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Educational Lessons from a Pandemic: Lecture Recording and Learning Outcomes

Melissa Lesser  
*Saint Joseph's University*, mlesser@sju.edu

Lora Packel  
*Saint Joseph's University*, lpackel@sju.edu

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Educational Lessons from a Pandemic: Lecture Recording and Learning Outcomes

Abstract

Purpose: The use of lecture capture (LC) in higher education classrooms has increased, especially since the onset of the COVID-19 pandemic; however, its effectiveness as a learning strategy is largely untested in graduate students. In undergraduate students, the use of LC has mixed findings related to academic performance. Some studies show no improvement in assessment or course grades while others show small gains. The purpose of this study was to investigate the impact of LC on academic performance in graduate doctor of physical therapy students (DPT). Methods: In module 1, students received two virtual synchronous lectures which were recorded and uploaded to the learning management system (LMS). A sample of convenience of second year DPT students enrolled in a cardiovascular and pulmonary course. Scores on quizzes and exams and viewing data were extracted from the LMS, and students completed a survey about their experience with LC. A Mann-Whitney U was performed to compare grades amongst students who watched recordings versus those who didn’t. A linear regression was performed to determine if a duration of video viewing was associated with better performance. A similarity test was used to compare the quiz and exam scores for module 1 and module 2 for those students who watched one video or two videos. Results: Fifty-eight students met inclusion criteria (58/67). No duration of video viewing was associated with better performance on the quiz ($p=0.423$) or unit exam ($p=0.754$). There were no significant differences between students who watched the recorded lectures and those who did not on either quiz ($p=0.732$; Table 3) or exam performance ($p=0.773$; Table 3). Lastly, the similarity scores for those who watched both videos were a 0.98 for the quizzes and 0.92 for the exams, again showing similar performance whether or not students viewed the videos. Conclusions and Recommendations: No performance advantage was found for viewing recordings despite students’ positive perception of their utility. Professors should recommend the best-fit learning modality for each student, as LC may not be of benefit.

Author Bio(s)

Melissa Lesser, PT, DPT, is a Board-Certified Cardiovascular and Pulmonary Physical Therapist. She is an Assistant Professor and co-Director of Clinical Education at Saint Joseph's University in Philadelphia, PA.

Lora Packel, PT, PhD is the Chair of the Physical Therapy Department and Director of PT Accreditation at Saint Joseph's University in Philadelphia, PA.

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Melissa Lesser
Lora Packel
Saint Joseph’s University
United States

ABSTRACT
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Keywords: lecture capture, physical therapy, education, COVID-19 pandemic
INTRODUCTION
Lecture capture (LC) has recently gained popularity in higher education. Lecture capture refers to the recording of live lectures that are uploaded to a learning management system (LMS) for students to use as an optional learning tool. The onset of the COVID-19 pandemic (“pandemic”) caused professors to quickly shift to online learning. Our institution put forth many efforts to keep the learning going and maintain rigor while also offering a supportive learning environment given the multitude of new stressors. Lecture recording was one technique used to provide a safety net for learning and some professors have continued this practice after the shift back to in person teaching. However, the effectiveness of lecture capture as a learning tool has not been adequately studied in graduate student populations. The purpose of this study was to evaluate the impact of LC on short- and long-term learning in a cohort of second year Doctor of Physical Therapy (DPT) students.

Review of Literature
There are identified strengths and limitations to lecture recording (lecture capture), with no clear determination of best practice. Some researchers have found no difference in short- or long-term retention of material between those that had a live lecture compared to a recorded one. Other studies demonstrated a weak performance advantage when the assessment focuses on knowledge, but this advantage is lost when the assessment includes higher order skills such as application and integration. Attendance at live lectures has been found to be a key variable in learning, regardless of whether recorded lectures were accessed. Positive aspects of lecture recording include flexibility when learning occurs, the ability to fill in content missed or misunderstood in lecture, and a potential weak improvement in academic performance in limited situations. Drawbacks of lecture capture have been reported to be declines in classroom attendance, reduced interactions between student and professor, and reinforcement of memorization.

Lecture capture is not the standard of practice in health profession programs nor is there robust literature assessing its effectiveness in health profession education. Beginning in the Spring of 2020, many higher education institutions moved to an online or hybrid format of teaching due to the COVID-19 pandemic. The DPT department involved in this study made efforts to hold synchronous virtual classes with students to increase engagement and to create community in a period when many were feeling isolated. Some faculty members also recorded their live virtual lectures. Rationale for recording included addressing attentional fatigue due to an increase in the number of hours in front of a screen during “pandemic” learning, and to provide a safety net to attain the critical knowledge needed to graduate from an entry-level DPT program.

The majority of LC studies have focused on undergraduate education in STEM fields and have explored qualitative feedback from students and faculty, with few utilizing objective performance data to determine the effect on learning outcomes. The purpose of this study was to investigate the impact of LC on academic performance in graduate doctor of physical therapy students (DPT).

METHODS
Subjects
A sample of convenience of second year DPT students enrolled in a required course in cardiovascular and pulmonary physical therapy were recruited for the study. Students were informed that their participation in the research was voluntary, and they could withdraw at any time without penalty. Written informed consent was procured. All students, regardless of participation in the study, were required to complete every assessment outlined in the syllabus. Inclusion criteria were enrollment in the second semester of a required Cardiovascular and Pulmonary Physical Therapy course and attendance for the online synchronous classes included in the study. Exclusion criteria were absence from a live synchronous class or withdrawal from the class. Students attended synchronous classes via zoom and attendance was taken.

Study Design
This was a cohort based observational study approved by the institutional review board.

Procedures
Short- and Long-Term Learning
Module 1 focused on the intensive care unit (ICU) and mechanical ventilation. Two synchronous virtual lectures were recorded and uploaded to the LMS. The mechanical ventilation recorded lecture was 1 hour and 19 minutes and the ICU recorded lecture was 1 hour and 55 minutes. Students took a quiz two weeks after the module, and grades were recorded to reflect short-term learning. A two-week time frame was chosen to allow students time to process the information. Shorter time frames might have reflected memorization rather than deeper learning. Students also took a unit exam three weeks from the initial presentation of module 1, again to allow time for long-term learning. Performance on the questions relating to the recorded ICU and mechanical ventilation classes were included in the analysis to reflect “long term learning.” During week 10 of the 12-week semester, students
attended a live synchronous virtual lecture on the cardiovascular and pulmonary implications of the person with a primary neurological disorder (Module 2). This synchronous lecture was not recorded. Students took a quiz on this content one week after the module and a unit examination two-and-a-half weeks later. Performance on questions related to the neuromuscular lecture were included in the analysis. Both unit examinations were comprehensive, however, only the questions related to the specific modules mentioned above, were included in the analysis. The time frames between presentation of material and assessments were slightly different between modules resulting from the appropriate time needed to present the material to students. Lastly, students completed an optional web-based survey about their experiences using the recorded videos (Figure 1). The survey was developed by the researchers and reviewed by two faculty members with prior survey experience.

**Figure 1. Methodology**

The time frames chosen as “short-term” and “long-term” were intended to reflect whether LC impacted student performance when there was a shorter time period between presentation of material and the assessment or if LC played a different role when students had a longer period to prepare for the assessment. The literature on the impact of LC on academic performance varies widely in the time frames between presentation of material and the assessment.5,14

**Data Analysis**

The number of minutes and percentage watched of total video time was extracted from the LMS. A Mann-Whitney U test was used to determine differences in quiz and exam grades amongst students who watched the recordings compared to those who did not watch. A minimum of 5% of the watched video was required to be included in the analysis. A linear regression model was used to determine if there was a duration of video watching that was associated with a better grade on the quiz or exam. A similarity analysis was used to compare quiz and exam grades on module 1 and module 2 for those who watched one of the videos only, and those who watched both videos. The formula for the Similarity comparison was

\[ Sim(x, y) = \frac{2 \sum xy}{\sum x^2 + \sum y^2} \]

where x and y refer to quiz scores for the quiz comparison between modules or for exam scores for the exam comparison. A brief open- and closed-ended electronic survey was provided at the end of the semester for students to reflect on their experiences using recorded videos.
RESULTS
Ninety-one percent of eligible students consented to participate in the study (61/67). Data from three students were excluded due to absence from a mandatory class (n=58). For the mechanical ventilation recorded lecture, 15/58 students viewed the video however two were excluded from analysis as they viewed <1% of the total video duration.

Viewing Duration of Recorded Lectures
Thirteen students watched an average of 93.26 minutes and viewed an average of 90.46% of the total mechanical ventilation video recording time. For the ICU recording, 21/58 students watched the video with two students excluded for watching less than 1%. Of the students who watched the ICU recording, they watched for an average of 125.15 minutes and 86.33% of the total video.

Learning Outcomes
The cognitive process dimension of Bloom’s Taxonomy was used to categorize assessment questions (Figure 2). Mean scores for the quizzes and exams can be found in Table 1. There were no significant differences between students who watched the recorded lectures and those who did not on either quiz (p=0.732; Table 2) or exam performance (p=0.773; Table 2).

Figure 2. The Cognitive Process of Bloom’s Taxonomy

<table>
<thead>
<tr>
<th>Table 1. Performance on Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU quiz (mean)</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Watched video</td>
</tr>
<tr>
<td>Didn’t watch video</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Video Recording and Performance Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance on Quiz</td>
</tr>
<tr>
<td>Watched Video</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Performance on Exams</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

For module one (mechanical ventilation and ICU), there was no duration of video viewing that was associated with a better performance on the quiz (p= 0.423; Table 3) or the unit exam (p=0.754; Table 3). A similarity test was used to compare the quiz
and exam scores for module 1 and module 2 for those students who watched the mechanical ventilation video only, those who watched the ICU video only, and those who watched both videos. The similarity measure of quiz grades for those that watched the mechanical ventilation video was 0.98 and 0.92 for the exam scores indicating that academic performance for both modules were very similar. For those who watched the ICU video only, the similarity measure for the quiz grades was 0.99 and 0.92 for the exam grades demonstrating that the grades for both modules were also similar. Lastly, the similarity scores for those who watched both videos were a 0.98 for the quizzes and 0.92 for the exams, again showing similar performance whether or not students viewed the videos.

Table 3. Duration of Video Viewing (minutes) and Performance on Assessments

<table>
<thead>
<tr>
<th>Performance on Quiz</th>
<th>Watched Video</th>
<th>Beta</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (minutes)</td>
<td>0.244</td>
<td>0.833</td>
<td>0.423</td>
<td></td>
</tr>
</tbody>
</table>

| Performance on Exam | Time (minutes) | 0.073 | 0.318 | 0.754 |

Student Feedback
The survey had a response rate of 54% (36/67). Students reported utilizing lecture recordings for the following reasons: a) lost attention during live lecture b) clarify notes that were confusing or poor understanding of lecture material c) wanted to catch anything I may have missed during the lecture d) missing notes because the pace of the lecture was too fast. The majority of the respondents (96.96%) reported that lecture capture did not decrease their ability or motivation to attend to the instructor during synchronous classes. The majority of students somewhat or strongly agreed that recordings were a good use of their time, they enhanced learning, and improved academic performance. Eighty-eight percent strongly agreed that if offered in the future, they would want access to recorded lectures (Table 4).

Table 4. Student Feedback on the Use of Recorded Videos

<table>
<thead>
<tr>
<th>Student Comments</th>
<th>Strongly Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree or Disagree</th>
<th>Somewhat disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recordings were a “good use of my time”</td>
<td>66.67% (n=22)</td>
<td>30.30% (n=10)</td>
<td>6% (n=2)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Recordings further enhanced my learning</td>
<td>72.72% (n=24)</td>
<td>24.24% (n=8)</td>
<td>6.06% (n=2)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Recorded lectures improved my performance on quizzes and exams</td>
<td>62.5% (n=20)</td>
<td>28.13% (n=9)</td>
<td>6.25% (n=2)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I watched the entire recorded lectures again</td>
<td>63.63% (n=21)</td>
<td>15.15% (n=5)</td>
<td>6.06% (n=2)</td>
<td>12.12% (n=4)</td>
<td>3.03% (n=1)</td>
</tr>
<tr>
<td>If offered in the future I would want access to a recorded lecture</td>
<td>87.87% (n=29)</td>
<td>3.03% (n=1)</td>
<td>3.03% (n=1)</td>
<td>3.03% (n=1)</td>
<td>3.03% (n=1)</td>
</tr>
</tbody>
</table>

DISCUSSION
The availability of technology to record lectures has recently expanded, especially in the context of the COVID-19 pandemic, which necessitated virtual or hybrid learning practices. Research on the effectiveness of recorded lectures has primarily focused on undergraduate education, with little attention to graduate school or health related programs. The purpose of this study was to investigate the impact of LC on academic performance in graduate doctor of physical therapy students (DPT).

Learning Outcomes
There were no significant differences found in short-term or long-term performance on assessments for those who utilized lecture capture compared to those who didn’t. Similar studies suggest a small or weak relationship between watching recorded lectures and assessment scores for certain majors such as pharmacy and biomedical science, whereas other studies have confirmed these results and suggest performance advantage. In a study by Bos et al., viewing recordings seemed helpful for knowledge-based questions, but no benefit for higher order or application type questions. This has implications for health profession programs where application is germane to the professional practice. As noted in the present study, approximately 50% of the questions on any given assessment included higher order thinking skills such as applying knowledge, analyzing data, or evaluating information and making decisions. Lastly, Groen et al. found that low performing students were more likely to access lecture recordings with limited improvement on their test performance. These authors postulated that lecture viewing may help “middle-achievers” or those with grades higher than a C+, but offer little benefit to students with grades between a C+ and F. While not reported in this
study, others have found that recording lectures may benefit those who have difficulty balancing attention with note taking, those with disabilities who may have variable class attendance due to health issues, those who are non-native speakers, weather related absences, and athletes that miss class for competitions. The methodology in the aforementioned studies vary widely and focus largely on undergraduate students. If academic performance was evaluated at all, the timeframes for assessment of performance were varied, with many using the final exam or final course grade to determine the effect of lecture recording on performance.

Viewing Patterns
In the present study, there were no significant correlations between the amount of video watched and short- or long-term assessment performance. If viewed, students watched the majority of the lecture, which is a significant amount of time that may not yield better grades. Bos et al. found that time spent on viewing showed “diminishing returns,” related to examination performance. A more active, efficient, and concise study tactic using retrieval practice utilized by Palmer et al. demonstrated in similar assessment scores compared to lecture viewing. While not measured in this study, Zureick et al. examined the impact of being distracted during lecture and watching recorded lectures on examination grades in medical students. No matter the medium – live lecture or recordings, student performance suffered if the student was distracted by checking email, Facebook, or in those who were sleepy.

Student Perceptions
Student perception of lecture recordings was positive, with the majority stating that recordings were a good use of their time, enhanced their learning, and would continue to use this strategy if available, similar to previous studies. This overwhelmingly positive view of lecture recordings and their perceived impact on academic performance is not supported by the data in this study. Students who viewed the videos had no significant improvement in their academic performance compared to those who did not view the recorded lectures.

Limitations
This study only examined one cohort of students, which constitutes a small sample. Assessment scores were compared between two different content modules, so performance may have been impacted by differences in perceived levels of difficulty or interest. There were low numbers of students who viewed videos, limiting the ability to interpret the results and their generalizability. The second module occurred at the end of the semester when students made decisions to emphasize studying in other classes based on their cumulative grades heading into finals. The survey was provided at the end of the semester when many students were focused on final examinations and may not have been willing to respond to the survey. Lastly, there was no control for other study techniques used by either the watchers or non-watchers which may have impacted performance.

CONCLUSIONS
This study examined the role of lecture recording on short- and long-term academic performance in graduate physical therapy students taking a required course in cardiovascular and pulmonary physical therapy. No performance advantage was found for those who viewed recorded lectures despite an overwhelmingly positive student perception of their utility. Taken in context with previous research in this area, a professor’s greatest impact may be in recommending the best-fit learning modality for each student. There may be discrete student populations that benefit from watching recordings, although for many, active learning strategies may be more efficient and effective.

Address correspondence to: Melissa Lesser, PT, DPT, CCS Co-Director of Clinical Education, Saint Joseph’s University 4140 Woodland Avenue, Philadelphia Pa 19104 (mlesser@sju.edu).

This study was approved by the Saint Joseph’s University IRB, protocol #1684789-3

The authors declare no conflicts of interest.
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