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Does recording lectures help? A within-course availability comparison linking lecture capture and attendance to exam performance

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Lecture capture (LC) has become a standard feature in higher education, yet its impact on student performance and attendance remains contested. This study used a within-course availability comparison across four in-person undergraduate biology courses (N = 277, 352 enrollments), in which half of lecture blocks were recorded (LC-ON) and half were not (LC-OFF). Each block culminated in an independent exam, enabling within-student comparisons of performance under LC-ON versus LC-OFF conditions. Attendance was tracked electronically, and LC use was quantified from Zoom analytics.

Students who accessed at least one LC video scored 4.7% higher on exams than non-viewers, consistent with self-selection differences between viewers and non-viewers. Within LC-ON blocks, greater viewing predicted higher performance (+1.3% per hour). In contrast, in adjusted mixed-effects models, exam grades were 6.0% lower in LC-ON blocks. Attendance did not significantly decline in LC-ON blocks, but higher attendance consistently predicted better outcomes. An interaction model indicated that attendance mitigated LC's negative association with exam performance.

Together, LC viewers outscored non-viewers overall; within viewers, more LC view time in LC-ON blocks is associated with higher exam %, whereas lower performance in LC-ON blocks by all may reflect behavioural changes that coincide with recording availability.

Keywords: biology; education; lecture recording; lecture videos

To access the supplementary material, please visit the article landing page.

Introduction

Lecture capture (LC), the recording of live lectures for later viewing, has become commonplace in higher education (Banerjee, 2021). This adoption of LC has been driven by many different factors. First, the accessibility and affordability of multimedia technology have significantly lowered the barriers to entry for institutions to implement robust LC systems (Watt et al., 2014). Second, student demand for flexible learning options has increased, with many students valuing the ability to revisit lecture content at their own pace and convenience (Galad et al., 2024). Furthermore, the availability of recorded lectures has been shown to enhance student well-being

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and provide crucial support for students with disabilities, thereby promoting a more inclusive learning environment (Nightingale et al., 2019).

While LC offers significant benefits in terms of flexibility and accessibility, it can also facilitate passive learning strategies and surface-level engagement if not integrated thoughtfully into the curriculum (Reid et al., 2022). From a self-regulated learning (SRL) perspective (Zimmerman, 1990), LC may support effective study behaviours such as distributed review, pacing and metacognitive monitoring for some students (Topale, 2016), while simultaneously enabling surface strategies like last-minute cramming or selective engagement for others (Yen et al., 2018). These behaviours are not unique to LC. Most learning resources can support SRL when used strategically, but LC may uniquely lower the barrier to repeated, flexible review. Together, these factors likely underpin the inconsistent findings regarding LC's impact on student learning across various studies (Johnson et al., 2021).

The impact of LC on student attendance in traditional face-to-face sessions is a critical point of contention, with some educators concerned about potential declines in physical presence despite the demonstrated benefits of such attendance on student performance (Banerjee, 2021). Reviews highlight attendance as the most frequently cited drawback of LC, and recent discussions characterise this within broader 'attendance crisis' (Uekusa, 2023). Attendance may relate to LC in two ways. First, LC availability could be associated with changes in attendance. Second, attendance may shape how (or whether) students benefit from LC and other study resources, making it important to examine attendance both as an outcome and as a potential moderator of performance (Blair & Clancy, 2024).

There is also mixed data on whether LC usage enhances student learning outcomes. Some studies find a positive correlation between access to LC and improved exam scores (Danielson et al., 2014; Gorissen et al., 2012; Hillsley, 2025). However, other studies find a negative correlation on student performance (Baillie et al., 2022; Edwards & Clinton, 2019), and some studies report no impact of LC usage on student achievement (Hadgu et al., 2016; Lusk et al., 2023). This discrepancy aligns with SRL theory, where habitual, evenly distributed strategies are associated with deeper learning (Hillsley, 2025), while reactive or last-minute behaviours often undermine performance (Voelkel et al., 2023).

Despite an extensive LC literature, few designs enable within-student contrasts of LC availability (as opposed to use) under typical course conditions. Cohort comparisons before and after LC introduction (or across sections with/without LC) are informative, but remain vulnerable to between-cohort differences (Baillie et al., 2022; Edwards & Clinton, 2019). Randomised experiments that compare live versus recorded delivery address a different question from course-long availability (Artz et al., 2022).

The present study addresses this gap using a within-course, quasi-experimental design across four undergraduate biology courses in which half of lecture blocks were recorded and made available (LC-ON) and half were not (LC-OFF), pre-specified before the term. Non-cumulative, independent exams were associated with each individual lecture block. It was hypothesised that students who engage with LC in ways consistent with SRL principles (i.e. sustained and distributed use in conjunction with regular attendance) would achieve higher exam performance, whereas LC availability without such engagement could correspond to lower outcomes overall. Furthermore, it was hypothesised that LC availability would itself impact students' study behaviours.

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Methods

Ethics

This study was approved by the Trent University Research Ethics Board (file # 29141). Study participation required opt-in consent. In initial raw data files, students were de-identified and assigned anonymised IDs that were consistent across courses for students enrolled in multiple courses.

Course setting

Four courses were included: a 1st year introductory biology course for non-biology majors, and three 3rd year biology courses. All courses had in-person lectures (10 × 2-hour weekly lectures per 12-week course) taught by the same biology instructor. Each course comprised three lecture blocks, with each block culminating in a non-cumulative exam. Exams were typically composed of a mix of multiple-choice questions testing recall and conceptual understanding with a minority of short-answer items testing conceptual understanding, application and analysis. Across courses, Block 1 lectures typically focused on foundational concepts, with Blocks 2 and 3 building on the core content. Hence, there may be varying inherent difficulty of topics between both blocks and courses. However, all exam assessments were intended to be of comparable difficulty, and students were informed that questions are *primarily* focused on conceptual understanding of content. Across students who took all three 3rd-year courses ($n = 16$), course-to-course differences in exam percentage were small and not statistically significant, supporting broadly comparable exam difficulty across courses.

Study design

LC videos were recorded using Zoom and posted on Blackboard within 24 h of lecture. Over all courses, half of the in-person lecture blocks were recorded, and half the lecture blocks were not recorded. Recordings remained available until the end of the semester; but for a given lecture, only views up to and including the day that lecture content was examined were included in analyses. Each course comprised three lecture–exam blocks; one or two blocks per course were designated LC-ON such that overall ~50% of exam blocks across the dataset were LC-ON. LC-ON/LC-OFF status was pre-specified before the term, with an equal split within each exam block across courses (i.e. half of first-block exams were LC-ON, half of final-block exams were LC-ON). Because LC status was assigned at the block-level, LC-ON contrasts are block-level interpreted as block-level availability comparisons, strengthened by replication across multiple courses taught and assessed under similar structures. Students were informed at the start of the semester which lectures would be recorded and were reminded when during the course when there was a change in LC availability. Enrollment refers to a unique student–course pairing.

Attendance was measured once per lecture using a mid-lecture electronic prompt delivered via classquestion.com. Students logged in with their university email account; the prompt recorded a participation mark that served only to register attendance for teaching research purposes only and was not for any course grades. Attendance was summarised as a proportion (0–1) of scheduled lectures attended within each block.

For LC-ON blocks where LC recordings were available, Zoom analytics logs allowed for the extraction of the following metrics: (1) lectures viewed: number of distinct lecture recordings accessed for that block; (2) unique views: total number of play sessions across the block's recordings; (3) total view time: minutes watched across the block's recordings; (4) timing of view access relative to the exam. The primary outcome was exam % for each block. The secondary outcome was attendance % for the corresponding block.

Statistical analysis

Unless otherwise noted, continuous summaries are reported as mean ± SEM and tests are two-sided with $\alpha = 0.05$. Counts and proportions are reported for enrollments (viewer/non-viewer) and for LC-ON exam observations (viewed/not viewed), including 1st versus 3rd year strata. Differences between 1st and 3rd year viewing data were evaluated with Fisher's exact test. Given the significant difference between the single 1st year course and three 3rd year courses, the 3rd year stratum was treated as the primary analytic population. Pooled analyses across all courses and 1st year only analyses are presented in supplementary data for comparison.

Complementary mixed-effects models were fit addressing distinct questions: (1) an availability-based intention-to-treat (ITT) model estimating LC's association with exam performance, (2) a parallel model testing whether LC availability influenced attendance, and (3) a moderation model testing whether exam grade was moderated by attendance. These models are not treated as multiple tests of the same hypothesis, but rather as complementary perspectives on the LC–exam relationship.

An ITT linear mixed-effects model estimated the association between recorded lecture blocks (LC-ON) and exam performance while accounting for the repeated-measures structure of the data. Models included fixed effects for course and exam block, and a random intercept for student to adjust for stable differences between students. The LC-ON term is interpreted as the adjusted difference in exam percentage between LC-ON and LC-OFF blocks, averaged across students and courses:

- Exam model (primary): exam % ~ LC-ON + course + exam block + (1 | student)
- Attendance model (secondary): attendance % ~ LC-ON + course + exam block + (1 | student)

Coefficients are interpreted as percentage-point differences associated with LC-ON (vs. LC-OFF). The intercept corresponds to the reference course and first exam block under LC-OFF. Between-student heterogeneity is summarised by the random-intercept variance (and its standard deviation [SD]). Random slopes for LC-ON by student were considered; however, with three exams per enrollment and limited within-student replication of LC-ON/LC-OFF within a course, slope models were not pursued. Wald z-tests with 95% CIs are reported.

To assess whether the LC availability effect varies with attendance, a moderation model added attendance (proportion, 0–1) and the interaction term: exam % ~ LC-ON * attendance + course + exam block + (1 | student). A positive interaction indicates attenuation of the association with LC-ON at higher attendance. Data from this moderation model generated predictive data for the impact of increasing attendance moderating exam grades in both LC-ON and LC-OFF conditions.

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A post-hoc exploratory analysis within LC-ON exams only was performed to illustrate the relationship between greater LC viewing and exam %. A linear mixed-effects model with the same fixed effects and student random intercept related exam % to viewing time per exam. Data plotted yielded a slope interpretable as exam-percentage-points per viewing hour.

Results

Data are reported from 277 unique students across 352 student–course enrollments who collectively attempted 1,045 exams after exclusion of 11 missed exams. A summary of enrollments is shown in Figure 1a. Of the 352 enrollments, 68.8% opened at least one LC recording during the term (viewers), whereas 31.3% never accessed a single LC video (non-viewers). Aggregate exam performance was higher among viewers (64.6% ± 0.9%) than non-viewers (59.8% ± 1.3%; $t = 3.17$, $p = 0.0018$). LC availability is denoted as LC-ON when recordings for an exam lecture block were recorded and posted, and LC-OFF when lectures in an exam block were not recorded. Across all lectures, LC was available as a study tool for 50.5% of exams taken (LC-ON $n = 528$, LC-OFF $n = 517$). Unless otherwise noted, LC-ON / LC-OFF counts refer to exam-by-student observations.

There was a marked difference in LC viewing behaviour between students in the single 1st year level course and those in the three 3rd year level courses as shown in Figure 1. In the 1st year course, less than half of the students (45.5%) ever watched an LC video during the course, compared to 74.1% of students in 3rd year courses. The odds of a student being a viewer were 3.44 times higher in the 3rd year courses

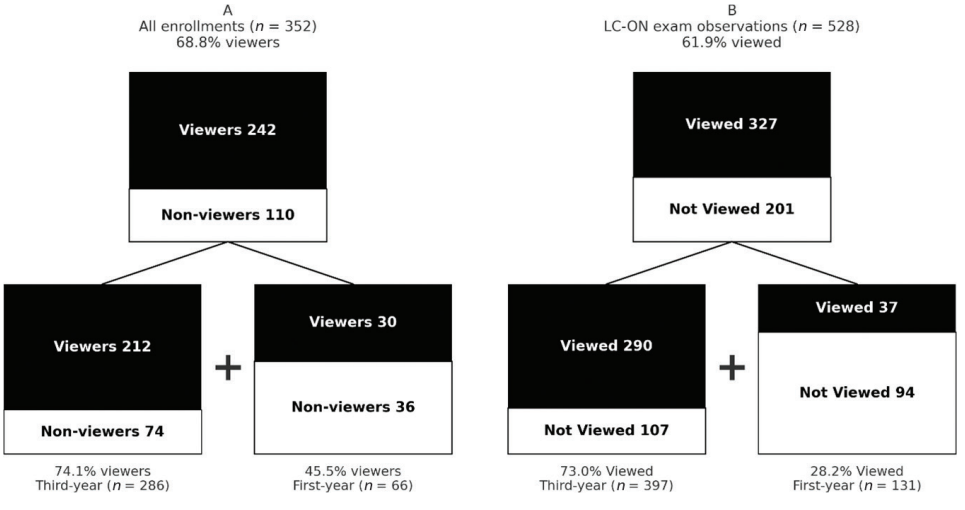

Figure 1. Enrollment composition and LC-ON usage. (a) Enrollments. Stacked boxes show composition of all student-course enrollments (top; $n = 352$) and the two strata: 3rd year ($n = 286$) and 1st year ($n = 66$). Viewers opened ≥ 1 LC recording in that course during the term. (b) LC-ON exam observations. Stacked boxes show exam-by-student observations when LC was available (top; $n = 528$) and the two strata: 3rd year ($n = 397$) and 1st year ($n = 131$). Viewed = accessed ≥ 1 LC recording in a lecture block for a given exam.

than the 1st year course (Fisher's exact $p = 1.39 \times 10^{-5}$). At the exam level, for exams taken by students when LC was available, 28.2% of 1st year students accessed ≥1 LC recording. In contrast, 73.0% of students in each of the three 3rd year courses viewed at least one LC video (range = 62%–89%). Given that 3rd year data pools across three courses and that most recent literature shows that most students access LC videos when available (Chapin, 2018; Johnston et al., 2013; Leadbeater et al., 2013), the 3rd year data are treated as the primary analytic population. All data and 1st year only data are presented within the supplementary materials for comparison. Within the 3rd year courses, there were a total of 849 exam-by-student observations. LC was available in the associated lectures for 46.8% of exams (LC-ON n = 397, LC-OFF n = 452).

An enrollment-level summary of exam percentages by viewer status in the 3rd year courses is shown in Table 1 and illustrated in Figure 2. Overall, exam grades were higher among viewers than non-viewers (+4.7%). When this analysis was restricted to LC-OFF exams, exam grades remained higher than non-viewers (+4.5%). For exams where LC was available, the exam % for viewers increased to +5.7% compared to non-viewers.

Table 1. Enrollment-level exam % by viewer status in 3rd year courses. Values are mean ± SEM of exam percentages using the student–course enrollment as the unit. 'Viewers' opened ≥1 LC recording in that course during the term; 'non-viewers' never accessed LC. These summaries are descriptive and unadjusted for course or exam block.

Group	Exam % – Overall	n	Exam % (LC-OFF)	Exam % (LC-ON)
Non-Viewers	59.6 ± 1.5	74	61.2 ± 1.5	57.7 ± 1.9
Viewers	64.3 ± 0.9	212	65.7 ± 1.0	63.4 ± 1.0

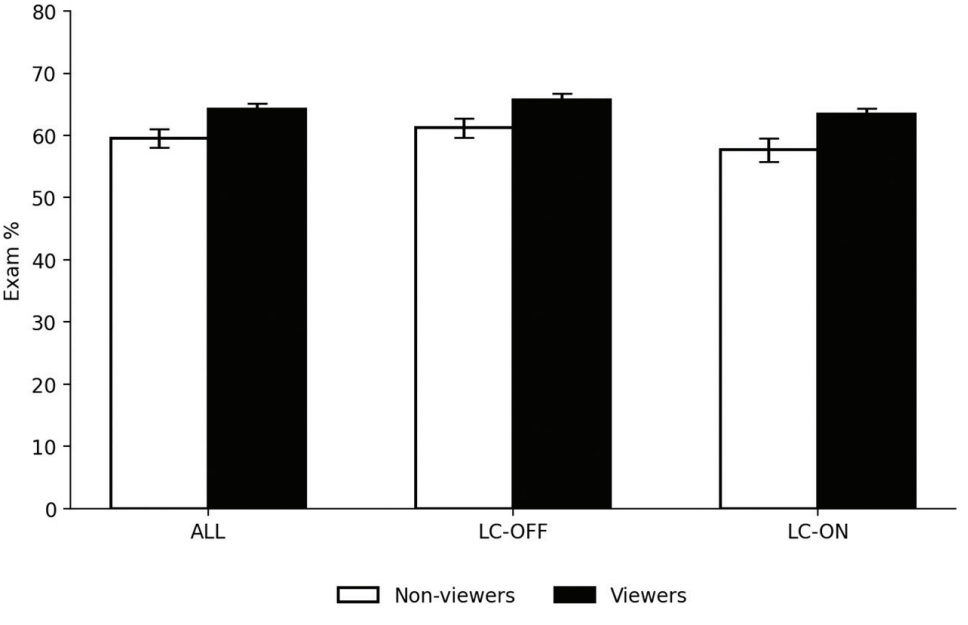

Figure 2. Enrollment-level exam percentages by viewer status for 3rd year courses. Bars show mean exam % with ± SEM whiskers.

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Within LC-ON exam blocks, exam performance scaled positively with viewing behaviour. Viewing time was positively associated with exam performance (+1.3 % points/h) among LC users as shown in Figure 3 (linear mixed-effects estimate: $\beta = 1.30 \pm 0.23$, $z = 5.60$, $p = 2.15 \times 10^{-8}$). This indicates that sustained engagement with recordings was block-level associated with higher achievement among those who used LC as a study resource. However, they also raise the question of whether the availability of LC itself alter behaviours which impact student performance. To address this, exam outcomes in relation to LC availability were examined using both descriptive comparisons and mixed-effects models.

In an unpaired analysis comparing block-level means, the mean exam % was reduced in lecture blocks where LC was available, from 64.24% ± 0.71% with LC-OFF, to 61.92% ± 0.76% with LC-ON. In a paired analysis comparing how individual 3rd year students' performance in a course varied with LC availability, it showed significantly lower exam % with LC-ON ($n = 284$ pairs, $t = -4.22$, $p = 3.33 \times 10^{-5}$), with a mean reduction of 2.62% ± 0.62%.

To estimate the LC-ON / LC-OFF block-level contrast while adjusting for course and exam block, an ITT linear mixed-effects model with a random intercept for student treated LC-ON / LC-OFF as the exposure and adjusted for course and exam block (exam % ~ LC-ON + course + exam block + (1|student)). In 3rd year courses, exam grades were 6.02% lower in LC-ON blocks than LC-OFF blocks, with data shown in Table 2. Model-based adjusted mean exam grades, averaged over 3rd year courses and blocks, were 65.16% in LC-OFF blocks and 59.13% in LC-ON blocks.

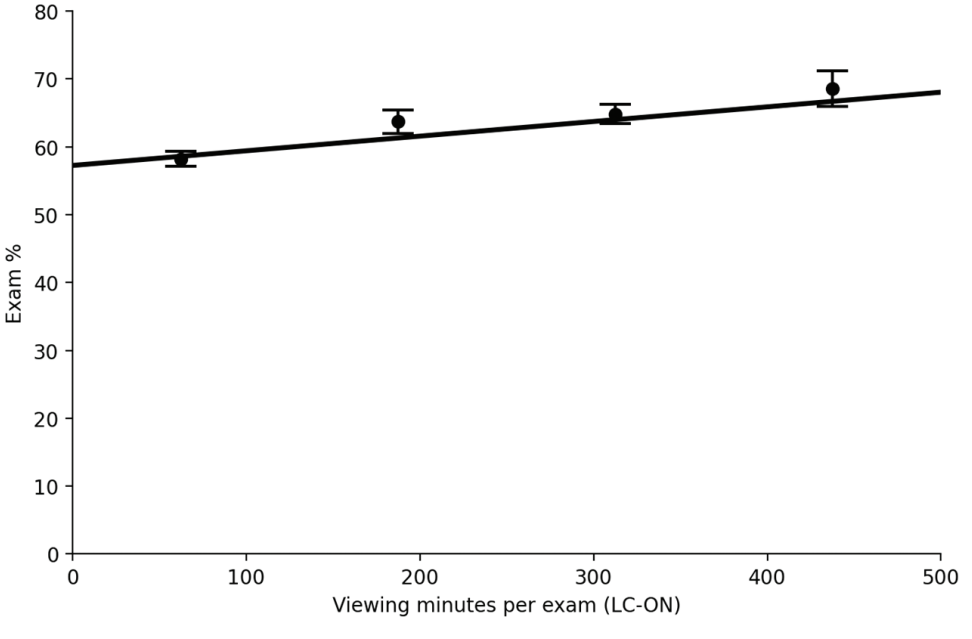

Figure 3. Dose–response of exam % to viewing minutes per exam with LC-ON in 3rd year courses. Solid line shows the adjusted prediction from a linear mixed-effects model (exam % ~ viewing hours + course + exam block + (1|student)). Points denote binned means (four approximately equal-count bins within 0–500 min) with ± SEM whiskers. Minutes reflect total viewing time across all LC recordings associated with that exam block. Analysis conditions on LC availability and observed viewing so is exploratory / associational.

Table 2. ITT mixed-effects model for exam % (intent-to-treat) and core parameters. Linear mixed-effects model with student random intercept. The intercept is the predicted mean for the reference cell (Course 1, Block 1, LC-OFF). The LC-ON coefficient estimates the mean difference in exam % (points) in LC-ON versus LC-OFF blocks. Group Var (student), the between-student variance of the random intercept (reported with its SD for interpretability), indicates substantial between-student heterogeneity in exam performance.

Term	Coefficient (β)	SE	*z*	*p*	SD
Intercept	69.62	1.43	48.71	< 0.0001	-
LC-ON	−6.02	0.88	−6.81	< 0.0001	-
Group Var (student)	153.26	-	-	-	12.4

The same mixed-effects model was re-fitted with attendance (%) as the outcome to test whether LC-ON blocks were associated with changes in class attendance (%) as shown in Table 3. The model estimated the association of LC-ON with attendance (%). LC-ON was not associated with a significant change in attendance (β = +0.16%, 95% CI [−4.50, +4.82], $p = 0.947$). Model-based adjusted means for attendance were 43.6% for LC-OFF and 43.7% for LC-ON.

To test whether the availability-based effect varies with attendance, an interaction term was added to the mixed-effects model, and the results are summarised in Table 4. LC-ON was associated with a significantly lower exam grade (−7.16% ± 1.14%). Attendance (%) was itself a significant positive predictor of exam grade (+0.04 ± 0.01 points per 1% increase in attendance). The LC-ON × Attendance interaction was positive, but not significant. The interaction trend predicted from this model is shown in Figure 4.

Table 3. Mixed-effects model for attendance (%) (intent-to-treat) and core parameters. Linear mixed-effects model with student random intercept. The intercept is the predicted mean for the reference cell (Course 1, Block 1, LC-OFF: high early semester attendance). The LC-ON coefficient estimates the mean difference in attendance % (points) in LC-ON versus LC-OFF blocks. Group Var (student), the between-student variance of the random intercept (reported with its SD for interpretability), indicates substantial between-student heterogeneity in exam performance.

Term	Coefficient (β)	SE	*z*	*p*	SD
Intercept	45.78	3.77	12.15	< 0.0001	-
LC-ON	+ 0.16	2.38	0.07	0.947	-
Group Var (student)	999.6	-	-	-	31.6

Table 4. Moderation of LC availability by attendance (availability-based model). Linear mixed-effects model with student random intercept and fixed effects for course and exam block; outcome is exam grade (%). Coefficients (β) are reported in percentage points with model-based SE, two-sided Wald z and p. A slightly positive interaction indicates that the negative LC-ON effect slightly attenuates as attendance increases.

Term	Beta (points)	SE	*z*	*p*
LC-ON	−7.13	1.14	−6.28	< 0.001
Attendance (%)	+ 0.04	0.01	3.09	0.002
LC-ON × Attendance	+ 0.02	0.02	1.52	0.128

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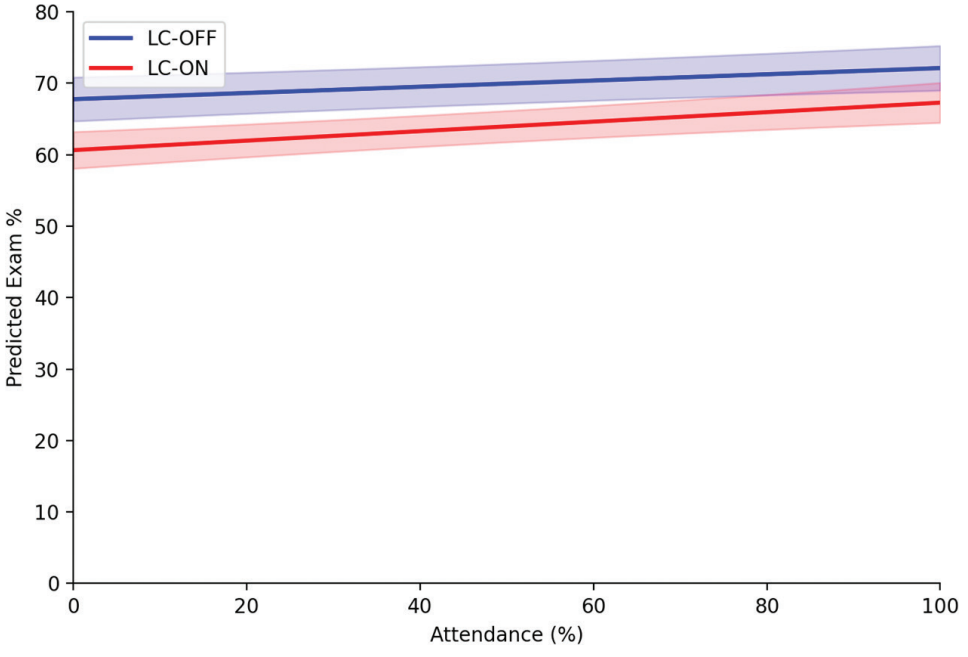

Figure 4. Predicted exam performance by attendance and lecture capture (LC) availability. Predicted exam % (solid lines) with 95% confidence intervals (shaded bands) from a mixed-effects model of 3rd-year courses (student random intercept; fixed effects for course and exam block).

Discussion

The central question motivating this research is straightforward: Does providing LC videos confer a net benefit to students? The answer to this question is far from straightforward though. Overall, exam grades were higher among students who accessed at least one LC recording than among non-viewers. However, exam performance was lower on average in LC-ON blocks, with two clarifying patterns: (1) when LC was available, greater viewing time was positively associated with exam percentage amongst viewers, and (2) the LC-ON association with lower exam percentage was partially mitigated as attendance increased.

Overall, exam grades were 4.7% higher among LC viewers than non-viewers. This positive association between LC viewing and higher academic performance has been observed in other studies (Baillie et al., 2022; Brooks et al., 2014; Hillsley, 2025). Due to the variable availability of LC videos within this study, the correlation between LC access and student outcomes could be explored for individual students ± LC availability. The fact that viewers' exam grades remain 4.5% higher than non-viewers even for LC-OFF exams is consistent with intrinsic differences between students who do versus do not engage with LC recordings, possibly indicating higher motivation, higher self-regulation or more effective study habits (Edwards & Clinton, 2019). This inherent difference suggests that student self-selection into LC usage groups might confound direct causal inferences about its impact on academic performance in observational studies (Baillie et al., 2022).

The results of this study also show that when LC videos are available, greater viewing was associated with higher exam % (+1.29% per hour of viewing). This positive association is consistent with the interpretation that sustained engagement with recordings may support learning and contribute to a deeper understanding of the course material. Together, these findings are consistent with the possibility that students who are already more motivated/self-regulated both use LC more and may derive additional benefit from recordings as a supplement (Baillie et al., 2022; Sloan & Lewis, 2014). This dual benefit highlights the potential importance of providing LC resources not as a substitute for live attendance, but as a complementary tool that can enhance learning for a diverse range of students, particularly those who are self-regulated learners (Morris et al., 2019).

Although greater LC viewing was associated with higher exam performance, exam grades were ~6 percentage points lower in LC-ON blocks in adjusted models. This pattern suggests that recording availability may coincide with changes in student behaviour in ways that negatively impact performance. For example, fostering a sense of complacency, delaying the processing of key concepts or encouraging surface approaches to learning (Trenholm et al., 2019). These findings may help explain the mixed results on the impact of LC on student performance reported in the broader literature (Banerjee, 2021).

Viewed through the lens of SRL theory (Pintrich, 2004; Zimmerman, 1990), these apparently contradictory findings highlight that LC effects are not uniform; rather, its impact depends on how students regulate their engagement. Students who adopt strategic, distributed approaches appear to leverage recordings productively, whereas those who reduce lecture attendance or defer processing of material may treat LC availability as a cue for surface-level strategies. This heterogeneity within SRL profiles provides a theoretical explanation for the wide variation in LC outcomes reported across prior studies (Banerjee, 2021).

Another key mechanism underlying this divergence of findings may be lecture attendance. Attendance is consistently linked to academic performance (Credé et al., 2010). In the present study, attendance did not differ significantly between LC-ON and LC-OFF blocks after accounting for course and block. Nevertheless, using a mixed effects interaction model with the exam % as the dependent variable offers an important nuance. Within both LC-ON and LC-OFF conditions, higher lecture attendance was significantly associated with higher exam grades. In other words, students who continued to attend more lectures appeared less affected by the lower performance observed in LC-ON blocks. This reinforces prior literature demonstrating the positive link between attendance and grades (Credé et al., 2010).

More broadly, the results indicate that the impact of LC may not be fully captured by attendance metrics alone. Beyond simply influencing whether students are physically present, LC availability may alter the quality of engagement, potentially encouraging more surface-oriented strategies such as passive listening or deferred review rather than active note-taking and immediate processing. From the perspective of SRL, recorded lectures could, for some students, reduce perceived urgency to engage deeply during live sessions, thereby weakening opportunities for effective encoding and integration of new information (Edwards & Clinton, 2019; Gardner, 2022).

There is also evidence consistent with an observer/accountability effect, whereby attendance monitoring can influence student behaviour, even in the absence of grade incentives. For example, a study in an introductory psychology course, students attended more frequently when they were required to sign in, despite no marks being attached, and their quiz performance was correspondingly higher (Shimoff & Catania, 2001).

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Similar patterns have been noted in studies of electronic monitoring, where awareness that attendance is being tracked can reduce absenteeism by creating a subtle sense of accountability (Childress, 2018). Consistent with this, attendance within the courses in this study was ~45%, compared to informal observational estimates of ~20% attendance for these same classes in the prior year, where attendance was not formally tracked.

Limitations

Several limitations qualify interpretation of this study. First, an inherent limitation of the study design is that different topics were covered in LC-ON and LC-OFF blocks; thus, block topic differences are a potential confounding factor. In the subset of students ($n = 16$) who completed all three third-year courses, there were no statistically significant course-to-course differences in adjusted exam performance, supporting broadly comparable grading difficulty across courses. In addition, models included fixed effects for course and exam block to account for systematic differences in performance across courses and across the semester. Nevertheless, because LC status was assigned at the block level within each course, LC-ON contrasts may still partially reflect unmeasured block-specific topic or difficulty differences. Replication across multiple courses mitigates, but does not eliminate, this possibility because LC-ON occurred in different blocks across courses rather than always early or always late.

A second limitation is that the attendance tracking used in this study was imperfect. Because no grades or participation credit were tied to attendance, students were not forced to respond to the electronic polling prompt. This limitation may partially explain why the ITT attendance model did not detect a significant effect of LC availability. One remedy for this limitation may be to offer small grade incentives for attendance, although doing so may raise pedagogical and ethical concerns which would need to be considered.

Another limitation of this study is that it was conducted within a single institution and involved courses taught by the same instructor. As such, the findings may reflect contextual factors such as teaching style, course design or institutional culture. Prior research has shown that the impact of LC can vary across disciplines and pedagogical contexts (Banerjee, 2021), suggesting that the generalisability of these results should be interpreted with caution. Future research employing multi-instructor or multi-institution designs would help determine the extent to which these patterns hold across diverse settings. The 1st year course, taught in the fall with high baseline attendance and low LC uptake, serves as a contrasting context in which exam performance did not show the same LC-ON / LC-OFF pattern. However, notably, in the minority of 1st year students who did view LC videos, the same general trends in the data were observed: LC viewers scored higher on exams than non-viewers, and viewing LC videos for more time was associated with a higher exam %. The supplementary materials document the same results in all four courses in this study, including the 1st year data. It is important to note that the main findings from the main reported dataset of 3rd year courses only are not substantially altered when the 1st year data are also included.

Conclusion

In this within-course comparison, LC availability was associated with a reduction in exam performance, but greater viewing within LC-ON blocks was positively associated with performance. Attendance itself was predictive of higher exam outcomes, and greater attendance attenuated the negative LC-ON association. These findings

reinforce that LC's value is contingent on self-regulated use. The same resource can scaffold deeper engagement or encourage surface learning, depending on how students deploy it. Pedagogical practices that promote regular attendance and guide students towards distributed, active review, rather than reactive or last-minute reliance on recordings, may help maximise the benefits of LC while minimising its risks.

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