicity**
Communication 101 Students	Male - 40.7% Female - 58.3%	Caucasian (non-Hispanic) - 36.1% Asian/Pacific Islander - 27.8% African American (non-Hispanic) - 16% Latino/Hispanic - 12.4% Other - 7.2%
Rutgers University Students	Male - 47.2% Female - 52.8%	White - 42% Asian - 20% Latino - 13% African American - 10% Foreign - 9% Other - 6%

Note: Categories of Race/Ethnicity were different between our demographic survey and the approach that Rutgers University uses

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 within 24 hours of the conclusion of the

class session via a link in the course management system (CMS) and all students were given a

viewer-only account to the Panopto (Panopto - http://www.panopto.com) lecture capture system

using their university credentials to access the recordings. Captions for each recording were

created using 3Play Media (http://www.3playmedia.com/) and captions were uploaded into the

Panopto system generally within 72-96 hours after the recording was created. After uploading,

captions were automatically indexed. An example of what students would see when viewing a

lecture with captions is available in Appendix F. Note that the Captions tab is not selected by

default, students must select it to see the captions. A separate text transcript was not provided.

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. For

each exam there was a review session, which was recorded and made available, and students

were provided with a study guide to use for exam preparation.

Method

In the third week of the semester each student in the Communication 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 and a demographic survey. Table 24

provides further details about the Communication 101 students and indicates results from the

demographic survey.

Table 24.
Demographic characteristics of study participants from the Communication 101 course.

Credits earned prior to course	0-12 13-30 31-60 61+	99 38 41 25
Prior Interest in course or subject	Strongly Disagree Disagree Neutral Agree Strongly Agree	6 12 83 82 20
English Proficiency	English 1st Language:	164

| | English 2nd Language, but as strong as 1st | 26 |
| | English 2nd Language | 14 |

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

The provision of recordings 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. 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 captions created, read along with the lecture.

Throughout the study multiple types of data were captured at multiple points in time. The most applicable items for this article come from the initial demographic survey, exam #2 scores, final course grades (4pt scale), exam study strategies surveys, and end-of-course survey. The results on exam #2 and final course grade focused on the impact of student use associated with the lecture recordings and captions. Exam #2 was selected as it is considered the most difficult exam and focuses on explanation and analysis. The exam study strategies surveys, conducted after each exam, 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 and captions but how they used them. Finally, the end-of-course survey contained two Likert style questions on use and perceived value of the captions and also an open-ended question where students could share comments on the lecture recordings.

Results

Student use of lecture recordings.

To provide a context for the use of captions, this section will provide an indication of overall use of the lecture recordings. The Panopto lecture capture system provided log-files available in a comma-separated value, .csv, format. There were two log-files available - views and breakout. Views is a listing of each recording with an indication of when it was viewed, who viewed it, and the duration of the view. Breakout is a listing by viewer (student) of amount of views, minutes viewed, and average viewing time. Both types of log files from the Panopto server were downloaded and analyzed. Log files indicate that the recordings were heavily utilized, especially on the days immediately preceding the exam. There were 227 students on the final roster for the course. In total these students account for 5,854 views totaling 52,354 minutes of viewing of lecture recordings.

Fifty seven percent of total viewing clustered around course examinations. Exams for the course were held on 10.2.14, 11.6.14, and 12.2.14. Table 25 below indicates the usage of lecture recordings for the two days prior to the exam and up to 5:00 PM the day of the exam. Breakdowns of views and unique viewers is below. Exam #2 is considered the most difficult in the course as it focuses on application of theories and concepts and is also the exam in which we applied a training intervention using either self-explanation or more detailed system training. Exam #3 is conducted in an alternative format where students answer questions using an iClicker audience response device and students have 45 seconds in class to collaborate on potential answers before answering. While students have this time to debate answers/choices, exam scores are still individually assessed.

Table 25.

Viewing totals for two days prior to exams till beginning of exam.

Exam	Viewing Dates	Total Views	Unique Viewers
1 - 10.2.14	9.30.14 - 10.2.14	922	101

2 - 11.6.14	11.4.14 - 11.6.14	1858	126
3 - 12.2.14	11.30.14 - 12.2.14	585	78

Note. Views of <10 seconds and views by course instructor and systems administrators removed.

Student use of captions.

To determine if and how students used captions we looked at questions from the end-of-course survey and the responses on the three study strategies surveys. One hundred and seventy seven students out of 227 (78%) responded to the end-of-semester survey. One question asked students to respond to the prompt - "I utilized the caption/transcription feature of the lecture recording system." 75% (132) students responded Yes. As was indicated previously, students were not automatically presented with captions. To use the caption feature, students had to take an action (clicking on the caption tab in the viewer), to see them.

In addition to the Likert style question we also asked students for their comments on their study approaches and use of the lecture recordings on the end-of-course survey and on the exam study strategies surveys we administered after each exam. The specific use of captions were indicated 107 times and students frequently wrote how useful they were with comments such as "The captions helped a lot" and "(I) always had the captions on."

We reviewed student responses multiple times and inductively coded and refined our code set. We categorized responses into four main areas: Navigation - comments specific to utilizing the captions for navigational purposes; Multi-modal/Reading - student use of captions to make use of the text or read instead of listen; Clarification - use of caption text to clarify/complete notes; and, Other - comments which did not fit into the other categories, but which were deemed important to understanding student use.

One of the most frequent uses of captions was for navigation purposes. While there were multiple ways to navigate through the set of recordings and each recording individually, students surprised us with their creative use of the captions to locate what they needed. Several students indicated their discovery of the original purpose of the captions, to increase searchability - "The captions were highly useful because I could find exact keywords from lectures." Other students utilized captions for a browse based approach - "I would skim through looking for specific parts using the caption feature…" and, "I liked the "captions" because I could skim through to see what I needed." Yet other students indicated utilizing the captions to increase their speed of finding what they needed - "...get through the lecture recordings faster, I scrolled through the captions to the key points and definitions" and, "...utilized the caption ability in Panopto to quickly find the time frame where...used the word." Finally, students indicated using the caption features to focus only on what they needed - "I went through the caption features so that I can only listen to what I really needed."

Many students also expressed a preference for the caption text in comparison to the audio. Multiple students indicated that they "read along" with the lecture recordings. Sometimes this was for pragmatic purposes "When unable to hear audio (bc I was at work) I used the captions." Some of these students indicated doing this because of the instructor's vocal delivery - "sometimes I would mute it...and read the captions. Professor … had an annoying voice" and, "I used the captions a lot...he talks too fast." Some students even went as far as to indicate a personal learning style preference - "...I sometimes remember better by reading so captions were helpful."

The captions were seen as especially helpful for clarification processes. One term that frequently appeared was "definitions" - "captions are great for definitions he didn't post on the

slides" and "to understand and emphasize key points I used the captions a lot, especially for definitions." Many students also indicated using the captions to help with their notes. Either to fill in gaps "...having the lecture transcribed made it so much easier to fill in the holes in my notes" and "I watched the entire recordings while looking at my notes. I loved the caption features because it helped point out things Nick said that I did not catch before." Or, to take original notes "I mostly used the caption feature and read every single word, and then took notes." Many also indicated use for general clarification purposes - "I was on the caption, just to make sure I was getting every, all the words correct."

In addition to the uses above there were some comments that indicated insightful or novel approaches to use. Some students indicated using the caption as a way to control their ability to ingest content - "I was overwhelmed...stuck to the captions," "...sometimes I felt distracted in class and it really helped me out on the days that I felt like this" and, "It made the content more easily accessible when I needed it." Other students indicated ways they used the captions as part of their study process aside from note taking or clarification - "I would read along and use the text to make flash cards that I could later study from," and "retyped the text /reading along and copy and pasted text."

Impact of using captions.

Based on the end-of-course survey students believe that the captions helped them to learn course content. Further, based on assessment results, use of the captions did improve student assessment scores. Table 26 indicates responses from the end-of-course survey and Table 27 indicates impact on assessment scores.

Table 26.
Response to end-of-course survey question - The captions/transcriptions helped me to learn the content of the course and do better on course exams.

Not Applicable	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
7% (13)	5% (9)	2% (4)	29% (51)	27% (48)	29% (52)

Note. A total of 177 students responded to this survey question.

While the level of student confidence that the use of captions improved their learning outcomes is positive, we also see this impact based on scores on exam #2 and the overall course grades. To review this we focused on the exam #2 study strategies surveys as exam #2 is generally considered the most difficult exam in the course. Only students who explicitly indicated the term "caption(s)" in their survey response were added to the Lecture recordings and captions group.

Table 27.
Effect of use of lecture capture recordings and captions on select course assessments.

	Neither lecture recordings nor captions	Lecture recordings use but not captions	Lecture recordings and captions
Exam #2 (25pt)	n=53 mean=15.66 sd=3.26	n=118 mean=17.03 sd=3,13	n=29 mean=18.17 sd=3.23
Course Grade (4pt)	n=53 mean=2.92 sd=.79	n=118 mean=3.19 sd=.7	n=29 mean=3.5 sd=.44

Note: n=200 based on number of students with available exam #2 scores.

We were curious to see if the use of captions would impact student assessment scores. Given the student comments and their belief that the captions did help, our hypothesis is that if students utilized the captions when studying that there would be a positive effect on their overall course grades. To determine this we conducted a one-way ANOVA on exam #2 scores and the overall course grade scores (4.0pt scale) and whether students indicated that they used neither lecture recordings nor captions, used lecture recordings but not captions, or used lecture recordings and captions.

For exam #2 data are mean ± standard deviation, unless otherwise stated. There was homogeneity of variances, as assessed by Levene's test for equality of variances (p = .98) and differences in scores between groups was statistically significant F(2, 197) = 6.383, p < .002, η^2 =.06, indicated a moderate effect size. Tukey post hoc analysis revealed the difference between the lecture recording/no captions group, 17.03 ± 3.13, and the neither group, 15.66 ± .3.26, was 1.36 (95% CI, .12 to 2.61) and was statistically significant (p = .027). Additionally, the difference between the lecture recording/captions group, 18.17 ± 3.23, and neither group, 15.66 ± .3.26, was 2.51 (95% CI, .78 to 4.25) and was statistically significant (p = .002). When comparing the lecture recording/captions group, 18.17 ± 3.23, to the lecture recordings/no captions group, 17.03 ± 3.13, the difference was 1.147 and was not statistically significant (p=.193). Thus our hypothesis is partially accepted as use of lecture recordings and captions made a significant impact between lecture recording/caption use and no use, but did not make a significant impact between the lecture recording/caption group and the lecture recording/no caption group.

For final course grades data are mean ± standard deviation, unless otherwise stated. There was homogeneity of variances, as assessed by Levene's test for equality of variances (p = .148) and differences in scores between groups was statistically significant F(2, 200) = 6.945, p < .001, η^2 =.06, indicating a moderate effect size. Tukey post hoc analysis revealed the difference between the lecture recording/no captions group, 3.19 ± .7, and the neither group, 2.92 ± .79, was .275 (95% CI, .009 to .542) and was statistically significant (p = .027). The difference between the lecture recording/captions group, 3.5 ± .44, and neither group, 2.92 ± .79, was .58 (95% CI, .203 to .955) and was statistically significant (p = .001). When comparing the lecture recording/captions group, 3.5 ± .44, to the lecture recordings/no captions group, 3.19 ± .7, the

difference was .303 and was not statistically significant (p=.093). Thus our hypothesis is partially

accepted as use of lecture recordings and captions made a significant impact between lecture

recording/caption use and no use, but did not make a significant impact between the lecture

recording/caption group and the lecture recording/no caption group.

Discussion

Based on the results above it can be concluded that:

- Students like having lecture recordings and captions available and will utilize captions for

  a variety of purposes.

- Captions enable students to interact with lecture recordings in ways that are valuable for

  them when they are studying and learning.

- Students make the connection of using the captions to help fill in gaps in their notes

  and/or clarify their notes.

- Use of captions modestly improves student outcomes on assessments.

The most interesting discovery to us is that students were able to use lecture recordings

and captions to help address the fact that they do not take adequate notes in lectures (Kiewra,

1985; Kiewra, DuBois, Christian, & McShane, 1988). Further, that some students did this

without prompting. While we provided some training on using the lecture recording system, we

did not indicate to students the value of using lecture recordings or captions to modify or

enhance their notes. It seems that students can use the exam study guide, lecture recordings and

captions, and their notes to overcome some of the identified challenges with note-taking such as

lecture rate, lecture organization, identification of important items, etc.

When searching the research literature to determine if others have seen these types of

results we found no articles that specifically addressed lecture recordings and caption use for a

general student audience. What we found was addressed to increasing accessibility to recordings,

generally for students with hearing disabilities or language challenges. We also found multiple

articles dealing with the process of creating captions or transcripts. While not in the journal

literature, we did find a 2015 report on a project from the University of Washington, *Captioning*

Lecture Capture Videos: A Promising Teaching Practice, that affirms our findings. Additionally,

we found case studies reported by MediaCore, an educational video platform and 3PlayMedia, a

captioning and transcription company.

The reports and case studies we discovered corroborated our findings. Students reported

being more engaged with lecture recording videos with captions, captions assisted with language

comprehension and comprehension of complex concepts, captions enabled students to interact

with content in multiple modes, and use the video in a variety of settings which enabled them to

engage with materials where they were most able to learn (e.g. places without distractions). In

the University of Washington report, where Panopto was also used, there were extensive

indications of how captions increased the navigability and searchability of recordings.

One implication for our findings is that captions can perhaps provide an alternative

solution for something that is frequently called for in the literature on note-taking. Throughout

these articles there is a call for instructors to alter their lectures and presentations to help students

identify what is important to make note of (Hartley & Marshall, 1974; Titsworth & Kiewra,

2004). Alterations would include modifying presentation materials to clarify the organization of

the lecture, specifically indicate important items, or revamping verbal presentations to cue

students to organizational approach and/or important items. Since instructors are often hesitant to

alter their teaching methods or invest the significant amount of time needed to alter materials,

lecture recording and captioning provides students with a way to mitigate challenges they have

with lecture rate, organization, or distractions they encounter in large lecture halls. Thus,

focusing on lecture recording and captioning may be more effective than attempting to change approaches to instruction.

      We are encouraged by student uses of captions for studying and learning, but are aware of the limitations of this study in terms of our reliance on a single study and the use of student self-reports to determine caption use. Additionally, given the lack of empirical studies (and corresponding literature) in this specific area related to lecture capture, more work is needed to fill in gaps in our knowledge of how captions can best incorporated to help students study and learn. To verify and validate our findings, further study is needed. We hope to continue to research student use of captions and/or transcriptions with lecture recordings. We would like to repeat this study in the Communication 101 course and with other lecture hall courses in other disciplines to determine the validity our results. Further, we are interested to explore other methods to study caption use to get an improved understanding of student motivations and specific approaches to use. As examples, it would be helpful to pursue experimental studies with direct observation of student use of captions when studying and modifying notes. We may also want to explore the quality of student notes before and after the use of captions for exam preparation to gauge improvement.

Chapter 5: Conclusion

This mixed-methods study utilized multiple surveys, log-files, and student demographic and course assessment data to identify if, how, and why students use recorded lectures and if that use had an impact on student learning and assessment scores. Further, it explored the impact of training students on the application of self-explanation to effectively study and learn from lecture recordings.

Because of the portfolio format of this dissertation and the generation of three articles on particular facets of my study, detailed specifics about the study, methods utilized, findings, limitations and indications of ideas for further study are indicated in Chapters 2, 3, and 4 in this document. In this chapter, I consolidate the findings, limitations and ideas for further research from those chapters and also discuss the significance of this study for various purposes. Where chapters 2, 3, 4 were written in first person plural for publication purposes, in this chapter I will return to first person singular.

Findings

As indicated, results of this study were reported in three different articles that looked at different facets of my study. Chapter 2 looked broadly at whether students used lecture capture if made available to them and, if they did, whether or not that use had an impact on learning and assessment scores. Chapter 3 specifically focused on an intervention which utilized self-explanation as a possible approach to help students effectively incorporate the lecture recordings into their study and learning practices. Chapter 4 focused on a serendipitous finding regarding students' attitudes toward and use of captions that were incorporated into the lecture recordings.

Lecture capture and student learning. The key findings from my broad study of lecture capture use and impacts on student learning include:

- Students will use lecture recordings if made available and they see relevance in their use (e.g. using the recordings = higher exam scores).

- Students feel that the lecture recordings help them to do better on course assessments and with learning course material.

- Students who utilized the lecture recordings achieved higher assessment scores and overall outcomes than those who did not.

- Students use the lecture recordings strategically to study and learn. Specifically, they do not view entire recordings, but use features such as search to locate what they need, pause to take or clarify notes, and captions to read and navigate.

- Non-native English speaking students utilize lecture recordings to a slightly higher degree, but generally in the same way as their peers who are native English speakers. They value having the lecture recordings and are able to use them to do well on course assessments.

Based on the prior results of student surveys in the course that was studied, student use of the recordings was expected, this study indicated the extent and details of that use and the impact of that use. I found the strategic use of the lecture recordings especially informative, specifically that students used the search feature to locate what they needed instead of a more surface learning strategy of simply viewing the entire recording to see the lecture again.

Training students to effectively use recordings. In this facet of the study, I conducted an intervention to determine the impact of training students in the treatment group to use self-explanation when studying with the lecture recordings. I compared that group against a control group who received training in use of the lecture recording system and against a group that received no training whatsoever. The key findings from this aspect of the study include:

- Students who received training in self-explanation did not indicate a change in their approaches to learning/studying and did not achieve higher assessment scores.

- Students who received training in self-explanation did not achieve improved assessment scores in comparison to those who received training on how to effectively use the lecture recording system.

- Students who received further training on how to use the lecture recording system to study/learn achieved higher, but not statistically significant, assessment scores than those who received training in self-explanation. However, these students did achieve statistically significantly higher results than the non-participant group who received no training whatsoever.

The higher assessment scores for students who were trained to use the system is attributed to training students to use the lecture recordings so that they could incorporate them into their already existing strategies for studying and learning. Self-explanation, while shown to be a powerful skill for learning, may not have been as effective as it prompted students to change their approaches and thus students may have simply reverted to their regular study habits.

Student use of captions. The use of captions was not something that I originally set out to study, instead it was a feature added to improve the searchability of the recordings. However, student comments indicated direct use of and appreciation for the captions. The key findings from the data that emerged in this facet of the study include:

- Students like having captions available and will utilize captions for a variety of purposes.

- Captions enable students to interact with lecture recordings in ways that are valuable for them when they are studying and learning.

- Students make the connection of using the captions to help fill in gaps in their notes and/or clarify their notes.

- Use of captions modestly improves student outcomes on assessments.

Students used captions in multiple ways to study and learn. Some students used them to navigate the recordings and find particular terms or concepts and some turned off the audio and read the captions, sometimes indicating a preference to read instead of listen. Finally, some students used the captions in combination with their notes to fill in gaps and/or provide clarity.

The most interesting aspect of these findings to me is that students were able to use lecture recordings and captions to help address the fact that they do not take adequate notes in lectures (Kiewra, 1985; Kiewra, DuBois, Christian, & McShane, 1988). Further, that students did this without prompting. While we provided some training on using the lecture recording system, we did not indicate to students the value of using lecture recordings or captions to modify or enhance their notes. It seems that students can use the exam study guide, lecture recordings and captions, and their notes to overcome some of the identified challenges with note-taking such as lecture rate, lecture organization, identification of important items, etc.

Limitations.

Limitations to this study include several factors, some of which are more general in nature and some which are associated with specific aspects of the study, to wit, training with self-explanation and captioning. In general, this study was conducted only a single time using a large lecture hall course in one particular discipline. Thus the results may not be generalizable to other disciplines or to smaller courses, especially courses where there is a greater possibility of interaction with the instructor. There is also the possibility that the instructional approaches used in this course affected the results. Examples of this could be the instructor's presentation style, the use of the audience response system which helped to ensure attendance and engagement, or

the provision of a study guide for each exam which helped students to identify what was important and guided their searches in the lecture recording system.

Training students to effectively use recordings. While I attempted to create an effective training approach by indicating to students that self-explanation is a highly effective study strategy and by providing students with a practice exercise on self-explanation, the training may not have been sufficient for students to incorporate the practice of self-explanation into their study and learning strategies. The training may have been more effective if I had repeated the training over a period of time using multiple examples or if I had added self-explanation prompts to resources such as the exam study guide.

Additionally, and explored in more detail in chapter 3, 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 search, find, play, pause, replay, etc. in the lecture recording system may have seemed a more valuable approach to students than trying to have a deep understanding of content. With this explanation it is understandable that those students who received training on how to effectively utilize the lecture recording systems were able to achieve higher assessment scores than those who did not receive training. Essentially, these students were able to better incorporate the lecture recordings into the study and learning techniques that they already utilized

Student use of captions. While I am encouraged by the findings in this facet of my study, I am aware of the preliminary nature of my findings. As these results emerged serendipitously from the data collected instead of from a planned study focused on captions, there are several things that I did not attempt to collect or control for. For example, these findings would have been strengthened by the existence of more survey questions that attempted

to elicit specific practices with the captions or to discover challenges encountered with the captions. Further, the reliance on student self-reports to determine caption use limits the validity of the findings.

Further Research.

As was indicated throughout this dissertation study, multiple aspects of lecture recording processes and use have been reported in the research literature, especially since 2002 (Kay, 2012). The results of this study add to that literature and further the understanding on various aspects of lecture recording use and impact. While each facet of this study would be rendered more valid by repeated rigorous study, each area is unique enough that I have split this section so that each area can be highlighted. Suggestions for future research in each are indicated below.

Lecture capture and student learning. Based on the results of this study two particular areas should potentially be explored in future studies:

1. A review of studies across multiple disciplines or a study using a similar lecture capture approach and study methodology across courses in multiple disciplines. This would help to determine if the positive impacts found in this study are replicable in other disciplines. Some of this research is already available in the literature, but differences in recording and distribution approach and study methods would need to be accounted for. A single study using consistent approaches and methodology with courses across multiple disciplines may be the more valid than trying to compare studies.

2. Determine the impact of directly indicating to students how they can use lecture recordings and what has generally provided the most impact on course assessments. For example, indicating to students that use of the lecture recordings can help them fill in gaps in their notes. While training students to effectively use lecture recordings and lecture recording

systems is important, it is also time consuming. Simply providing students with information on how they can get the most out of the recordings may be enough to help them effectively use them.

   Training students to effectively use recordings. Training students to use self-explanation when studying with lecture recordings was not as impactful as we expected. We did see however that training students to use the lecture recording system more effectively was impactful. Since one of the principal gaps in the literature that I discovered was the issue of a lack of training, future studies should:

1. Further explore the issue and impact of training. I believe this study provides an impactful and efficient training model utilizing a learning object and brief assessment for reinforcement, but there are many options to training students that could be explored.

2. Continue to ascertain if self-explanation could be a valuable technique. Critical here is to ensure the alignment of the purpose of self-explanation, namely, deeper understanding, with the level or assessments in the course.

   Student use of captions. As has been indicated previously, student use of captions when using lecture recordings for studying and learning was a serendipitous finding, but one that I believe might have the most overall importance. Given the lack of empirical studies (and corresponding literature) in this specific area related to lecture capture, especially for students other than NNES or those with a hearing disability, this area has the most potential for growth. Therefore, there is a wide range of studies, study approaches, etc. that can and should be explored. Amongst these:

1. Exploratory studies to identify how and why captions are used by a general audience. My findings indicate a strong correlation to student notes, but there could be other factors and

purposes that students use these for, especially in different learning contexts with

different instructional approaches

2. Experimental studies in a controlled setting to remove the reliance on student self-reports

of use. Achieving a better understanding of how students utilize the captions from

reliable and valid approaches is key to helping improve their use and helping build

systems that allow student to more effectively utilize audio and text in their learning

processes.

3. Based on the literature of note-taking, that frequently calls for instructors to modify their

teaching approaches to provide better clarity of organization and important items, it

would be beneficial to gauge the impact in alterations of instructional practice against the

provision of captions or transcripts. Captioning and transcription, though more costly in

financial terms, are much easier to do than altering instructional practice.

Significance of the Study.

This study adds depth to the literature on the process and use of lecture recordings. Each

facet of my dissertation study can be incorporated into the literature so that instructors,

instructional designers, and instructional technologists can potentially review their processes to

help improve the learning environments for their students.

While I believe this study has many potential applications, there is one underlying aspect

that I have perhaps understated thus far. This aspect is the return-on-investment for the lecture

recording process. After some initial learning and adjustment on part of the instructor to create

and distribute recordings, lecture recording is a fairly simple process. Anecdotally, I see students

requesting to record lectures themselves (or recording without the instructor's knowledge). Given

this and the potential impact for student learning, lecture recording should be an instructional

tool that all teachers, professor, etc. have access to.

This study is also relevant to for the literatures on self-explanation and note-taking. Lecture capture and the process of lecture recording is a fairly new instructional approach. Broadening these literatures to include this type of educational technology provides new opportunities to see how theories and practices apply and review these applications for student learning.

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Appendix A

Visual overview indicating the highest level of views, minutes viewed, and unique users.
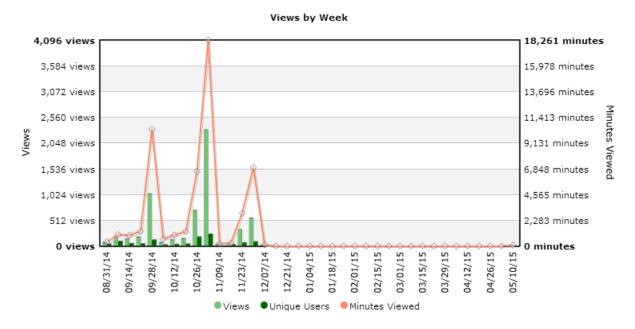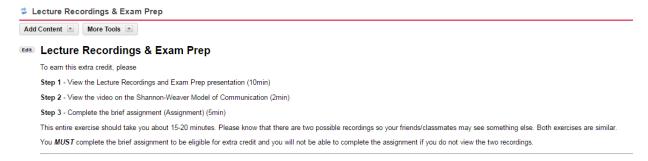
Appendix B

Top sessions by total Minutes viewed

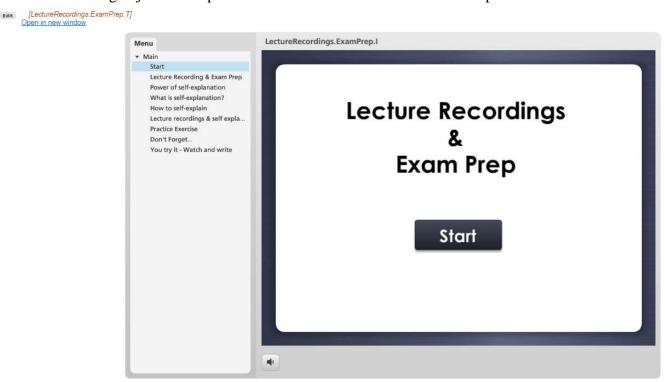| Session (top 100 by minutes viewed)	Views	Minutes Viewed	Average Minutes Viewed	Unique Users
Organizational Communication & Leadership-Asynchronous Session (default)	595	8344	15	265
Day 11-IC Wrap and Stanley Milgram (default)	357	3011	9	114
Day 9-Com Theory and Exam 1 Review (default)	311	3004	10	109
Day 3-Definitions Continued (default)	288	2848	10	125
Day 19-PR & Advertising (default)	184	2763	16	76
Day 18: Exam 2 Results & Mass Comm Wrap (default)	194	2646	14	72
Day 12-IC Wrap-SM-FNL (default)	262	2574	10	112
Day 10-Exam 1 Resuts and IC (default)	319	2320	8	112
Day 16-Group Communication and Intercultural Applications (default)	293	2287	8	112
Day 15-Intercultural Wrap (default)	284	2217	8	108
Day 6-Perception (default)	197	2196	12	97
Day 7-Verbal Messages (default)	194	1923	10	92
Day 21: Interviews, PS and Exam 3 prep (default)	151	1873	13	64
Day 4: Communication Ethics (default)	224	1817	9	103
Day 8-Non-Verbal (default)	172	1688	10	88
Day 1 (default)	277	1578	6	130
Day 20: Advertising Wrap, Exam 3 Decision (default)	177	1561	9	81
Day 17: Mass Media Intro-Exam Prep (default)	252	1541	7	98
Exam 2 Review (default)	274	1380	6	130
Day 2 (default)	243	1362	6	116
Day 14-FNL Wrap and Intercultural Intro (default)	222	1147	6	100
Day 5-Panopto Study & Self Concept (default)	175	1127	7	89
Day 13-Midterm & FNL (default)	184	954	6	98
Wrap (default)	12	112	10	6
Interviews Core (Interviews core)	7	79	12	3
Day 22: Exam 3 Results, The Future, Communication Scenarios (default)	6	15	3	6

Appendix C

Training and Activity for Treatment Group in Self-explanation Training Intervention
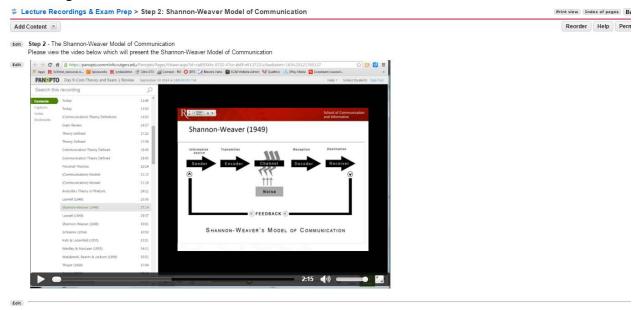
Introduction

Electronic learning object that explained and demonstrated the use of self-explanation

Recording of Shannon and Weaver model of communication

Activity prompt (used to determine student ability with self-explanation)

Assignment List ▶ Lecture Recordings and Exam Prep.i

Lecture Recordings and Exam Prep.i

DUE: Oct 28, 2014 12:00 AM

Assignment Details

Open Date	Oct 20, 2014 3:00 PM
Graded?	Yes
Points Possible	1.0
Resubmissions Allowed?	No

Assignment Instructions

After you have viewed a brief segment of a lecture recording on the "Shannon–Weaver Model of Communication" please:
- Write a 1-2 paragraph (maximum) self-explanation of the Shannon–Weaver Model in the assignment area and submit.

Appendix D

Exam #2 questions on the Shannon & Weaver model of communication

Q1: If we apply Shannon & Weaver's model to an example of a television show carried by cable
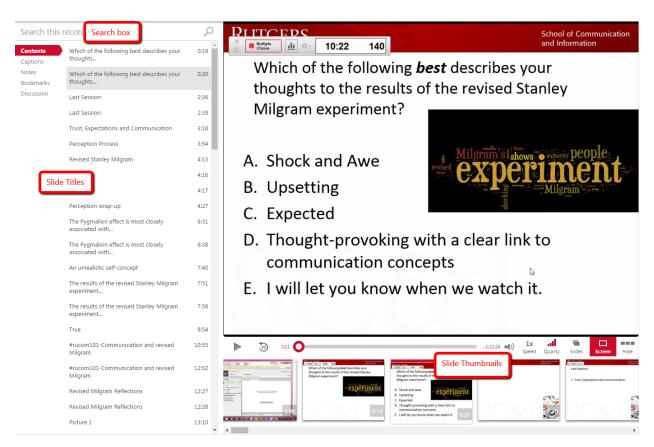
television, the *television set* serves as:

    A. Noise

    B. Transmitter

    C. Correction channel

    D. Receiver*

    E. Information source

Q2: The Shannon & Weaver model can be applied in a variety of settings beyond the traditional

view of Person A sending a message to Person B. Which of the following is an additional key

contribution of this model to our understanding of communication?

    A. It explicitly linked interpersonal communication dynamics to mass communication.

    B. It prompted the study of the effect of noise in the communication process.*

    C. It accounted for the effect of multiple messages.

    D. It highlighted how communication is part of a system.

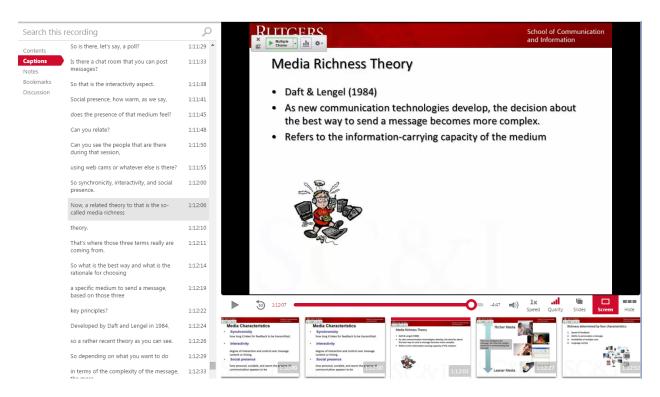   E. All of the above were contributions of the specific model.

Appendix E

Navigation within a Panopto lecture recording.

Appendix F

Student view of lecture recording with captions*

*The Captions tab is not selected by default, students must select it to see the captions.