8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14543

Assessing the impact of recorded lectures on learning effectiveness

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Abstract

Recorded lectures are a useful tool for pedagogical practice in tertiary education. This study provides a large quantitative analysis to examine the impact of using supplementary lecture recordings and empirically corroborates results from other fields. Our analysis examines impact on student academic performance which explores a facet that is complementary to similar studies in the existing literature. Our findings indicate that the usage of recordings is positively related to academic performance. Our results also demonstrate that the lowest performing decile of students have less motivation to use recorded videos and additional resources may need to be provided to improve the learning experience for these students.

Keywords: *Educational teahnology; Learning assessment; Teaching and learning experiences.*

1. Introduction

Recorded lecture videos are important study tools for study (Armstrong, Idriss, & Kim, 2011). Students can use lecture videos to review material at their own pace, and these systems are integrated into many university courses. With the support provided by this additional resourse, many students have changed their study strategies, increasingly relying on the online video resources as a substitute for attendance at lectures. Based on the existing research, having access to the video based lecture materials could improve students' learning experience (Brecht, 2012; Shih, 2010; Brame, 2016; Stohr, Stathakarou, Mueller, Nifakos, & McGrath, 2019). Although students' study behaviours might be highly influenced by the video content, the effectiveness of this video content depends on its design, structure, and provision of interaction (Zhang, Zhou, Briggs, & Nunamaker Jr., 2006; Brecht, 2012; Mitra, Lewin-Jones, Barrett, & Williamson, 2010).

Due to the pandemic, many universities have been forced to switch their teaching-and-learning mode from face-to-face to virtual delivery (Mohmmed, Khidhir, Nazeer, & Vijayan, 2020). Using recorded lecture videos are one of many ways to deliver contents virtually. Students are able to remain engaged with lectures and content albeit via a different modality which has proved to be effective in learning.. However, students who rely on such video content might also face challenges with their remote studies, such as lack of interaction, lack of motivation experience in using information and communication technology (Aristovnik, Kerzic, Ravselj, Tomaazevic, & Umek, 2020; Bezerra, 2020).

Several guiding principles have been established for effective use of videos in learning design (Mayer & Moreno, 2003; Clark & Mayer, 2016), most notably on the management of cognitive load. Homer et al. (2008) found that students with high visual preference experienced greater level of cognitive load under the learning by audio narration (i.e., without video), whereas students with low visual preference reported greater level of cognitive load under the video learning conditions. This finding suggests that individual preferences of learners are important in the design of multimedia learning.

Previous studies found that learning effectiveness and satisfaction can be improved through videos with interactive features (Zhang, Zhou, Briggs, & Nunamaker Jr., 2006; Ronchetti, 2010) that promote better engagement. Students indicated that their interactions with video-based lectures were similar with face-to-face instruction (Borup, West, & Graham, 2012). Hung et al. (2018) developed embodied interactive video lectures (EIVL) by embedding six types of interactive learning activities (engaging, prompting, experiencing, facilitating, demonstrating, questioning) in video lectures based on different scaffolding functions. The use of short videos can be advocated by the positive outcomes for student performance (Ali, 2019). Robertson and Flowers (2020) showed that the combination of video contents and PowerPoint slides is an effective studying approach. Hung et al. (2018) found that learners

under EIVL outperformed learners under other learning conditions in terms of both comprehension and retention.

However, the utilisation of the video content has also been suggested to have a negligible or even negative impact on the students' learning experience. Sykes (2012) stated that dedicated students can still perform well irrespective of video use. Williams et.al (2012) cautioned that the use of lecture recordings as a replacement for attending face-to-face lectures yields no additional benefit for students, and often has severe adverse effects on students' marks.

In comparison to reading-based content, video lectures feature high media richness and are better suited to the delivery of subjective and complex ideas, both in terms of learning performance and learning satisfaction (Sun & Cheng, 2007). Kizilcec et al. (2013) reported that different behaviours of video engagement by MOOC participants result in varying levels of overall learning experience. Wang and Baker (2015) found that students' interest and engagement with video content is crucial in predicting their completion of MOOC courses, whereas Sinha et al. (2014) documented that video clickstream interactions could predict dropping out from videos and courses. Giannakos et al. (2015) found that the peaks of video navigation activities correspond to discussions on assessment answers, whereas Li et al. (2015) reported a positive correlation between video interaction and perceived content difficulty.

In this article, we investigate the effectiveness of online video content as a complementary to the traditional lecture. We use a quantitative study to examine the impact of ECHO lecture recordings on learning outcomes based on pre-pandemic data. Specifically, we investigate the relationship between usage of ECHO and student academic performance. We consider not only the level of ECHO usage, but also frequency of use and its effect on academic performance. Our research taps into a large and previously unused student data set to explore any relationships between academic performance and video usage. We would naturally expect that increased usage to correlate positively with higher academic grades, but no studies have explored this hypothesis. Furthermore, if these recordings are indeed beneficial, an immediate avenue of inquiry is the extent to which they benefit students. The goal of this research is to quantify the true value of ECHO for learning experience.

2. Methodology

2.1. Data collection

To investigate the impact of the video usage on students' academic performance, we used data of 1,485 students who enrolled in a first-year finance course: ACST101 Finance 1A at Macquarie University in 2018 semester 1.

There were 13 teaching weeks in 2018 semester 1 and students were assigned 2-hour weekly lectures as part of their learning. These lectures were delivered face-to-face on campus and students were given unlimited access to the corresponding video-based lecture recordings for revision. The video usage data has been recorded for each student which shows their number of views as well as a viewing percentage for each recorded lecture. A binary Video Usage measure has been created to investigate students' engagement with this online content. For each weekly recorded lecture, each student is assigned a value of 1 if the student (i) viewed at least once, and (ii) viewed at least 50% of the recording; and a value of 0 if either of these two conditions do not hold. Over the course of 13 teaching weeks, the Total View measure for each student ranges between 0 to 13 inclusive. Students were required to complete several assessments for ACST101, comprising of 10 online quizzes, an Excel assignment, a class test and a closed-book final exam.

The improvements in students' academic performance is measured using the difference between their initial ranks and the subsequent final ranks in the student cohort. The average mark across the first three (online) quizzes is calculated for each student, and from this average their relative rank (percentile) is calculated. This measure of initial rank is used as a measure of their initial performance when entering the course. The students' final rank was calculated using their overall grade for the semester, and is intended as a measure of performance when exiting the course. A change in rank is then calculated for each student by subtracting the individual percentile at the start of the semester from the corresponding individual percentile at the end of the semester. A positive change in rank means that the student has improved relative to other students, whereas a negative rank change implies that the relative performance of the student has worsened.

2.2. Data analysis

We firstly plotted the distribution of the Total Views in **¡Error! No se encuentra el origen de la referencia.** and found that close to half of students have the Total Views less than 1. This implies that students might not have strong motivation to use the lecture recordings.

We further analysed the usage among different groups of students and found that the usage of online content is statistically significant correlation with students' academic performance. As stated before, we use the relative rank (percentile) generated from the first three quizzes to measure students' initial performance. We then grouped students into bottom 10%, middle 80% and top 10% based on their initial ranking and calculated the average Total View number for each group is 1.87 for bottom 10%, 3.49 for middle 80% and 3.31 for top 10%. We found that the middle 80% students have the highest average Total View number while the bottom 10% students have the lowest number. In other words, compared to middle 80% group, bottom 10% and top 10% are less motivated to use the online contents. Hence, we are interested to investigate the performance change for each group by the end of the semester.

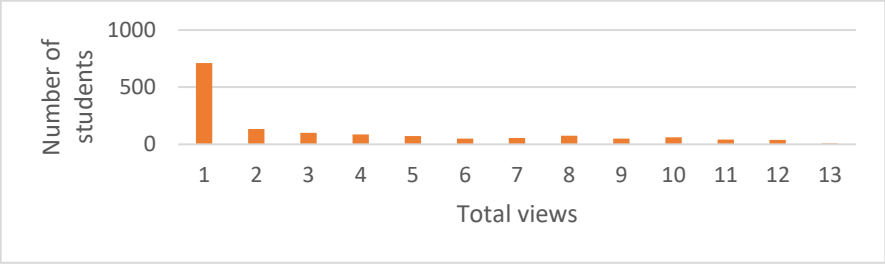

Figure 1. Distribution of Total Views.

3. Result

A linear model approach was applied to examine the effect of video usage on the performance of students, which is measured in terms of their ranking in the course in order to normalise for any course-specific effects. The results of the fit are given in **Table 1.**

Table 1. Average Total View number for different groups

All Students	Estimate	P-value
Intercept	-44.909	4.30e-05
Total Viewed	13.277	1.29e-09

We can see that usage of the videos has a statistically significant effect on the final ranks of the students.This approach was also applied to segments of the data set to examine how this effect changes depending on the initial ranks of the students, which is determined based on their performance on the first three quizzes of the course. The students were segmented into: Top 10%, Bottom 10% and Middle 80%. The results of the linear fit are given in Table 2.

Table 2: Coefficient estimates and p-values of the linear model for different segments

		Estimate	P-value
Top 10%	Intercept	-157.978	8.62E-12
	Total Viewed	8.444	0.051
Bottom 10%	Intercept	181.729	5.67E-12
	Total Viewed	3.283	0.613
Middle 80%	Intercept	-62.946	1.10E-06
	Total Viewed	16.834	1.79E-11

While all of the coefficients related to video usage are positive, it can be seen in Table 2 that this does not provide a statistically significant difference in both of the extreme deciles.

4. Conclusion

Our data has shown that, for this first year finance course, the usage of video recordings has a strong impact on a typical (in our case, someone in the middle 80%) student's academic performance. This aligns with our personal expectations and experiences in delivering this course, and conclude that providing lecture recording to augment traditional learning methods does indeed benefit most students.

However, these effects are not as clear in either of the extreme ends. For these extremes, our hypotheses are as follows. The students that start in the top 10%, in general, may simply be inherently strong enough that video usage has minor impact on their academic performance. Conversely, the students that start in the bottom 10%, in general, may be either inherently weak, broadly disengaged, or had serious ongoing external interruptions to their study to the point that, again, video usage has minor impact on their academic performance.

We also recognise that there are many other influencing factors impacting a student's performance, such as time spent on practice questions and attending tutorials, and that use of video recordings is not the sole deciding factor of a student's performance. However, we do not have useful data available on these other factors and cannot give any definitive comments here. It would also be very difficult to control for these factors.

We would also like to add a comment that the students in this data set would have, for the most part, already graduated, and so contacting them for more data would be highly impractical.

The immediate implications of our results here are that, again, recordings should not only be provided to students, but their use should also be encouraged. More broadly, it reinforces the idea that a student's engagement is pivotal to their learning and performance; additional engagement with the content provided in a course yields clear benefits.

Finally, we suggest a few possibilities for future research. The time delay between lecture recording being made available and the time it is viewed by the individual student may also turn out to be an important factor in predicting a student's performance. In light of online delivery resulting from the pandemic, this option is much more practical as the data is readily available (as compared to F2F delivery). The weekly quizzes and weekly lecture recordings could be analysed using time series methods. Like before, this idea is much more viable given online delivery and the associated extra data that can be collected. This analysis could also be repeated for a smaller second or third year course to see if the same effects are observed. Based on past teaching experience, we expect that a similar pattern would be observed, but

less extreme. This study could also be pushed further by adding additional multimedia content, and running a similar analysis on the additional content.

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