2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #40046

Lighting Engagement : Student Engagement in a Lightboard vs. Traditional Video Lectures

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Abstract

The creation and use of digital content to deliver lectures and supplement instruction has been on an upswing for a number of years. This trend showed a tremendous growth over the pandemic as expected with the transition to some variation of online delivery whether it was remote teaching or via the development of high quality online courses. A dominant mechanism for lecture delivery in engineering disciplines at a large university in the southwest has been the use of video. A short survey of faculty identified 3 dominant strains in video production (1) Video content captured using Zoom (2) Video content captured in professional studio settings and (3) Video content captured in classrooms using existing lecture capture technologies built in class. The second strain of video creation has consisted of faculty either using a standard camera setup in a studio or using a lighboard. The lightboard is a large glass pane illuminated by LED strips around the edges. The instructor stands behind the pane and writes on the board with various colored grease pencils. A mirror-effect is added for the reversal of the image for the camera. The result is an instructor facing the audience with drawings and schematics which are easily discernable by the viewing audience (Birdwell & Peshkin, 2015; Ganbat & Naidandorj, 2018). The key advantage of this technique is that it essentially lets the faculty member lecture like they normally would using a whiteboard, except the lightboard is a transparent board which lets the students see the faculty expressions and interactions. This qualitative study was designed to compare student engagement between the two video types that were used for instruction. Further we also surveyed faculty on their preferred methodology of lecture capture, along with the advantages and disadvantages of the two.

The data shows that the students overall felt that the lightboard videos showed a slight advantage in providing engagement over the traditional video. It was interesting to note thought that even though the students strongly preferred the lightboard videos for engagement, stimulation and satisfaction, a large number of them indicated easier learning from the standard video. Analysis of the open ended responses show that the students may potentially view the lightboard videos as a bit distracting compared to what was termed “old school” videos or standard videos in our parlance.

Background

Some studies have shown the students prefer and consume video over other digital formats in education [1]. In addition other studies [2][3] have shown that student perceive greater learning gains and increased critical thinking with well designed videos. Such studies have led to an increase in the creation and use of videos and digital content in higher education over last many years. This trend which had been on an upswing for a number of years saw a sudden sharp uptick over the pandemic. An article in Campus Technology [4] shared the results of a survey that showed that 97% of educational professionals said that video and digital content was essential for the student experience. This national trend was replicated on the campus of a large university in the southwest.

A short survey of faculty identified 3 dominant strains in video production (1) Video content captured using Zoom (2) Video content captured in professional studio settings and (3) Video content captured in classrooms using existing lecture capture technologies built in class.
The second strain of video creation has consisted of faculty either using a standard camera setup in a studio or using a lightboard. The lightboard is a large glass pane illuminated by LED strips around the edges. The instructor stands behind the pane and writes on the board with various colored grease pencils. A mirror-effect is added for the reversal of the image for the camera. The result is an instructor facing the audience with drawings and schematics which are easily discernable by the viewing audience [5][6]. A study [7] demonstrated that student performance in a statics course went from a 20% completion rate to 95% which was mostly attributed to the inclusion of lightboard videos in the course, and another study showed the potential of increasing student performance using a lightboard [8]. Conversely another study found [9] that the integration of a lightboard or videos did very little to affect student performance in the course.

A course in digital signal processing was offered as an online course using a combination of pre-developed long format videos, interactions and textual content, all delivered via a learning management system. The course was going through an update and it seemed to be an ideal opportunity to create new content for the course and update the course using the learnings from previous studies. Rogers et al [10] demonstrated that students showed a strong preference for lightboard videos and also perceived better learning through the use of the videos. While that study was inconclusive about the exact learning gains, it nonetheless made a good case for the use and creation of lightboard videos. Brame [11] has demonstrated the most effective way for producing videos that maximize student engagement. Some principles that are proposed in the paper and adopted in the development of these videos were (a) cuing : which involves providing visual cues to the topic being discussed (b) weeding : involves the removal of any external stimuli and (c) matching modality to content : essentially describe in words what is seen on a screen. The next question about the length of the videos was answered by Guo et. al [12] on their work that analyzed the student use of video in MOOC's. They found that videos had the maximum viewing at approximately 6 minutes with a drop off in attention with every minute after that. Previous experiences had informed us that it was difficult to get meaningful information into a 6 minute video for us. But while we understood the attention dropoff beyond 6 minutes, Roediger and Karpicke's work (13) helped us understand the value of testing in retaining attention and content. To achieve our goals of engagement, we built in a check for understand quiz in the middle of the videos to ensure students had a way to recall information and hopefully would help keep the students engaged in the longer form video.

Rationale and study questions

A course in Digital Signal Processing was offered in an asynchronous online format with some live recitations. A whole series of videos were created for this course and also curated from other sources and edited to conform to our time guidelines and design guidelines. We had a set of videos that were standard videos and in addition after research we recreated the videos using a lightboard setup in the studio facilities of a digital learning support group in engineering.

With this study, we set out to understand student perception of learning and engagement between videos created on a lightboard vs. videos created in a studio that were not just lecture captures from a classroom. We also wanted to understand the reasons why students preferred one format over another and perceived better learning from one format over another. Ancillary questions were also to look at preferences based on age or gender of the respondents.

In addition the aim was also to capture the faculty experience in creation of both the videos and the advantages and disadvantages between the two video capture formats so we could better inform our next course creation processes.

Video creation process

The video creation process: In both cases of the videos (lightboard and standard), the instructors followed templates based on research by (14,15) that has demonstrated that students appreciated videos that followed a stricter scripting process. Care was taken to ensure that the instructional delivery followed a specific routine where we (a) first introduced the topic (b) talked about the value of the topic (c) walked through the derivation of equations and concepts as appropriate and (d) wrapped up the topic with an exercise the students could perform on their own. We also ensured that each video was as similar in length as much as possible with very few exceptions where the studio videos were longer by a few minutes at the most.

Both the videos were created by instructors with minimum professional help. For the standard videos, the instructors used a studio with a green screen and a tablet which displayed slides when used and could be written on using a digital pen (Figure 1). The lecture was captured by the tablet and the instructors face was inserted on the video as part of the chromakey process.

In the case of the lightboard videos, the instructor used a studio with a lightboard instead of tablet (Figure 2). The instructors lectured like they normally would with the exception of using special markers to write on the lightboard. In some instances, lectures or parts of lectures were re-recorded and edited to ensure consistency in the quality of the overall products that were to be used for the comparison.

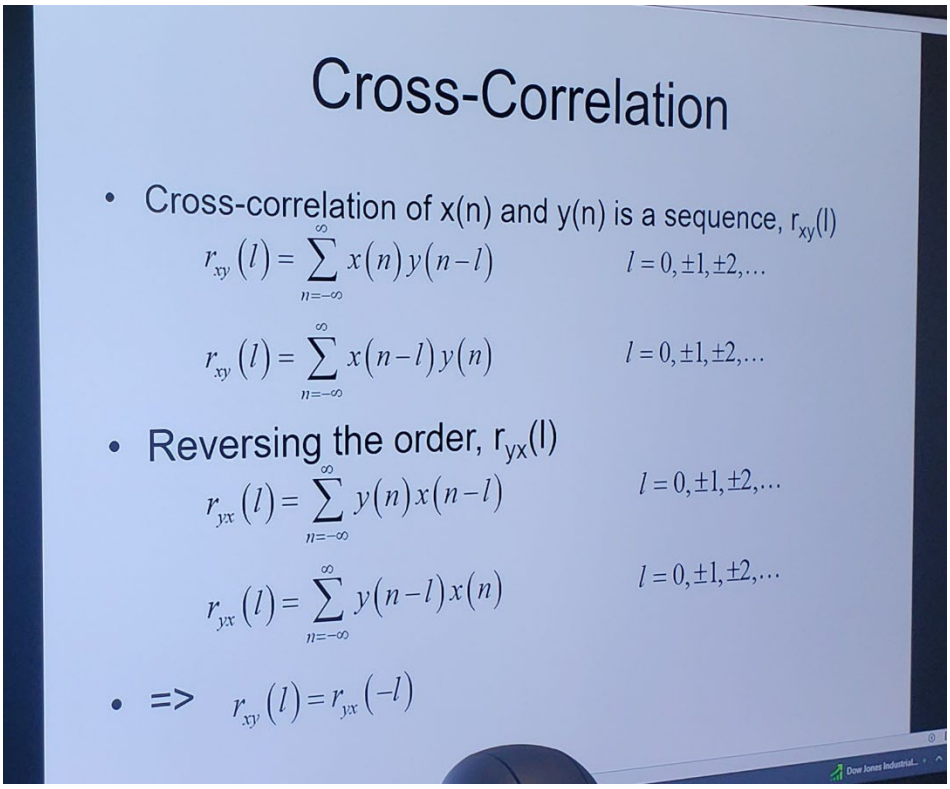

Figure 1: Snapshot of a standard video lecture on Cross-Correlation

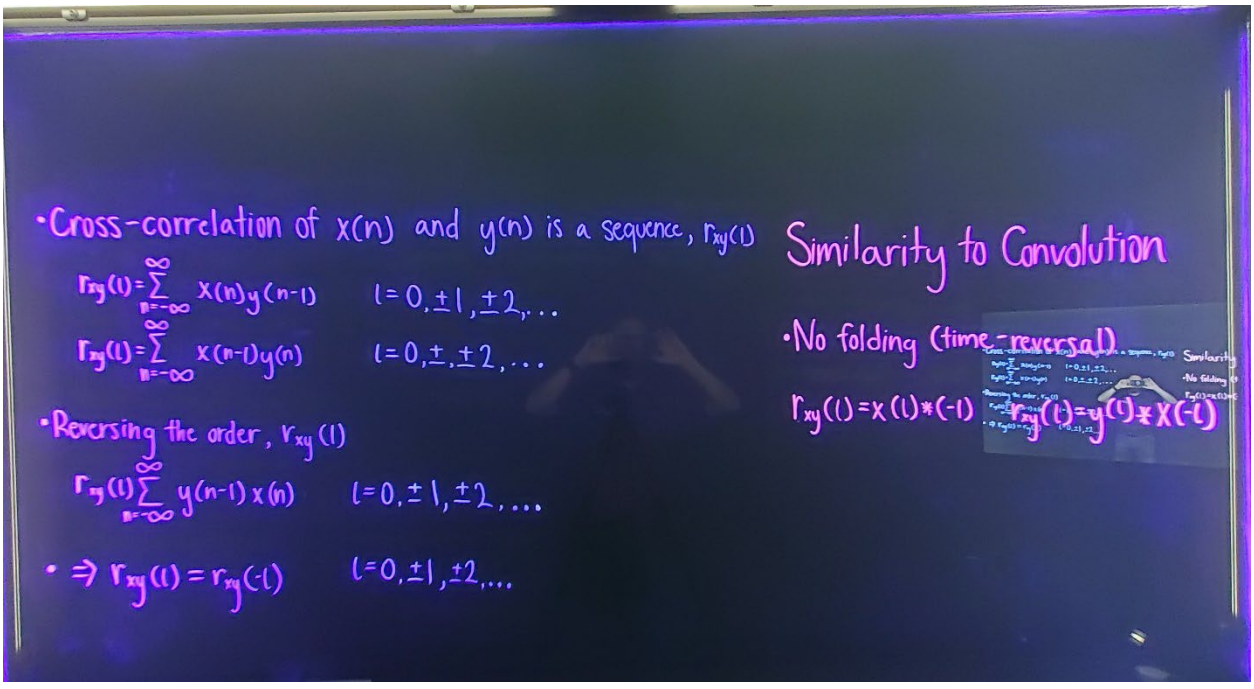

Figure 2: Snapshot of a video lecture on cross-correlation using a lightboard

Videos were created on the following topics and subtopics

- Discrete-Time Signals and Systems
- Discrete-Time Fourier Analysis
- The Z-Transform
- The Discrete Fourier Transform (DFT)
- The Fast Fourier Transform (FFT)
- Digital Filter Structures
- Finite Impulse Response (FIR) Filters
- Optimal Equal-Ripple Design Techniques
- Infinite Impulse Response (IIR) Filters
- Applications of DSP

Study methodology

To ensure that the students had a base understanding of the first four concepts in the course, we asked the students to use videos in both the formats as they worked their way through the class materials. Each of the videos was kept to ten minutes and students were first asked to rate both the video formats side by side. The students were asked to rate the videos on the same topic on 7 functional questions and they were give three choices 1. Strongly Disagree 2. Agree and 3 Strongly Disagree. We deliberately chose this strong scale to ensure that we could get the best information from the students. In addition to this rating, students were then also asked to chose which of the videos formats were their preferred formats for engagement and learning. In addition, an open ended question was asked allowing the students to give us detail on their preference and perceived learning.

In addition to the students, we also had the three faculty complete a brief survey on the ease of each of the methodologies and their perceptions of the efficacy of the methodologies. Lastly the faculty were asked to identify a few advantages and disadvantages of each of the video capture methodologies.

Data and Results

Student survey results

The course had a total of 33 students with two students abstaining from taking the surveys. A majority of the students were juniors, with 4 students being seniors and 4 students being graduate students.

Table 1 Age distribution of the respondents.

#	Answer		Count
3	19	6.45%	2
4	20	22.58%	7
5	21	32.25%	10
6	22	25.81%	8
7	23 or older	12.90%	4

The gender distribution in the class is shown in Figure 1.

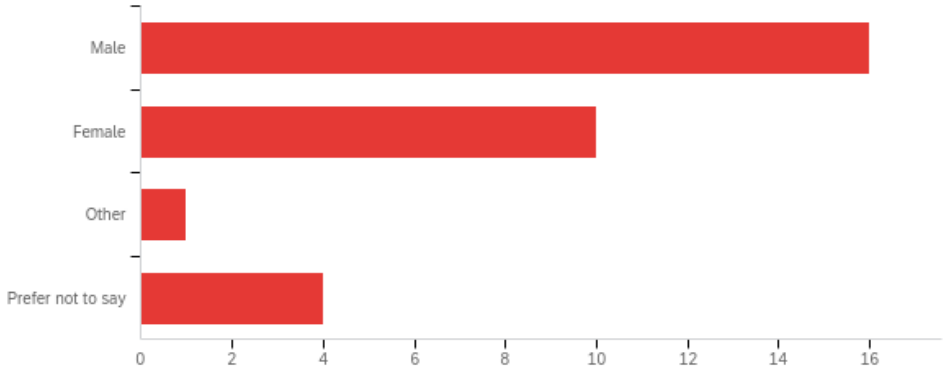

Figure 3: Gender distribution of respondents

Table 2 shows the results of the student survey on the 7 functional questions. The student surveys indicate that overall the students like both formats for helping them with problem solving, and improving their understanding of the subject matter. The students also felt that the average video length of ten minutes was appropriate for both the formats. In addition, the students indicated that the videos were a worthwhile investment of time irrespective of modality. The students did seem to indicate that they found the lightboard videos a bit easier to understand compared to the standard video. It was also interesting to note that students did not think that having live handwritten notes vs premade equations on a slide presented any advantages in formats.

Table 2: Results of student survey about functional questions on the two video formats

#	Question	Strongly Disagree		Agree		Strongly Agree	
		Lightboard	Standard	Lightboard	Standard	Lightboard	Standard
1	The videos were easy to watch and understand.	6.45%	10.00%	38.71%	56.67%	54.84%	33.33%
2	The videos helped me visualize the problem solving process.	3.45%	16.67%	51.72%	63.33%	44.83%	20.00%
3	The videos helped identify major points in solving each problem.	16.67%	22.58%	46.67%	58.06%	36.67%	19.35%
4	Having handwritten notations (equations, etc.) helped with my understanding.	3.23%	3.23%	61.29%	67.74%	35.48%	29.03%
5	Overall, the videos improved my understanding.	9.68%	9.68%	48.39%	64.52%	41.94%	25.81%
6	The length of the videos was appropriate.	9.68%	9.68%	61.29%	64.52%	29.03%	25.81%
7	Watching the videos was an effective use of my time.	6.45%	9.68%	64.52%	67.74%	29.03%	22.58%

In addition to the functional questions, the students were also asked to choose their perceptions about engagement, ease of learning, stimulation and overall satisfaction with time spent on learning vs the two video formats. Figures 1-4 show the distribution of the student perceptions of the video formats. Overall the students showed a clear preference for the lightboard videos vs. the standard video. What was interesting to note was that while the students felt the lightboard videos were more engaging and stimulating, a substantial number of the students indicated that the standard video was an easier format to learn from. While this number did not exceed the

number of students who thought the lightboard video was easier to learn from, it was still an interesting to note that ten of the thirty one students felt it was easier to learn from the standard video format.

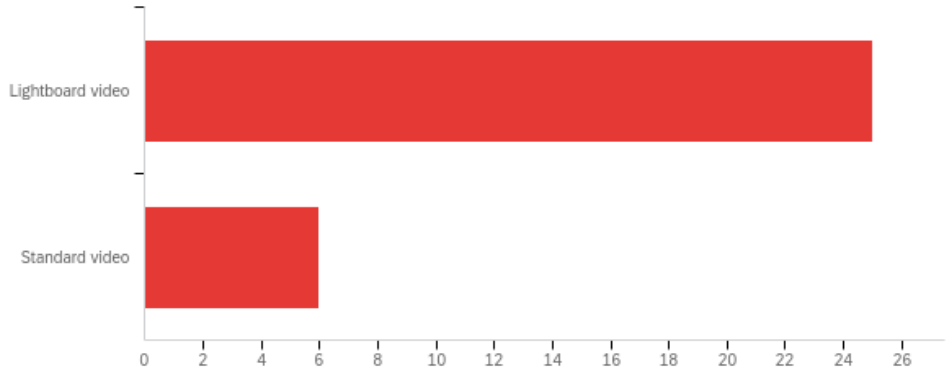

Figure 4: Which of the video formats did you feel was more engaging?

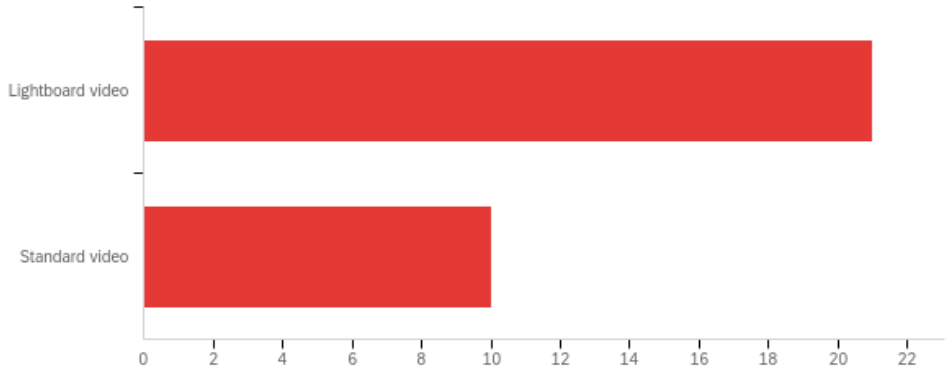

Figure 5: Which of the video formats do you think was easier to learn from

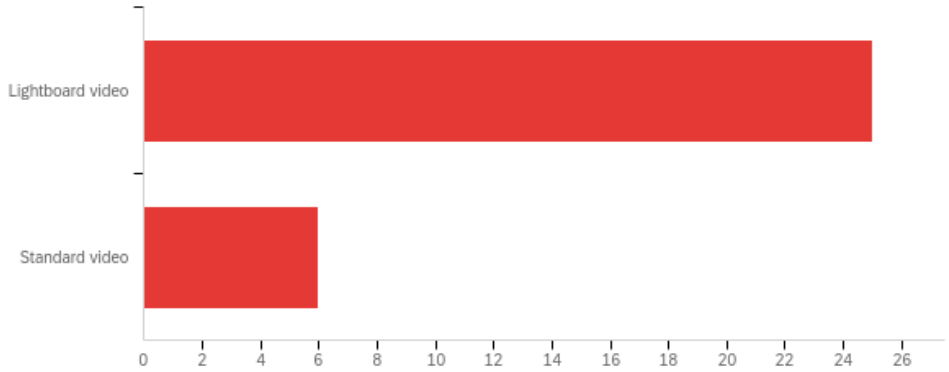

Figure 6: Which of the video formats did you find more stimulating?

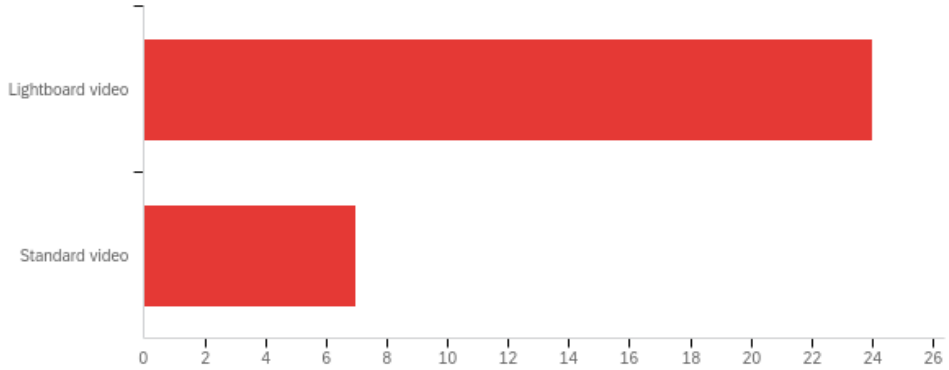

Figure 7: Which of the video formats were you more satisfied with in terms of time spent and learning?

Table 3: Cross tabulations of Gender

		Gender				
		Total	Male	Female	Other	Prefer not to say
	N	31	16	10	1	4
Q5: Which of the video formats did you feel was more engaging?	Lightboard video	80.6%	75.0%	80.0%	100.0 %	100.0%
	Standard video	19.4%	25.0%	20.0%	0.0%	0.0%
Q6: Which of the video formats did was easier to learn from?	Lightboard video	67.7%	56.3%	80.0%	0.0%	100.0%
	Standard video	32.3%	43.8%	20.0%	100.0 %	0.0%
Q7: Which of the video formats did you find more stimulating?	Lightboard video	80.6%	75.0%	80.0%	100.0 %	100.0%
	Standard video	19.4%	25.0%	20.0%	0.0%	0.0%
Q8: Which of the video formats were you more satisfied with in terms of time spent and learning?	Lightboard video	77.4%	75.0%	70.0%	100.0 %	100.0%
	Standard video	22.6%	25.0%	30.0%	0.0%	0.0%

The crosstabs indicate that even though the students preferred the lightboard videos and felt they were more satisfying in terms of time spent and overall engagement, they also showed a fairly strong proclivity towards believing that the standard video format was easier to learn from.

In addition to the above we found no statistical significance between preference for a particular format to age, gender or ethnicity.

Select open ended student responses

Please tell us why you preferred the particular video format you chose
It was easier to follow along with videos where it looked like the professor was looking at you where his face was a small window at the bottom
I did not think the videos were easy to compare. Some topics were better in one format over another so the comparison was difficult. I would have liked to see an option to select both
I liked both formats but prefer the old school video (*standard video*) because they get to the point.
The equations and worked out problems look much better on the lightboard than the other video with the powerpoint format. It may not be the instructors fault so I don't mean to penalize the instructor, but the lightboard also looks better overall. I do think the lightboard video is slightly washed out and need adjustment, but I felt like I should pay more attention.
I felt that the instructor spent more time creating the lightboard video and I appreciate that much more.
I like the lightboard videos because they seem shorter. when i go back and timed the video, the videos were almost the same lenght of time, but the lightboard videos seem shorter. So if I have to go revise, I think i will use the lightboard videos.
This *(standard)* video resembled the different notes and books so I found it better to learn from. The videos on the glass were very interesting because it felt like the instructor was interacting with everyone directly.
I liked the lightboard video because it felt like the instructor was teaching to me and felt more personalized. I don;t mean to say that the other video was bad, but this video was like a see through blackboard and we could see the instructors expression like we would in class

Discussion

This study matched previous studies that showed a strong preference among students for the lightboard videos vs the standard videos. It was interesting to note thought that even though the students strongly preferred the lightboard videos for engagement, stimulation and satisfaction, a large number of them indicated easier learning from the standard video. Analysis of the open ended responses show that the students may potentially view the lightboard videos as a bit distracting compared to what was termed “old school” videos or standard videos in our parlance. Further study is needed to tease out the exact nature of this slight deviance from the expected.

Social presence and instructor presence has a very strong influence on student perceptions of learning and we speculate that the fact that the instructor can be seen in a lightboard video make the building of social presence easier leading to the students feeling a great sense of instructor presence and engagement.

Overall student performance measured in terms of grades did not show any statistical significance, but the students choosing lightboard videos always indicated that they felt they learned more from those videos. We are designing a study to track these students and see their performance in future courses that leverage the content from this course.

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