

Student Perceptions of Indexed, Searchable Videos of Faculty Lectures

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Abstract—*This paper describes a large-scale study of student use and perceived value of videos of faculty lectures as an additional learning resource. The survey-based study was conducted with ~2,300 college students in biology, chemistry, computer science, geology, and mathematics. The study provides a nuanced understanding of the nature and frequency of students' video usage; student perceptions of value of video use; and differences in use and value by students representing different groups (field of study; student demographics; demands on students' time; students' goals, previous experience, and commitment to education). Most students used the videos and a very strong majority valued them as a learning resource. Students with longer commute times were more likely to use the videos. No evidence was found that videos are used in place of going to class. On the contrary, students who used more videos also were more likely to attend class. Students overwhelmingly valued the finding tools (index and search). The value that students place on video lectures as a learning resource exceeds expectations. This study contributes to the growing body of evidence that making video lectures available, especially when they have features that aid finding specific sections, is worth faculty time.*

Keywords—*study aids; educational technology; audio/video capture*

I. INTRODUCTION

Electronically mediated learning, or e-learning, has become more and more prevalent as departments and professors seek to improve undergraduate education. One strategy that has gained increasing attention in science, technology, engineering, and mathematics disciplines is the capture of faculty lectures. Faculty use software to record videos of whatever is projected onto the screen of classroom lectures as well as the accompanying audio, then post them as a resource for students' learning and reviewing. While several studies have examined the utility of this innovation in blended or distance learning [1]–[3], a growing number of faculty who teach traditional courses are making lecture videos available to students. In an effort to improve understanding of whether student outcomes of providing lecture videos warrant the faculty resource of providing them, we examined student use and perceived value of lecture video recordings at a large, public university in the United States. In this paper, we begin by reviewing existing scholarship regarding lecture videos, then report on the results of our survey-based study. We discuss overall student use,

students' beliefs about the value of videos, and the effect video availability has on self-reported attendance.

We should note that the literature we review here primarily deals with lecture videos used alongside traditional instruction, and not inverted or so-called 'flipped' classrooms. Inverting a class means asking students to watch a video or review foundational material before class, then using class time for other learning activities, such as collaborative problem solving. While lecture videos provide the ability to invert classrooms in subsequent semesters—indeed, as has happened at the university where we conducted this research—this study only examined use and value of recordings that were captured during class and later posted as a study aid. For more information on inverted classrooms, we recommend articles by Bishop and Verleger [4]; Mason, Shuman, and Cook [5]; and Redekopp and Ragusa [6].

II. REVIEW OF SCHOLARSHIP ON LECTURE VIDEOS

A. Studies on Student Outcomes

Several studies have identified positive student perceptions of using lecture recordings. Typically when faculty provide videos for optional use, students use them, enjoy using them, and perceive them to be a valuable resource for learning [7]–[20]. Lecture videos allow students to review material at their own pace [13], [15], [20], which can be particularly useful in classes where either the students or the instructor are non-native speakers of the language of instruction [8], [21]. Overall, students report a positive impact on grades and overall satisfaction in class [8], [12], [13], [15], [16], [20], [22]. A few studies compare student quiz and/or test scores when they were either provided video lectures in addition to regular lectures or not [9], [15], [20], [22]. These studies have mixed findings, some finding a significant difference between treatment and control groups, while some find no significant difference. More rigorous study in which researchers randomly assign students into treatment vs. control groups may shed light on the conditions under which students derive improved learning outcomes.

Although nearly every study reports that students value lecture videos, students can have negative or ambivalent experiences with lecture capture. This generally occurs when

students are not told that the tool exists or the professor did not draw attention to the resource [12], [13]; technical issues; using static, slide-only videos [22]; and increase in student workload associated with learning unfamiliar technology [16], [22].

B. Faculty Concerns about Providing Recorded Lectures

Faculty raise substantial concerns about implementing lecture recordings in their classes. Faculty want to make sure videos are used by students and want to make sure that videos do not significantly change how they perform their roles as educators.

1) Use: Cost of Production Compared to Use

One concern faculty have about making lecture videos available to students is that after the necessary time and financial investments necessary to record and post videos, students may not use them. Previous studies have shown mixed results. For example, in a study by Bell, Cockburn, Mckenzie, and Vargo [23] only thirteen people out of 764 accessed the digital records throughout a four month period, which was further exacerbated by low attendance rates. Yet when the professor asked if the digital lectures should be removed, fifty-three students responded to say that they should be kept available, because they were hoping to use them in the future. Similarly, in several other studies, optional use levels often hovered at between 40 and 68 percent [12], [13], [21], [24], [25]. Some evidence indicates that usage decreases as a semester progresses [22] or spikes only before exams [12], [26]. With these low figures, many faculty wonder if the time, finances, and resources required to record, render, and post lecture videos is worth the effort.

2) Attendance: Fear that Students Will Skip Class

Faculty also want to make sure that students are using videos for review or study, and not as a substitute for attending class. There is widespread—and somewhat justified—fear among faculty members that providing videos may result in a decrease in attendance [7], [10], [17], [20], [21], [23], [25], [27], [28], which may have a negative impact on student performance. Several studies have shown that absenteeism *writ large* has a substantial negative impact on grades, even when controlling for other things like aptitude and previous grade point average [29]–[33]. Similarly, some studies indicate that students who use online class resources (e.g., lecture videos or online notes/slides) in lieu of attending class often perform poorly compared to those who attend class [14], [15], [34]. In two studies, some students believed online class material eliminated the need to attend lectures, but didn't access the lectures because there was no pressure to do so [15], [23]. These students subsequently performed poorly because they had little, if any, exposure to the material.

Empirical evidence concerning how lecture videos influence attendance is mixed. Some studies refute an absenteeism effect, finding no change or even an increase in attendance when lecture videos are provided to students [8]–[12], [21], [25], [35]–[37]. However, some comparative studies support a relationship between absenteeism and lecture videos.

These studies show that the availability of online lecture videos is associated with decreased attendance [15], [20], [23] sometimes as much as 25 percent of the total class enrollment [15]. Furthermore, several studies show that up to two-thirds of students use videos to make up for a class they missed [14], [20], and in at least one study, video use increased when attendance declined [20].

3) Role Change: Replacing the Live Person with Video

Students in most studies report that they do not want videos to replace live face-to-face lectures or class time, but instead prefer them as a supplement [8], [15], [22]. However, faculty still fear that their roles as educators may be fundamentally changed by lecture videos, and not for the better. Faculty believe that as educational services expand, universities will respond to student demands and forcibly transition traditional classes to a distance learning format, which will reduce contact with students and require faculty to perform roles in a new, challenging environment.

C. Summary of Existing Scholarship

The majority of the studies reviewed here were small studies and often surveys were conducted by the faculty members teaching the class. Nevertheless, nearly every study suggests that students value having the videos as an additional resource for learning. In several studies, students report that they value the videos for getting high grades, but we found few controlled studies that used random selection and assignment to compare student learning outcomes with or without videos. Such studies may be less likely if ethically, researchers believe that a resource strongly valued by students should be made available to all students. Despite strong value by students, faculty are uncertain that it is worth their time and effort to produce videos, since they are not sure if students will use them, fear that attendance will drop, and relatedly, fear that faculty-student interaction may be greatly reduced. Few studies conducted inferential tests to identify groups of students who might value or use lecture videos more. Students at university have many competing demands on their time that can influence their academic performance, including commute times, gainful employment, and family obligations. Most students in our sample reported relatively long commute times to campus, take full course loads, and worked at least part time to earn income. For many students, English was their second language. Some students provide for dependents (children, aging parents, etc.).

Below we present the findings of a large-scale survey created and administered by the first author, who was not involved in any of the courses taught, that examines differences in value, use, and attendance under different student conditions.

III. LECTURE VIDEOS AT UNIVERSITY OF HOUSTON

The Indexed, Captioned, Searchable Video Player (ICS Player) was developed by Subhlok and colleagues at the University of Houston Department of Computer Science. The ICS Player provides video enhanced by indexing based on scene changes and time as well as search capability created

with optical character recognition and image recognition algorithms. (For more information on the technical development of the player, see Tuna, et al. [38].) As shown in Figure 1, the ICS Player user interface consists of an index menu on the bottom that displays a slide keyframe and time index, a playback timeline, a search bar on the top right corner, and in some cases, a transcript and captions of associated audio. The search and index features allow users to either watch the entire video or to jump to specific places of interest. The developers of this video framework have made it freely available to faculty at any academic institution who wish to implement the system.

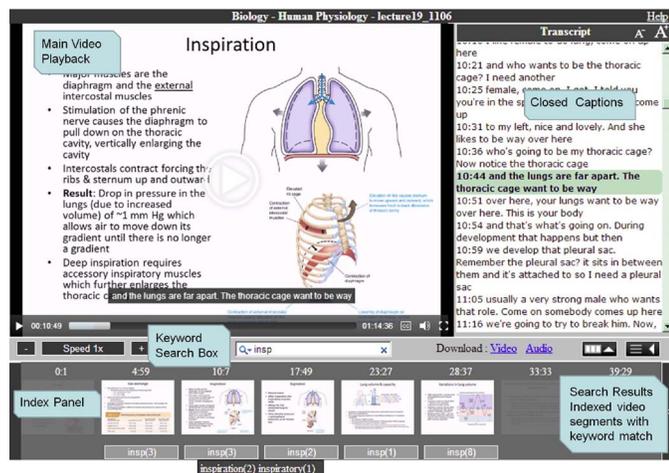


Figure 1: ICS Video User Interface

The lecture videos on which this study is based included anything a faculty member projected during class as well as the audio of the lecture itself. Faculty used tablet PCs so that they could actively write or draw on slides or other media. The video contents could include lecture slides, annotations, equations, algorithms, answers to student questions, and more. The videos were accessed by students in a password protected location usually available within several hours after a lecture completed. Videos could be streamed directly from the site (which enabled mobile device playback), or downloaded and played from a personal or campus computer, depending on faculty preferences for copyright.

Between Spring 2009 and Spring 2011, individual faculty members posted anywhere between 7 and 50 videos per course (mean = 25.13, $S = 9.89$). This study uses data collected from courses in biology (14 sections), chemistry (3 sections), computer science (13 sections), geology (10 sections), and mathematics/physics (3 sections). Class sizes varied in size from 8 to 1,000, with an average of 390 ($S = 275.88$). In 6 sections, attendance was required either explicitly or implicitly (e.g., by including graded quizzes) by the professor.

IV. METHODS AND PROFILE OF STUDENTS SURVEYED

A. Data Collection Period and Procedures

Data were collected from 2,394 students at the end of each of five semesters between spring 2009 and spring 2011. Index and search functions were not available in the first semester, spring 2009. Sample sizes in spring and fall semesters were relatively similar ($n = \sim 600$ /semester), though specific course response rates fluctuated in part due to the class size (response rates negatively correlated with class size) and partially due to the optional nature of participation and the reliance on faculty to publicize the survey. Faculty were provided a script and survey link to send to students via email; the script heavily emphasized that faculty would not know whether students took the survey or not and that taking the survey would not positively or negatively affect their grade. Faculty were also asked to send a reminder, but did not always comply. The overall response rate was 29 percent of total enrollment in the courses.

Students who took sequence or linked classes, or who took more than one class in a single semester in which ICS videos were implemented, may have been included multiple times in the sample. However, because each faculty member implemented the videos according to their own personal preferences and incorporated the videos with greater or lesser effectiveness, we believe that including each response represents a sufficiently 'independent' case in that each respondent interfaced with videos in a unique way.

Surveys were collected in the last two weeks of the semester using an online survey instrument. The surveys were developed from open-ended questionnaires used in previous work [19], tested in 2008, then standardized in subsequent terms. Survey items solicited information regarding video access, including the use, nature, and frequency of use; need, value, and class preparation; variables related to educational experiences including expected grade, credit hours taken, hours spent studying per week, and academic year; and individual life experience variables including hours worked to earn income, commute time, marital status, number of dependents, English competence, and demographic information. Further details concerning the procedures and results of the survey are available online at icsvideos.cs.uh.edu.

B. Survey Respondent Profile

Most survey respondents were undergraduates, though some graduate students also participated. While the majority of courses used in this study were introductory or lower-level undergraduate classes, student distribution among academic year was broad (Freshmen = 23 percent, Sophomores = 23 percent, Juniors = 29 percent, Seniors = 25).

The majority of respondents were drawn from biology (73.6 percent), followed by computer science (13.0 percent), geology (5.8 percent), chemistry (3.9 percent) and mathematics or physics (3.8 percent). Reflecting a U.S. national trend in biology and life sciences, 61 percent of our total respondents were female, largely due to the overrepresentation of females

in biology; the combined percentage of females in other disciplines in our sample was 42 percent. While 94 percent of respondents were American citizens, approximately 33 percent report that English is not their native language. Still, most non-native speakers rated their English competence highly.

Students at the University of Houston often do not live in resident halls on campus and work more than the national average. Houston is a large city, the fourth most populous and fifth largest in size in the U.S. Thus, commute time for students was considered a possible predictor of use and value of videos. The average one-way commute time to campus was between 30-45 minutes. More than half of full time students, 54 percent, reported being employed to earn income, which is higher than the national average of 41 percent [39]. Seven percent of our total sample reported working 36 or more hours per week.

Eleven percent of undergraduates and 30 percent of students who were post-baccalaureates (seeking second postsecondary degrees) reported being married. Three percent of undergraduates were single parents, while 11 percent reported caring for one or more dependents, including parents or other relatives. The majority of students (88 percent) felt that attending class was important regardless of whether videos were available or not and almost every respondent (99.7 percent) reported being very concerned about their course grade and their overall grade point average.

V. FINDINGS

Below are the findings of the survey. We report differences among groups only when they were shown to be statistically significant. Otherwise, the reader can assume there were no differences found among groups.

A. Overall Use and Differences in Settings and Groups

1) Use, non-use, and reasons for both

A majority of students, 84 percent, used at least one of the lecture videos made available by faculty, while on average students viewed about 40 percent of the videos offered. Thirty-four percent of students reported viewing all of the videos their professor posted. Most students viewed a video only once or twice. Students were asked how they used the videos, the results of which are listed in Table 1. The most common reason for not using videos was that students felt attending lectures and taking notes was sufficient, but most felt videos were a good idea. In only a few cases did students cite technical issues as a reason for not using videos.

Table 1. Students were allowed to answer with as many responses as were applicable. Of the students who responded to this question, more than three-quarters typically used videos in a targeted way to study for tests or assignments. Nearly the same percentage reported using videos to cover difficult material, or material they did not understand during the lecture. Roughly 70 percent used videos to make up for an absence. A little over one-third of students used videos to review material they had missed while in class.

The most common reason for not using videos was that students felt attending lectures and taking notes was sufficient, but most felt videos were a good idea. In only a few cases did students cite technical issues as a reason for not using videos.

Table 1: Why Students Used Lecture Videos

Student Use of Video	% Selected
Review for Test or Assignment	76.7
Review Difficult Material	76.2
Make Up for Absence	70.4
Review Something I Didn't Hear in Lecture	36.2

2) Student and course factors influencing use

Several factors influenced student use of lecture videos, though some factors expected to influence use did not. Among the variables working to earn income, course load (in semester hours), being a single parent, number of dependents, and commute time, only commute time was positively, albeit weakly, associated with use of videos ($r_{n=1064} = .087, p < .01$). Females accessed more videos throughout the semester than males ($t_{df=849.54} = 3.158, p < .01$).

Eastern/Southeastern Asian students, and South Asian students were both more likely than Whites to use videos ($p < .05$); South Asians were also more likely to use videos than Black or Hispanic students ($p < .05$). Confirming previous studies that show videos may be more helpful to non-native language speakers, non-native speakers of English accessed more videos than native-English speaking students ($t_{df=1041} = 2.645, p < .01$) and were more likely to watch a single video more times ($t_{df=525.54} = 4.840, p < .001$). However, native and non-native speakers rated videos equally highly in facilitating getting the grade they wanted and in clarifying material.

The total number of students in the class affected use: size of enrollment was weakly, positively correlated with use of videos ($\rho_{n=1086} = .231, p < .001$) indicating that as class size increased, so did the percentage of videos viewed.

B. Perceived Value of Lecture Videos and Comparison to Other Learning Resources

Overall, we found convincing evidence that students found the videos valuable. On a battery of questions using a six-point Likert scale (1="strongly disagree" to 6="strongly agree"), we found that students overwhelmingly believed videos helped clarify material, helped students review material, and helped study for quizzes and tests (see

Table 2). In fact, fewer than 2 percent of students disagreed that videos were valuable on any of these questions. Almost two-thirds (65 percent) of students rated the videos as very important in earning the grade they hoped to receive.

Female students were significantly more likely to agree that having access to lecture videos was important ($p = .02$). This is likely due to gendered differences in attitude towards school: women also agreed more strongly that their grade point average was important to them ($p = .011$) and that getting a good

grade in the class was important (though the latter is just past the conventional threshold for statistical significance at $p=.057$). However, males typically expected to receive slightly higher grades in the course—average around a “B”—than their female counterparts, who expected to get a “B minus” ($p=.000$). This is consistent with many other studies in which men over-report and women under-report confidence.

Table 2: Perceived Value of Videos

Survey Item	N	Mean*	SD
Lecture videos help me to clarify material that was not clear in class.	1945	5.45	.81
Lecture videos are useful for reviewing.	1982	5.64	.71
Having access to lecture videos for this class is important to me.	1960	5.60	.78
The lecture videos helped me to study for quizzes or tests.	1932	5.54	.82

*Scale, 1=Disagree strongly, 6=agree strongly

Students rated the importance of the videos in comparison to other resources offered for learning. Figure 2 shows the relative numbers of students who rated each resource as “very important” to their learning in the class. Professor’s lecture notes had the largest percentage (87 percent) of “very important” ratings, while lecture videos had the second-highest percentage of “very important” ratings, at 66 percent. Personal notes received slightly fewer “very important” ratings than lecture videos. Textbooks were only thought to be very important by 30 percent of students.

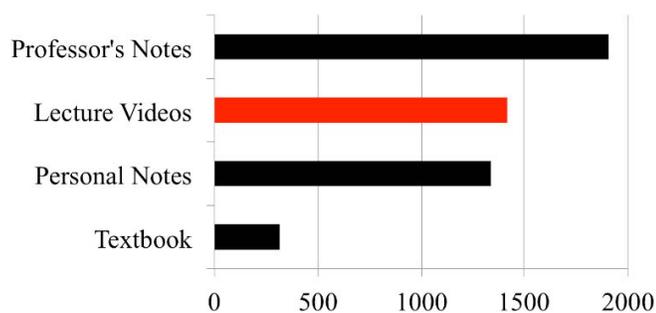


Figure 2: Student Ratings of "Very Important" Resources

C. Attendance Unaffected by Video Availability

Debate about attendance is far from settled, but our evidence suggests that the availability of lecture videos did not increase absenteeism. About 17 percent of students reported attending every class, with an additional 54 percent of students reporting attending three-fourths or more of class sessions. Nonetheless, 70 percent of students used lecture videos to make up for an absence at least once during the semester, which was positively (but weakly) correlated with the number of lectures a student viewed ($r_{n=444} = .139, p<.01$). We also compared absenteeism of students who reported watching no

videos at all to absenteeism of students who watched at least one video and found that those who watched at least one video attended significantly more class sessions ($t_{df=235,346} = -3.205, p=.002$; equal variances not assumed).

Overall attendance rates were positively, moderately correlated with using videos for absences ($r_{n=1488} = .312, p<.001$), meaning that the more students went to class, the more likely they were to use videos in the event that they were absent. This finding is consistent with a positive, moderately weak correlation between overall use and attendance ($r_{n=1064} = .218, p<.001$), meaning that students who attend more actually use the videos more. Second, a variable asked students to what extent on a scale of 1 (strongly disagree) to 6 (strongly agree) they agreed that events in their personal or work lives had interfered with their studies; this variable was positively, weakly correlated with attendance ($r_{n=1136} = .156, p<.001$), meaning that students who felt extracurricular life events got in the way of studying were more likely to attend class. Similarly, extracurricular life events were also positively correlated with using videos to make up for an absence. Finally, attending class was positively correlated with the belief that the lecture videos were important in earning the grade the student hoped to get ($r_{n=1896} = .181, p<.001$).

D. Index and Search Features

What differentiates the lecture videos used in this study from many other studies is the incorporation of indexing and search functions in the videos. To test the value added by these features, we created a reliable scale variable, Overall Attitude Towards Videos, by combining six variables (Cronbach’s alpha was .84):

- Lecture videos help me to clarify material that was not clear in class;
- Lecture videos are useful for reviewing;
- Having access to lecture videos for this class is important to me;
- The lecture videos helped me to study for quizzes or tests;
- How important was use of the lecture videos for this class for getting the grade you hoped for?
- Rating of the importance of lecture videos for learning in this class.

We then compared the results of this composite variable between students who had access to indexed, searchable videos and students who had access to video that lacked these features. Students who used indexed videos scored significantly higher than students who did not use the index feature ($t_{df=616} = -3.284, p<.001$), showing that students valued videos more when they were indexed. We calculated the magnitude of the effect size using Cohen’s d , and found it to be small to moderate ($d = 0.265$).

Of the 447 students who used the index feature of the videos, responses were very positive concerning the usefulness

of the index. An overwhelming 97 percent felt the index was helpful. Ninety-three percent reported knowing immediately how to use the index (operationalization of “intuitive”), while 96 percent felt the placement of information and images made the index easy to use. Ninety-one percent felt the time intervals were appropriate for the lectures. No significant differences were found in use or appreciation of the index feature between race, gender, or nationality groups.

In open-ended questions, students noted that the indexing feature saved them time and helped them return to where they were if studying interruptions occurred in open-ended comments. For example, one student wrote, “I didn’t have to wade through the rest of lecture just to answer one question,” while another wrote, “Sometimes I would have to pause the lecture to take care of other responsibilities that I had to attend to, and when I was ready to come back to the lecture I’d pick up exactly where I was at. It was great!”

The search tool was first implemented during the 2010-2011 academic year and evaluated in the Spring 2011 survey; as a result, the available sample size is small. The search tool was underutilized by students; only 46 students used this feature. We speculate that the lack of use is largely due to several issues the students had no control over. Students were not informed by their faculty that a search feature existed, the search icon did not stand out in the interface, and the feature was inactive for part of the semester due to technical reasons. Nonetheless, of those that used the search function, 96 percent reported that the tool was easy to use, 72 percent usually knew which search terms to use to find what they were looking for, and 70 percent felt the tool was helpful most of the time in jumping to segments of the video they needed.

VI. DISCUSSION AND CONCLUSION

Large lecture courses are often the only possible response to a very real problem of increased demand and scale as an affordable way to manage large enrollments. Having 200 to 1000 students enrolled makes it extremely difficult for an instructor to interact personally with students, an important predictor of student engagement and retention [40], [41]. While lecture videos cannot replace dialogic communication with one’s professor, it does allow a student to re-hear a professor’s explanations and viewpoints on what they are learning. This study adds to the growing body of evidence that providing videos of faculty lectures, especially when they contain useful finding tools for finding specific content, is highly valued by students for their learning.

This study was consistent with previous studies that most students use sections of a video to review concepts they are struggling with [12], [13] especially before assignments, quizzes, and exams [8], [9], [12], [14], [16], [35]. We also found a weak, but significant correlation between a student’s self-perceived competence with English and use of videos. In contrast to previous studies [12], [13], [35], students overwhelmingly indicated viewing all or nearly all of the lecture (81 percent). However, our results confirm that when it is possible to easily find a section one is looking for through

index and search functions, students take advantage of the opportunity and then value lecture videos even more. Notably, two other studies [8], [13] have incorporated search features and both found that students were overwhelmingly positive about the ability to find specific concepts or sections of a lecture, saw improvement in grades, and were better able to engage with material. Despite the small sample size, we found evidence that supports future use of this feature and recommend that faculty draw attention to the search tool.

Lecture videos were strongly valued by students, second only to professor’s lecture notes. This finding is consistent with other research that indicates providing “complete” lecture notes or lecture scripts may have similarly beneficial outcomes [34], [48], [49] and with previous research that shows students value having digital media as a resource more than they value their own notes or textbooks [42]. We also found that students with longer commute times use videos more. No doubt those students would benefit from the ability to review lecture videos during their commute, whether they only listen or are able to both listen and view (e.g., on a train).

In contrast to faculty concerns that furnishing students with videos of lectures may be a waste of time and money, we found that a majority of students in this sample viewed one or more videos. Some faculty concern could be resolved by maximizing the efficiency of recording, rendering, and posting videos, and only incorporating features students find valuable. For example, faculty could survey students to find out which devices students expect to use for viewing and then render them only for commonly-used devices or platforms. Similarly, there are a number of inexpensive or free video rendering software tools such as iMovie on MAC or Windows Movie Maker, and inexpensive or free delivery modes including iTunes podcasts and YouTube that can reduce costs and the amount of time it takes to learn new software. Several articles offer detailed instructions on how to use “off the shelf” software that automates much of the effort (for example, see [11], [35]).

We found no evidence for faculty concerns that students will not attend class when videos are provided. In other studies we reviewed, most (but not all) had average attendance rates no higher than 68 percent, and in the case of a German dermatology medical graduate program, as low as around 20 percent [25]. Second, studies of the availability of other online resources like PowerPoint slides have shown that attendance similarly drops when non-video resources are provided [34]. Finally, student-related factors such as personal motivation, previous positive experiences in field-related coursework, GPA, race, and academic year strongly influence attendance [29]–[33], [43]. Although these are not typically thought of as factors professors can influence, there are several attendance-related factors that can be influenced, such as improving interactivity in class, showing enthusiasm for the material, creating personalized expectations of commitment and engagement, and reinforcing attendance as a grade component, either by directly calculating attendance into final grades, or through classroom-based quizzes [4], [33], [43]–[47].

In this study, dedicated students used lecture videos to review material regularly and get the grade they hoped for; it is therefore no surprise that videos were also helpful to them in the rare event that they missed class. Evidence that students whose life constraints had interfered with their studies were more likely to attend class suggests that certain students probably put a lot of pressure on themselves to attend class. The availability of the videos may have helped alleviate any punitive repercussions of missing for legitimate reasons, as was the case for one student who missed class due to morning sickness associated with a pregnancy. We therefore find no evidence that the availability of lecture videos encouraged students' absenteeism.

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