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Introduction

The rapid transition to remote teaching due to the novel coronavirus (COVID-19) pandemic has taken higher education by storm. There is no shortage of advice, guidelines, and opinions on best practices in online learning and teaching on myriad websites, social media channels, webinars, podcasts, journal articles etc. No doubt, there are several commendable success stories and plenty of lessons learned with implications for and advice on the best way forward. Butler-Henderson et al. (2020) have documented 138 peer-reviewed articles in higher education published in the first 6 months of 2020 ranging from theoretical perspectives, case studies, commentaries, literature reviews, etc. pertaining to COVID-19. Clearly, the pre-COVID-19 world of higher education is a distant reality as universities scramble to devise the optimal blend of online and face-to-face learning and teaching in the face of financial challenges brought on by a global health and economic crises.

COVID-19 merely accelerated the rate of increase in online learning which was at unprecedented levels (Qayyum & Zawacki-Richter, 2018) pre-COVID-19. In the United States, the percentage of higher education students enrolled in degree-granting institutions who took online courses increased from 25.9 percent in 2012, to 27.1 percent in 2013 and 28.3 percent in 2014 (Allen & Seaman, 2017). In Australia, revenue from the online industry was expected to increase at an annual rate of 0.4 percent up until 2018-2019 (Online Education, 2018). In China, the online education market was expected to grow 20 percent annually, reaching US$41 billion in 2019, up from US$23 billion in 2016 (Yu, 2018). Even prior to COVID-19, across the globe, universities were increasingly providing online instructional media to students as lecture recordings via lecture capture or live streaming of lectures with explorations of the impact on on-campus attendance and attainment, as in relatively recent research by Edwards and Clinton (2019), where generally negative effects were ascribed. Live streaming of lectures involves the broadcasting of a lecture over the internet at the same time as it is being delivered in the traditional lecture theatre. Live streaming enables learners to be remote from the physical space in which the lecture is delivered yet access it in real-time thereby allowing a synchronous and asynchronous learning experience.

The value of the lecture has long been questioned as the primary mode of teaching in higher education. From Bligh (1972) to Nordmann et al. (2019), many studies have been published on factors impacting student attendance in traditional face-to-face lectures (Sloan et al., 2019), the pedagogical value of lectures like impact on student performance (Andrietti & Velasco, 2015), and the effectives of lectures as a teaching strategy (Freeman et al., 2014). Literature indicates multiple factors affecting on-campus lecture attendance not all attributable to the provision of live streaming or lecture recordings (Fields, 2012). In the university at question, the widening of teaching methods from the on-campus lecture to live streaming of lectures over the last few years relaxed institutional rigidities by providing flexibility of attendance to students. However, the impact of this flexibility on students' attendance, and preferences and motivations to attend in the different modes (on-campus or live streaming) and/or utilize lecture recordings has remained under researched as is the case in general especially with regards to live streaming. Note that desktop lecture recordings or other digital teaching resources are not in scope of this research. The words lecture recordings and lecture capture are used interchangeably.

The study reported here was conducted pre-COVID-19 and before video-conferencing platforms like Zoom and Microsoft Teams took over synchronous lecture delivery. However, our findings hold important implications despite COVID-19 as the study seeks to address the broader question

of the value students place on different teaching methods, that is, on-campus lectures, lecture live streaming and lecture recordings, if given a choice. We take students' attendance patterns, usage of lecture recordings, and preferences and motivations for the same as being indicative of the value placed. To the best of our knowledge, such a large-scale comparative exploration has not been undertaken to date. Our findings and conclusions drawn from the findings hold useful implications for future planning, for those universities, like our own, who are faced with challenges such as changing student demographics with more and more students seeking flexible learning options, and pressure on physical infrastructure and resources.

An overview of literature

The literature review provides a brief overview of recent research on student attendance and motivation to attend lectures on-campus, via live streaming and to utilize lecture recordings. To reiterate, the focus here is not on the pedagogical efficacy or benefits of attending or viewing lecture recordings, which has been addressed in literature substantially (e.g. Bos et al., 2016; Nordmann et al., 2019), but on the perceived value of the teaching methods, that is, on-campus lectures, lecture live streaming and lecture recordings as indicated by students' attendance patterns, and preferences and motivation - a gap in existing literature.

The falling attendance rates for on-campus lectures are a matter of concern for educators as there is plenty of evidence of a positive link between face-to-face attendance and performance, retention, skills development, learning experience, etc. (Sloan et al. 2019). Jeffery (2017) summarises Australian National University's research showing a dramatic drop off in lecture attendance between 1st and 5th weeks of semester, while enrolment and pass rates remained stable. Matheson (2008) and French and Kennedy (2016) summarise compelling qualitative arguments both for and against the traditional lecture – commonly characterised in polarities, as either passive and ineffective or engaging and inspiring – but note increasing speculations on the value of the on-campus lecture as evidenced by falling attendance rates and declining student attention spans. Fields (2012) and Petrovic and Pale (2014) report several reasons for non-attendance of lectures including illness, boredom, transport issues, work and family commitments. The primary motivation for attendance includes expectation to attend, gaining knowledge about assessments and finding out what is required in terms of subject knowledge to pass the subject. There are others (e.g. Newman-Ford, Fitzgibbon et al. 2008) who attribute attendance to motivation for learning and lack of attendance to availability of course content and material elsewhere (e.g. Friedman at al., 2001; Massingham & Harrington, 2006). This shallow engagement with lectures indicates that it is important to understand what motivates students to attend on-campus lectures since student motivation has shown to be a significant predictor of attendance as reported by Fryer et al. (2018, p. 479) who found that students' "ability deficits" had a positive effect on attendance, and "effort belief deficits", a negative effect on attendance where the former refers to lack of ability for studying and the latter, the lack of effort. The impact of student motivation on on-campus attendance is also highlighted in a recent study by Sloan et al. (2019) who found that students who reported higher levels of motivation had higher on-campus attendance rates as well.

Of the three teaching methods or modes of lecture delivery, live streaming has perhaps received the least amount of interest from researchers of higher education. In a recent study on student and lecturer perception of live streaming, Rossouw (2018) found that students felt that live streaming lectures provided convenience, would not impact their ability to make friends, and that students who were willing to attend via live streaming rated their own technological abilities higher than

those who preferred on-campus lectures. On the other hand, Fredriksen (2015) reports that lecture live streaming resulted in lonely students due to low interaction with peers. In a study on students' perceptions of live streaming in nursing education, Wall et al. (2014) present arguments in favour of live streaming which is considered convenient and beneficial for learning content. Only a few studies report findings (e.g. Abdous & Yoshimura, 2010) addressing pedagogical and logistical reasons for which students attend lectures via live streaming. These include varied benefits including: supporting students who are unable to attend class; catering for individual learning strategies and styles; supplementing face to face lectures, but at a place of the student's choosing; accommodating student expectations regarding the digital delivery of course material; facilitating distance education as an alternate delivery mode; and providing flexibility for those who have to work while studying.

Research on lecture recordings has focused on two key questions, that is, the impact of lecture recordings on on-campus attendance and the use of lecture recordings. With regards to the impact on on-campus attendance, literature indicates that lecture recordings may influence some students to skip class. Harley et al. (2003) found that a quarter of students accessed lecture recordings instead of attending on-campus lectures. Similarly, Brother (2004) found that nearly one-third of students agreed that the availability of lecture recordings motivated them to miss classes and Edwards and Clinton (2019) report declining attendance after the introduction of lecture recordings. Implementation of web-based lecture technologies by tertiary education institutions has raised fears that lecture recordings will have a negative impact on class attendance (Subhlok & Tuna, 2014). These concerns concentrate on the argument that having easily accessible lecture recordings excuses students from attending classes as they can watch a recording at a convenient time at home or elsewhere. However, literature as summarized by Dommeyer (2017) indicates that lecture recordings have minimal negative impact on class attendance and do not cause absenteeism. In terms of the use of lecture recordings, research funded by the Australian Learning and Teaching Council (ALTC) conducted by Gosper et al. (2008) showed that 66.8 percent of students surveyed believed that web-based lecture technologies helped them to achieve better results and 79.9 percent of students believed that reviewing lecture recordings made it easier for them to learn thereby indicating students' preference for lecture recordings. Nordmann et al. (2019) noted lower on-campus attendance for lectures which were recorded but found attendance and recorded lecture use were positive predictors of performance for first- and second-year students. O'Brien and Verma (2019) found older first year students more engaged with digital resources and women more likely to utilise digital lecture materials. Edwards and Clinton (2019) report that students who are more engaged use lecture recordings as a supplement to traditional lectures to deepen learning engagement. Couperthwaite et al. (2014) found that some students used lecture recordings for targeted revision with the extent of use varying considerably across the cohort studied.

It is reasonable to assume that those students who can attend on-campus lectures, that is, do not have external factors that prevent them from doing so like work commitments, will likely attend if they are motivated to do so and this motivation potentially comes from the value they place on the lectures. Whether lecture recordings are used as a supplement to on-campus and live streamed lectures or they are used by students as "re-usable learning objects" (Crook, 2015, n.p.) for recap and revision is an important question for universities to consider for planning purposes. Given the flexibility of attending remotely, in real time, via live streaming one would expect the provision of live streaming to impact on-campus attendance rates however, whether this is the case or not has not been researched enough. Again, this brings us back to the point on motivation, that is, motivation for live streaming lectures which, besides external influential factors, is again driven by the value students place on live streamed lectures.

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Rationale for study

The face-to-face on-campus lecture, one of the oldest teaching mechanisms, though widely criticised, remains widely accepted but increasingly supplemented with lecture recordings and more recently, with live streaming of lectures. The latter attempts to make education delivery more flexible and accessible for busy students in universities where student enrolments continue to grow but also offsets the cost of university infrastructure and maximizes the use of human resources. There are studies that investigate actual attendance counts for classes with and without lecture recordings (Brotherton & Abowd, 2004; Harley et al., 2003; Maag, 2006) however, we are not aware of any research to date that compares students' attendance in on-campus lectures or via live streaming, utilization of lecture recordings, and preferences and motivations for the same. This is an important omission given that universities continue to invest in building new lecture theatres and in technologies to bring lectures to students on demand, in real time and post hoc.

Thus, we explore our students' attendance patterns, motivations and preferences for on-campus lectures, lecture live streaming and lecture recordings. Additionally, we look at the impact of employment and travel time on attendance and the relationship between students' perceptions of the technical characteristics of the live streaming and lecture recording platform and usage. We believe that an understanding of how some of the external (employment and travel time), internal (motivations and preferences) and technical factors impact student attendance (on-campus or via live streaming) and utilization of lecture recordings critically informs not only our university's future planning for infrastructure and resources but other institutes of higher education who are in a similar position.

The case study

Context

To explore students' attendance (on-campus or via live streaming), utilization of lecture recordings, and preference and motivation for the three differenATTENDANCt modes of delivery, a quasi-experiment was conducted in the Faculty of Arts and Faculty of Human Sciences at a large Australian University in 2018. In our university, lectures are live streamed through the Echo360 Active Learning Platform's live streaming utility. This platform provides students with flexible learning options including question and answer, private notes, bookmarking of important content, and flagging of confusing content, etc. Lecture recordings are made available for students via the Echo360 Lecture Capture utility. A sample of 830 students (response rate of 27 percent) volunteered to participate in the study from a total population of 3,051 students enrolled in 18 undergraduate courses across multiple departments within the Faculties. The courses included ancient history, politics, geography, anthropology, sociology, education, psychology, and criminology. The research was conducted in accordance with the regulations and ethical codes of the University (project ID: 2779).

Method

All students enrolled in the courses were invited to participate in the study during the introductory lectures where participant information and consent forms were distributed. Participating students were asked to complete a survey which was divided into three sections. The first two sections contained questions on the students' profile (gender, age, etc.), travel time to the university, employment status, years of experience in higher education, and enrolment for attending lectures

either on-campus, via live streaming, or both on-campus and live streaming. The university required students to indicate their mode of attendance at the time of enrolment to allow for provisioning of live streaming accordingly. This was necessitated due to limitation of space and timetabling issues. For the courses selected for the study, the on-campus lecture theatres had limited capacity therefore, in case the on-campus enrolments reached capacity, students were given the option of attending lectures remotely via live streaming. The third option, that is, on-campus and live streaming was made available for those students who required the flexibility of attending on-campus and remotely. The option of viewing recorded lectures is available for all students at the university therefore, students were not required to indicate lecture recording as a choice at the time of enrolment. The third section of the survey asked students to report on their attendance for each course in each week (weeks 1-10). This section included the option of lecture recordings as well. The fifth section questioned students on their motivation for attendance in each week for each mode of delivery and finally, the last two sections questioned students on their preference for each mode of delivery and their view on the technical characteristics of the active learning platform used for live streaming and lecture recordings.

We would like to clarify that missing data was identified early in the analysis as one of the limitations of the study. More specifically, we observed missing completely at random data (MCAR). This form exists when the missing values are randomly distributed across all observations (Graham, 2009). We dealt with this limitation by performing a cross check of all data containing missing values and all data cleared from missing data. This technique is a subtype form of Imputation (Pickles, 2005). Thus, we partitioned the data into two parts: one set containing the missing values and the other containing the non-missing values. After partitioning the data, t-tests of mean difference were carried to check for differences in the sample between datasets. No significant difference was found. Therefore, in the results presented below, the number of observations (n) is reported separately for each calculation. The missing data does not impact findings from our correlational analysis however, the missing data does complicate comparison of summary data, therefore, we have intentionally avoided this comparison in the correlational analysis especially since it is not required to achieve our objective. We performed ANOVA (Analysis of Variance) to calculate the correlations discussed in the following sections. Again, due to difference sample sizes, we also conducted Post-Hoc Analysis with Tukey's Test to check for significant differences in groups.

Sample

Of the 830 students in our sample, 85 percent were between 18-24 years old and 82 percent were female. Table 1 below presents some descriptive statistics on participating students. Of 806 students, 76 percent were working full- or part-time, 87 percent had a travel time of 31- 45 min to the university and 49 percent of 805 had at least a year of prior experience in higher education. 42 percent enrolled for on-campus lectures, 36 percent opted for live streaming and 22 percent chose flexibility in attending on-campus or via live streaming. Therefore, majority of the students opted for on-campus attendance at the time of enrolment.

Table 1.

Descriptive Statistics

	n	%
Employment status		

Working	611	76
Not working	195	24
Travel time to university		
0 – 30 min	19	2
31 – 45 min	681	87
40 – 60 min	47	6
60 min +	37	5
Years of experience		
1	396	49
2	140	18
3	130	16
4	74	9
5	35	4
6+	30	4
Enrolment		
On-campus	318	42
Live streaming	275	36
On-campus and live streaming	171	22

Attendance patterns, travel time and employment status

Figure 1 shows the mean frequency of attendance (on-campus, live streaming, both on-campus and live streaming) which drops gradually from week 1 to week 10. It must be clarified that students' attendance data was grouped, analysed and is presented as student's attendance percentage of their overall possible full attendance number. This analysis was considered essential to allow for a representative view of students' attendance during the semester. This has standardised and eliminated any effects from other factors related with students' tendency to avoid attendance in specific weeks.

Figure 1.

Frequency of Attendance by Week in All Modes

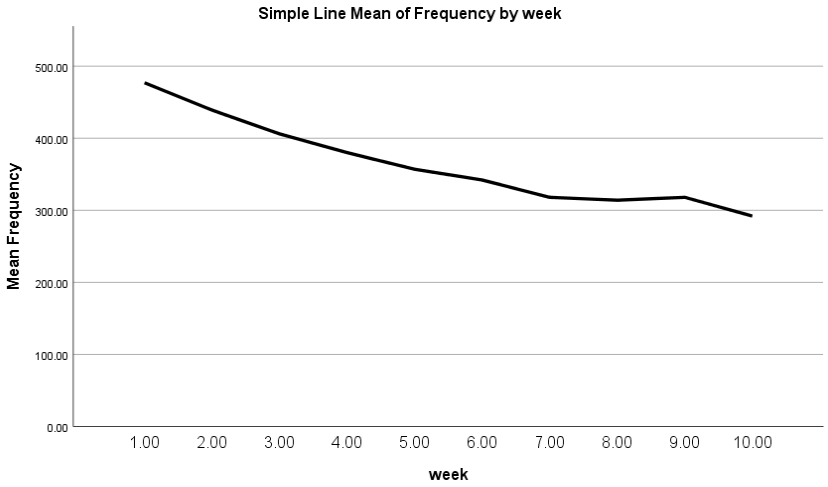
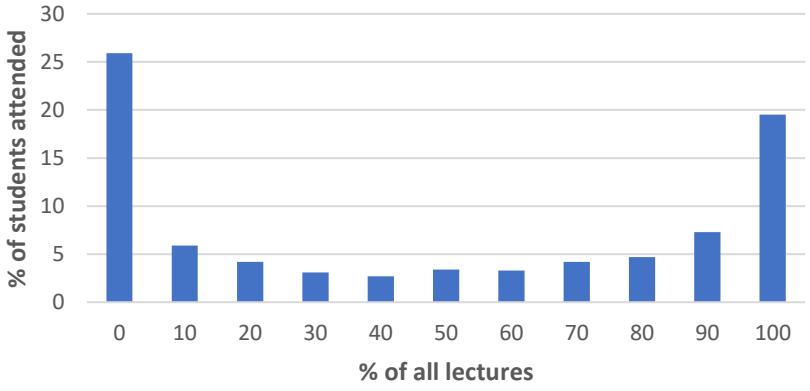


Figure 2 shows the percentage of total number of lectures in weeks 1 – 10 and the percentage of students who attended lectures in all modes of delivery. As shown, approximately 26 percent of the students attended 0 percent of the lectures, around 20 percent attended all lectures, 39 percent attended between 10 percent to 90 percent of the lectures and about 16 percent of the students did not report their attendance.

Figure 2

Attendance in All Modes of Delivery



We found no significant effect of the factor of travel time on attendance either on-campus and live streaming or both on-campus and live streaming however, we found a significant effect of employment on attendance for in all options in the first 10 weeks: $F(1, 697) = 16.74$, $p < 0.001$.

Attendance and preference to attend

Attendance data (on-campus, live streaming, and both on-campus and live streaming) or usage of lecture recordings for each course and week was as reported by students in the survey. For data on

students' preference for each mode of delivery, the survey required students to respond to four questions on a five-point Likert scale. The questions concerned the effectiveness of practicality and interaction with lecturers and students afforded by each of the three modes of delivery. We calculated a mean preference score for each student which was used in the correlational analysis below. Table 2 shows students' preferences for each mode of delivery. As shown in the table, the most preferred mode was lecture recordings followed by on-campus lectures, both on-campus lectures and live streaming and then finally, live streaming.

Table 2

Students' Preference for Mode of Delivery

	n	Mean	Std. Deviation
On-campus	541	74	23
Live streaming	410	62	27
On-campus and live streaming	314	71	27
Lecture recording	620	79	21

Table 3 below shows correlations between students' attendance (on-campus, live streaming and both on-campus and live streaming) and preference for on-campus lectures, lecture live streaming and lecture recordings.

Table 3

Attendance and Preference for Mode of Delivery

		Attendance	Preference
On-campus			
Attendance	Pearson correlation	1	0.29**
	sig. (2-tailed)		0.00
	n	699	518
Preference	Pearson correlation	0.29**	1
	sig. (2-tailed)	0.00	
	n	518	541
Live streaming			
Attendance	Pearson correlation	1	1.0
	sig. (2-tailed)		0.06
	n	699	392
Preference	Pearson correlation	1.0	1
	sig. (2-tailed)	0.06	
	n	392	410
On-campus and live streaming			
Attendance	Pearson correlation	1	0.18**
	sig. (2-tailed)		0.00
	n	699	300

Preference	Pearson correlation	0.18**	1
	sig. (2-tailed)	0.00	
	n	300	314
Lecture recording			
Attendance	Pearson correlation	1	-0.17**
	sig. (2-tailed)		0.00
	n	699	595
Preference	Pearson correlation	-0.17**	1
	sig. (2-tailed)	0.00	
	n	595	620

We found a significant relationship between attendance and student's preference to attend on-campus lectures which means that those students who attended on-campus lectures or via live streaming preferred to attend lectures on-campus. This implies that students value on-campus lectures more than live streaming. On the other hand, we found no significant relationship between attendance and students' preference for live streaming. This means that those students who attended lectures on-campus or via live streaming did not indicate a preference for live streaming therefore, confirming the lower regard for live streaming. We found a significant relationship between attendance and students' preference for both on-campus lectures and live streaming and on-campus attendance indicating that that students who had flexibility in attending lectures on-campus or via live streaming continued to value and prefer that flexibility. We found a significant negative relationship between attendance and preference for lecture recordings which implies that students who prefer lecture recordings do not attend on-campus lectures or via live streaming. This indicates that lecture recordings are used as a resource, ad hoc or post hoc, by students for recap and revision purposes, this being the value students place on them. This is an important finding as it supports the ongoing provision of lecture recordings which likely impacts on-campus attendance or live streaming of lectures.

Attendance and motivation to attend

To explore the impact of motivation on attendance (on-campus, live streaming and both on-campus and live streaming), the survey required students to respond to four questions on a five-point Likert scale. Similar to students' preference discussed above, the questions on motivation concerned the effectiveness of practicality and interaction with lecturers and students afforded by each of the three modes of delivery. However, the difference here was that we collected data on motivation to attend for each week separately. We grouped students' responses to the questions into two categories, that is, "acquiring knowledge" and "interaction" and calculated the mean overall motivation, motivation for acquiring knowledge and motivation for interaction for each student. These three mean motivation scores were used in the correlational analysis below.

Table 4

Attendance and overall motivation for mode of delivery

		Attendance	Motivation
On-campus			
Attendance	Pearson correlation	1	0.36**
	sig. (2-tailed)		0.00
	n	699	637
Motivation	Pearson correlation	0.36**	1

	sig. (2-tailed)	0.00	
	n	637	663
Live streaming			
Attendance	Pearson correlation	1	0.02
	sig. (2-tailed)		0.58
	n	699	605
Motivation	Pearson correlation	0.02	1
	sig. (2-tailed)	0.58	
	n	605	630
Lecture recording			
Attendance	Pearson correlation	1	-0.16**
	sig. (2-tailed)		0.00
	n	699	601
Motivation	Pearson correlation	-0.16**	1
	sig. (2-tailed)	0.00	
	n	601	626

We correlated motivation for on-campus lectures, lecture live streaming and lecture recordings with attendance (on-campus, live streaming, and both on-campus and live streaming) and found a significant moderate correlation between students' overall motivation for on-campus lectures and their attendance (see Table 4). This means that those students who attended on-campus lectures were motivated to do so. We found no significant correlation between overall motivation for live streaming and attendance. In other words, motivation for live streaming did not influence attendance either on-campus or via live streaming. Most interestingly, we found a significant negative weak correlation between overall motivation for lecture recordings and attendance which indicates that students' positive motivation for lecture recordings minimized possibilities for attending a lecture on-campus or via live streaming. These findings mirror our findings on students' preferences thereby corroborating our conclusions.

Table 5

Motivation for interaction and attendance

		Motivation for acquiring knowledge	Attendance
Motivation for acquiring knowledge	Pearson correlation	1	0.34**
	sig. (2-tailed)		0.00
	n	663	637
Attendance	Pearson correlation	0.34**	1
	sig. (2-tailed)	0.00	
	n	637	699
		Motivation for interaction	Attendance
Motivation for interaction	Pearson correlation	1	0.12**
	sig. (2-tailed)		0.00

	n	699	637
Attendance	Pearson correlation	0.12**	1
	sig. (2-tailed)	0.00	
	n	637	663

Next, in an exploration of the impact of motivation for acquiring knowledge and motivation for interaction, we found that motivation for acquiring knowledge had a positive mild effect on attendance on-campus, therefore, the higher the motivation for acquiring knowledge, the higher the attendance (Table 5). We also found that motivation for interacting with lecturers and classmates had a positive low effect on students' attendance on-campus. Therefore, students who attend lectures on-campus are motivated to do so for knowledge and interaction with lecturers and peers however, knowledge acquisition is a larger motivator. Taking it a step further, we correlated years of experience in higher education with motivation for acquiring knowledge for each mode of delivery. We did this as we wanted to explore if there is a difference in the value students place on the different delivery modes. We found (see Table 6) no significant correlation between the motivation for acquiring knowledge and years of experience in higher education for those students who attended lectures on-campus. However, we did find a significant low negative correlation between years of experience in higher education and motivation for acquiring knowledge for those who attended via live streaming. Thus, acquiring knowledge has a low negative effect on students' motivation for using live streaming indicating that experienced students are not motivated to use live streaming. We also found no significant correlation between years of experience in higher education and motivation for acquiring knowledge for those students who viewed lecture recordings.

Table 6

Years of study and motivation for acquiring knowledge

		Motivation for acquiring knowledge	Years of study
On-campus			
Motivation for acquiring knowledge	Pearson correlation	1	-0.06
	sig. (2-tailed)		0.14
	n	663	663
Years of study	Pearson correlation	-0.06	1
	sig. (2-tailed)	0.14	
	n	663	807
Live streaming			
Motivation for acquiring knowledge	Pearson correlation	1	-0.01*
	sig. (2-tailed)		0.01
	n	807	630
Years of study	Pearson correlation	-0.01*	1
	sig. (2-tailed)	0.01	
	n	630	630
Lecture recording			

Motivation for acquiring knowledge	Pearson Correlation	1	-0.06
	sig. (2-tailed)		0.12
	n	807	626
Years of study	Pearson correlation	-0.06	1
	sig. (2-tailed)	0.12	
	n	626	626

Technical characteristics and preference

For students' evaluation of technical characteristics of live streaming and lecture recordings, again the survey required students to respond to questions on a five-point Likert scale. The questions concerned the ease and speed of connection and quality of sound. We calculated a mean score for each student which was used in the correlational analysis. We found a significant positive correlation between student's evaluation of the technical characteristics of live streaming and their preference for live streaming (Table 7). Similarly, student's evaluation of the technical characteristics of lecture recording and their preference for using the lecture recordings were positively correlated. From this we conclude that technical characteristics of the platform used for live streaming and lecture recordings impact students' preferences and usage of each.

Table 7

Technical characteristics and preference

		Technical characteristics	Live streaming
Live streaming			
Technical characteristics	Pearson correlation	1	0.20**
	sig. (2-tailed)		0.00
	n	626	385
Preference	Pearson correlation	0.20**	1
	sig. (2-tailed)	0.00	
	n	385	410
Lecture recording			
Technical characteristics	Pearson correlation	1	0.41**
	sig. (2-tailed)		0.00
	n	623	581
Preference	Pearson correlation	0.41**	1
	sig. (2-tailed)	0.00	
	n	581	620

Discussion

The impetus to conduct this study came from the need to understand our students' attendance patterns, utilization of lecture recordings, and preferences and motivations for the different teaching methods or modes of lecture delivery. The study was framed by the overarching question of the acceptance of live streaming of lectures as an alternative to on-campus lectures in the face

of ever-increasing student populations and need for flexibility which is making demands on universities' infrastructure and resources. Correlations with two exogenous factors for impact on attendance were also explored, that is, the travel time to university and employment status – two factors reported as likely to hinder student attendance. We would like to discuss three valuable takeaways from our findings.

Firstly, in line with previous research (Jeffery, 2017), we found that lecture attendance on-campus and/or via live streaming declined over the semester in the first 10 weeks. We also found a negative relationship between employment status and attendance (on-campus or via live streaming), corroborating findings reported by Fields (2012). Brother (2004) and Edwards and Clinton (2019) reporting from a sample of science students, among others, strongly attribute this decline to the availability of lecture recordings. Our findings imply the same since lecture recordings were the most preferred mode of delivery by our sample population.

Secondly, we found that there was a significant difference between the students' preference in attending lectures, with more students preferring to attend lectures on-campus, and both on-campus and live streaming, than using the live streaming utility only. However, the fact that more students preferred to access the lecture recordings, more than any of the three delivery modes, highlights the importance of flexible approaches and provision of both synchronous and asynchronous modes of lecture delivery, a discussion carried by Crook (2015) in arguments for and against compulsory recording of lectures. In the study, the students with the higher motivation for learning avail themselves of the resources available, seeking flexibility and optionality in accessing lectures, with significant support for both on-campus and live streaming of lectures, but overall, the provision of lecture recordings proves to be the most widely preferred mode of delivery.

Thirdly, the study also points to some mild positive correlations for students to attend on-campus lectures to interact with lecturers and classmates. Student motivation for acquiring knowledge has a positive mild effect on students' attendance. The higher the students' motivation for acquiring knowledge, the higher their attendance. There is a significant moderate correlation between students' motivation for on-campus lectures and their attendance, findings in line with other studies reporting results from different disciplines such as clinical science (Matheson, 2008) and engineering (Nyamapfene, 2015). When it comes to motivation and attendance in higher education, it appears that the academic discipline itself is not as important a factor as the type of the teaching event (e.g. lecture or tutorial) indicating that motivational factors are of greater importance for non-compulsory classes compared to compulsory classes (Massingham & Herrighton, 2006). French and Kennedy (2016) also concluded from a thorough literature review covering several disciplines that for a lecture to be attractive for students to attend it needs to be well designed and effectively delivered, placing a strong emphasis on the pedagogy and the enthusiasm by the lecturer.

We found no significant correlation between the students' years of study and attendance. Thus, experience of university life and knowledge does not affect students motivation for attending a lecture on campus, but there is a significant low negative correlation between the years of study and students motivation for using live streaming, indicating that the more experienced students are less motivated to attend a lecture using live streaming. However, if we combine these results with the correlations between motivation versus on-campus lectures and lecture recordings, we could assume that they are motivated to acquire knowledge in different formats apart from on-campus lectures, live streaming and lecture recordings. Edwards and Clinton (2019) noted that the more

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engaged students used lecture capture to deepen learning engagement. A similar pattern can be inferred from this study based on student preferences.

Practical implications

The fact that more students preferred to access the lecture recordings, more than any of the three delivery modes, highlights the importance of flexible approaches and provision of both synchronous and asynchronous modes of lecture delivery. COVID-19 necessitated this at a large scale globally however, as per our findings, even pre-COVID-19, students were inclined towards blended and/or online modes of learning and teaching. The rapid transition to online learning due to COVID-19 simply accelerated the inevitable – as indicated by our findings. Clearly the on-campus lecture remains a significant teaching method, however, its' effectiveness as a learning method can only be inferred here from preference and motivation as no correlation with performance was attempted in the study. Of significance to the provision of university infrastructure and academic and student resources, is this study's confirmation of student preference for flexibility when accessing lectures, with those choosing both on-campus and live streaming lecture delivery, also having a strong preference for using recorded lectures and its embedded resources. This indicates that universities should provision for making these resources available on an ad hoc basis, for time-flexible viewing and revision. Furthermore, our findings with regards to the impact of technical characteristics of the live streaming and lecture recording platform on students' preferences confirm the necessity of investing in the speed and quality of the provisions.

Another significant finding is that attendance is positively correlated with overall motivation and that motivation for acquiring knowledge shows a stronger positive correlation with attendance as compared to motivation for interaction. This implies that for students to attend on-campus lectures, the lectures need to involve and engage students actively and effectively for them to realize the value the lecture adds to their knowledge. While this finding intuitively makes sense, our study empirically supports it. Therefore, if the goal is to encourage on-campus attendance, lecturers need to employ evidence-based student-centred and pedagogically strong approaches as suggested by French and Kennedy (2016) as well. We believe our findings provide some preliminary guidance to future pedagogical approaches for enhancing student participation and engagement. The results of our study cast some doubt on the requirement for live streaming however, more research and consideration are required before any conclusions can be reached on whether live streaming can adequately replace more traditional face-face on-campus teaching, or its acceptance amongst the broader student cohort.

Limitations

This study has several limitations. Some of the dependent variables were collected in a subjective manner which could have resulted in an inaccurate representation of student attendance. We asked students to self-report their attendance in week 1-10. These data would have been more accurate if the lecturer had maintained an attendance sign in form. Another limitation is the fact that we did not correlate any of the findings around attendance and motivation with academic performance in the form of final grades. This would provide valuable insight into the pedagogical value of lectures in terms of impact on students' learning and performance. A final limitation is the lack in our sample of students from other than Humanities and Social Science, such as Business, Engineering and Health. This limitation, though identified, may be mitigated by findings from all the studies which we reviewed in this paper and which demonstrate very little if any difference in how

students participation in lectures may differ because of the discipline they study. The limitations mentioned can be easily addressed by including actual attendance and performance data and exploring modes of lecture delivery across different disciplines in future studies.

Conclusion

The study offers a unique and deep insight into dynamics of lecture attendance, preferences, and motivations to attend in one large institution and informs decision making around the value of investing in lecturing and lecture capture technology. Given the global shift in the profile of learners who are increasingly requiring greater flexibility, our findings hold valuable implications for universities across the world. COVID-19 has made it even more important that more comparative studies are carried out which include all possible ways that a lecture can be offered as a study option in contemporary higher education including the various technological solutions of recordings and live streaming. A more focused area of study would include in the analysis such variables as the quality of the lecture in terms of its style of delivery, the design of the resources used within the lecture and the time in which the lecture is offered. It is also important, where feasible, to conduct further research which provides greater insights on how lecture attendance does or does not impact academic performance.

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