

Pre-Recorded Video Lectures versus Live Online Lectures: A Comparison of Students' Performance

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Abstract: The COVID-19 pandemic that led to the shutdown of classrooms throughout the world, has increased reliance on online forms of instruction. One of the efforts done to make online instruction a near equivalent to face-to-face instruction is the provision of pre-recorded video lectures (PRVL) and live online lectures (LOL). During the post-pandemic era, the use of these online learning instructions continues to evolve and expand, highlighting both opportunities and challenges. This research paper examines whether the PRVL has the same effect on students' performance compared to LOL. Students' performance is further analysed based on the six cognitive levels of Bloom's Taxonomy to compare the score differences across all levels between two groups of students instructed using PRVL and LOL. The target sample group for this study consisted of 134 Diploma in Accountancy students enrolled in the "Financial Accounting 4" (FAR270) course at Universiti Teknologi MARA Pahang Branch during the academic session from March to July 2021. The students were divided into two groups: the PRVL group (68 students) and the LOL group (66 students). The assessment questions were administered to both groups after the completion of each topic. The results of the study show that PRVL helped students to perform better in their overall assessments in comparison to LOL. It was also found that the PRVL group performed better on moderate and high cognitive level of questions. On the contrary, the LOL group outperformed the PRVL group on lower-order thinking questions. However, no significant difference was found between the PRVL and LOL groups for "remembering" questions. It is crucial to evaluate students' achievement in different cognitive levels of questions for these two online learning methods, as this allows educators to implement appropriate strategies to improve students' learning outcomes.

Keywords: Bloom's Taxonomy, live online lectures, online learning, Post-COVID 19 Pandemic, pre-recorded video lectures

Introduction

The COVID-19 pandemic had a significant impact on education worldwide, leading to a rapid shift from traditional face-to-face learning method to online and remote education. One of the efforts to make online and remote learning methods equivalent or nearly equivalent to face-to-face learning method includes the provision of pre-recorded video lectures (PRVL) where the educators record their lectures outside of their class time and share them with students in digital formats, such as MP4 (Islam et al., 2020; Shah et al., 2013). Pre-recorded video lectures available online offer flexibility for

students who have various tasks and other commitments (Hadgu et al., 2016, Quinn & Kennedy-Clark, 2015). Students can use PRVL to review course content, revise the topic they have learned, clarify important concepts, study the video content at their own pace, and revisit the videos as many times as needed (Syynimaa, 2019, Danielson et al., 2014). However, the effectiveness of PRVL is questioned due to its lack of interaction between students and educators. To increase the effectiveness of online teaching and learning activities, the live online lectures (LOL) offer a learning method that is very similar to face-to-face where lecturers and students can meet and interact with each other in real-time (Islam et al., 2020).

Online learning at higher learning institutions during the post-COVID-19 pandemic era is likely to continue evolving and expanding (Ermilinda et al., 2024). The experience during the pandemic demonstrated the importance of having flexible learning options in place. PRVL and LOL provide continuity in education during disruptions, such as health crises, natural disasters, or other emergencies. In addition, the pandemic accelerated the adoption of blended learning models, combining online and face-to-face instruction methods. PRVL and LOL sessions are often used to supplement face-to-face instruction, providing additional resources for students to reinforce their learning. Thus, ongoing research into the effectiveness of these online learning methods is crucial to support the continuous usage of PRVL and LOL as part of a comprehensive educational strategy that maximises student outcomes.

While numerous studies have been conducted to evaluate the effectiveness of online versus traditional forms of instruction, relatively few have addressed the relationship between instructional methods and students' achievement of different learning objectives in an online learning environment. As explained above, both PRVL and LOL have their own advantages and disadvantages. Therefore, this research paper examines whether PRVL has the same effect towards students' performance in comparison to LOL. The students' test scores were categorised based on the six cognitive levels of Bloom's Taxonomy (Bloom et al., 1956; Anderson & Krathworthl, 2001) and the score differences at all levels between two groups of students instructed using PRVL and LOL were analysed. It is important to compare students' achievement in different cognitive levels of questions for these two online learning methods, as educators can later adopt the necessary measures to enhance students' learning outcomes.

The objectives of this study are as follows:

1. to assess the difference between the test scores of PRVL group and LOL group; and
2. to analyse the difference between the test scores of PRVL group and LOL group for different cognitive levels of questions.

Literature Review

Transition to Online Learning during COVID-19 Pandemic

The COVID-19 pandemic presented a huge challenge to the education system worldwide. Lockdown and social distancing measures as the result of the pandemic has led to the closure of educational institutions across the world and necessitating the suspension of face-to-face learning to help prevent the spread of the virus (Jnr & Noel, 2021; Zayapragassarazan, 2020). This situation prompted a paradigm shift in the education system (Jnr & Noel, 2021; Mulenga and Marban, 2020), forcing educational institutions to employ various online platforms for teaching and learning activities during the pandemic (Ab Latif et al., 2021; Kumar & Verma, 2021; Zizka & Probst, 2021).

For students who are already accustomed to online classes, the transition to online/distance learning would have involved nearly zero change, but for those who enrolled in face-to-face classes, this transition resulted in entirely different experience, affecting aspects from mode of instruction to assessment procedures (Cavanaugh et al., 2023). Online learning tools have played a crucial role during this pandemic, helping schools and higher educational institutions facilitate student learning (Chung et al., 2020). Several terms have been used to describe online learning or learning via the

internet, including distance education, computerised electronic learning, e-learning, internet learning, and many others (Elfaki et al., 2019).

Students' Performance in Face-to-face Instruction versus Online Instruction

A considerable number of studies have compared the performance of students learning through online instruction to those learning through face-to-face form of instruction. For example, Sokout and Usagawa (2021) investigated students' academic performance in four courses taught face-to-face compared to six courses taught using blended learning instruction. They found that students taught using blended learning performed significantly better, as measured by their final scores. Using 80 under-graduate nursing students (40 in the experimental group and 40 in the control group), Elfaki et al. (2019) discovered that the mean final exam scores obtained by students in the e-learning group (experimental) were statistically higher than those in the traditional face-to-face group (control). Furthermore, this study revealed that the mean of the students' overall satisfaction with the traditional face-to-face lectures was lower in comparison to the e-learning. Similarly, Soffer and Nachmias (2018) compared three courses taught online and face-to-face and found that student grades were higher in online courses, with no difference in completion rates.

On the other hand, other studies have demonstrated that face-to-face courses are associated with higher performance compared to online courses. For example, Tratnik et al. (2019) found that students in a business English class seemed to learn more in a face-to-face setting compared to an online setting. Likewise, Bir (2019) revealed that academic performance was higher in a face-to-face engineering course compared to an online engineering course. Similarly, Hurlbut (2018) reported higher performance for students taking a face-to-face teacher education course against those taking an online course.

While some studies found superior students' performance in either online or face-face instruction, a number of studies found no difference in performance when comparing the two. For example, Jafar and Sither (2021) compared performance in an Introductory Anatomy and Physiology course taught in face-to-face and hybrid online formats. The study reported that students' performance in the two formats was not statistically different, but students evaluated the hybrid format more positively. Similarly, Bergeler and Read (2021) discovered that students taking a physics course performed equally well in both online and face-to-face formats. The students also reported greater satisfaction with the online format of the course. In law studies, Bahnson and Olejnikova (2017) compared retention of legal research concepts between two student groups: one taught by face-to-face lecture and one taught using an online recorded module. They found no significant difference in retention between the two groups. They also reported that students "really liked" using recorded videos and provided positive feedback on the videos. However, it is not clear that recorded modules are the best approach to increase efficiency and improve student learning. To determine which teaching method generated better student performance over an eight-year period, Paul and Jefferson (2019) analysed the scores of 548 students (401 face-to-face classroom students and 147 online students) in an environmental science class. They found no significant difference in the performance of online and face-to-face classroom students overall with regard to modality, gender, or class rank of non-STEM majors. A study in the medical field demonstrated that online recorded lectures produced the same knowledge gain as face-to-face lectures in the learning of clinical course (Orellano & Carcamo, 2021). Furthermore, the study discovered that watching a recorded lecture after attending a face-to-face lecture or vice versa, showed comparable additional knowledge gain, thus making it feasible for clinical courses.

Students' Performance in PRVL versus LOL

Several studies have compared students' performance in two forms of online instruction, namely PRVL and LOL. For example, Ramlogan et al. (2014) compared the knowledge and skills acquired by dental students in three clinical exercises in the field of periodontology through video and live lecture instruction. They found that the live lecture group performed better than the video group in the post-

test assessment. However, the students had a preference for video (97%) compared to the live lecture (78.8%). Likewise, Guo (2020) reported that students who attended the synchronous sessions performed better than those who depended on the asynchronous learning. However, Brockfeld et al. (2018) discovered that live and video lectures had the same effect on the examination performance of the medical students. In terms of subjective evaluation, 48% of students preferred live lessons, 27% preferred video lessons, and 25% stated 'neutral'. However, the items of 'learning atmosphere', 'ability to concentrate', 'presence of other students', and 'acoustic intelligibility' were evaluated significantly better for the video lectures than for the live lectures. Furthermore, Islam et al. (2020) made a comparison between pre-recorded lecture videos and live ZOOM lectures using a sample of 26 undergraduate students in the Business Management field at a university in South Korea. Their findings showed that students preferred pre-recorded video lectures to live ZOOM lectures due to their flexibility, convenience and educational effectiveness. However, they highlighted that learning through lecture videos relies on students' motivation to study the learning materials independently. The absence of motivation and clear deadlines for watching the lecture videos might lead to a buildup of workload, making it challenging to catch up before exams (Islam et al., 2020). Thus, the following hypothesis is proposed:

H1: There is a significant difference between the test scores of PRVL group and LOL group.

Students' Performance in Different Cognitive Levels of Bloom's Taxonomy

Bloom's Taxonomy is a classification of the different levels of cognitive skills that educators set for their students' learning objectives, as well as to create and align objectives, lessons, and assessments to achieve all cognitive levels within a particular course (Anderson & Krathworthl, 2001). There are six cognitive levels originally proposed by Bloom (1956), namely knowledge, comprehension, application, analysis, synthesis, and evaluation. The terminology has since been revised to include the following six cognitive levels (Anderson & Krathworthl, 2001): (a) remembering, which focuses on recalling facts and basic concepts; (b) understanding, which focuses on explaining ideas or concepts; (c) applying, which focuses on use of information in given situations; (d) analysing, which focuses on drawing connections among ideas; (e) evaluating, which focuses on justifying a stand or decision; and (f) creating, which focuses on producing new or original ideas. Bloom's taxonomy has also been used by researchers as an assessment tool to evaluate students' performance in traditional courses versus online courses (Hadgu et al., 2016; Halawi et al., 2009; Boyd & Murphrey, 2002). Using a sample of 60 Introductory Physiology students, Hadgu et al. (2016) found no significant difference in students' performance between live lecture and pre-recorded lecture groups on memory questions (basic factual details). However, they discovered that students in the live lecture group performed significantly better on comprehension questions (requiring processing of given information) compared to the pre-recorded lecture group. Their study also revealed that students in pre-recorded lecture group performed significantly higher on memory questions compared to comprehension questions. Therefore, the following hypothesis is proposed:

H2: There is a significant difference between the test scores of PRVL group and LOL group for different cognitive levels of questions.

Methodology

The main purpose of this study is to determine whether the PRVL and LOL have the same effect on students' performance. Students' performance will then be further analysed based on different cognitive levels of Bloom's Taxonomy. In this study, PRVL is defined as a lecture recorded in advance for students to watch during lecture hours or at their convenience. LOL refers to a lecture conducted in real-time through Google Meet platform that allows students to participate in video conferences. The target sample group for this study consisted of six groups of Diploma in

Accountancy students (134 students) enrolled in the “Financial Accounting 4” (FAR270) course at Universiti Teknologi MARA Pahang Branch during March to July 2021 academic session. The students in each group were selected randomly and were not ranked based on their previous grades.

The six groups of students who participated in this study were divided into two groups, namely the PRVL group (68 students) and the LOL group (66 students). Three topics from the FAR270 syllabus were selected for this study, namely MFRS 108 *Accounting Policies, Changes in Accounting Estimates and Errors*, MFRS 137 *Provisions, Contingent Liabilities and Contingent Assets*, and MFRS 101 *Preparation of Financial Statements for Publication*. These three topics were selected because their learning objectives align with all six cognitive levels of Bloom’s Taxonomy.

For the PRVL group, students were provided with a PRVL by the lecturer, which they were instructed to watch during class hours or at their convenience during the following time frames: (a) week eighth for MFRS 108 topic; (b) week eleventh for MFRS 137 topic; and (c) week thirteenth for MFRS 101 topic. During the same time frames, students in the LOL group were instructed by the same lecturer through the Google Meet platform. Discussions on exercise questions were also pre-recorded for the PRVL group, while for the LOL group, the discussions were conducted during the Google Meet sessions. After completing each topic, both groups of students were given approximately three to seven days to carry out their own revisions. Then, the assessment questions were distributed through the Google Forms application, and they were required to answer the questions within a specified time period.

All questions were designed by the lecturer and reviewed by the course specialists to ensure their conformity with the six cognitive levels of Bloom’s Taxonomy. The same questions were administered to both PRVL and LOL groups. The students’ scores were later analysed using IBM SPSS Statistics version 26.0.

Ethical Considerations

Before this study was conducted, students were informed about the objectives of the study and verbal consent was obtained from each participant. The confidentiality of the collected data was assured. The scores obtained from this study were not included in the students’ continuous assessment results or used to determine their grades. The data obtained was anonymised and will be retained only until the publication of this paper.

Findings and Discussion

Based on the results in Table 1, the mean scores obtained by the PRVL group ($M = 70.73$, $SD = 16.69$) are statistically significantly higher than the LOL group ($M = 60.19$, $SD = 10.52$), $t(132) = 4.385$, $p = 0.000$ (two-tailed). Clearly, these findings indicate that the PRVL group outperformed the LOL group in the overall assessment questions. Thus, hypothesis 1 (H1) is supported.

Table 1. Independent-samples t-test between Mean Scores of PRVL Group and LOL Group

M (SD)		Independent sample t-test (DF=132)	95% Confidence Interval	
PRVL N = 68	LOL N = 66		Lower	Upper
70.73 (16.69)	60.19 (10.52)	4.385	5.775	15.296

To further analyse the students’ performance in both groups, the questions are categorised into six cognitive levels, namely remembering (level 1), understanding (level 2), applying (level 3), analysing (level 4), evaluating (level 5), and creating (level 6). Kolmogorov-Smirnov tests reveal that the scores are not normally distributed. Thus, the nonparametric Mann-Whitney U test is used in the following analysis to compare the scores of the two independent samples. The results for each

cognitive level are presented in the following tables and divided into three categories: low cognitive levels (levels 1 and 2), moderate cognitive levels (levels 3 and 4), and high cognitive levels (levels 5 and 6).

A comparison of students' scores at the low cognitive levels (levels 1 and 2) is shown in Table 2. For level 1 questions, the results indicate no significance difference in the students' scores between the PRVL group (Md = 93.75, n = 65) and the LOL group (Md = 85.71, n = 66), $U = 1908.5$, $z = -1.123$, $p = 0.262$, suggesting that students' performance is not affected by the forms of instructions used. However, for level 2 questions, the scores obtained by the LOL group (Md = 85.71, n = 66) are statistically higher than the PRVL group (Md = 65.63, n = 65), $U = 470$, $z = -7.608$, $p = 0.000$. Therefore, hypothesis 2 (H2) is supported only for cognitive level 2 (understanding) of Bloom's Taxonomy.

Table 2. Independent-samples Mann-Whitney U test for PRVL and LOL Groups for Low Cognitive Levels of Bloom's Taxonomy

Level	Group	Median	N	U	Z	p
1 (Remembering)	PRVL	93.75	65	1908.5	-1.123	0.262
	LOL	85.71	66			
2 (Understanding)	PRVL	65.63	65	470	-7.608	0.000
	LOL	85.71	66			

A comparison of students' scores at the moderate cognitive levels (levels 3 and 4) is displayed in Table 3. The results reveal that the PRVL group (Md = 80.69, n = 68) scored statistically higher than the LOL group (Md = 59.62, n = 66), $U = 787$, $z = -6.503$, $p = 0.000$ on level 3 questions. The LOL group also performed poorly (Md = 62.5, n = 62) compared to the PRVL group (Md = 90, n = 64), $U = 386$, $z = -7.859$, $p = 0.000$ on level 4 questions. Hence, hypothesis 2 (H2) is supported for cognitive levels 3 (applying) and 4 (analysing) of Bloom's Taxonomy.

Table 3. Independent-samples Mann-Whitney U test for PRVL and LOL Groups for Moderate Cognitive Levels of Bloom's Taxonomy

Level	Group	Median	N	U	Z	p
3 (Applying)	PRVL	80.69	68	787	-6.503	0.000
	LOL	59.62	66			
4 (Analysing)	PRVL	90	64	386	-7.859	0.000
	LOL	62.5	62			

Table 4 exhibits a comparison of students' scores at the high cognitive levels (levels 5 and 6). It appears that the LOL group scored significantly lower on level 5 questions (Md = 75, n = 64) compared to the PRVL group (Md = 93.75, n = 68), $U = 1257$, $z = -4.088$, $p = 0.000$. Similarly, the LOL group performed less well (Md = 33.93, n = 66) on level 6 questions compared to the PRVL group (Md = 38.89, n = 68), $U = 1783$, $z = -2.057$, $p = 0.040$. Therefore, hypothesis 2 (H2) is supported for cognitive levels 5 (evaluating) and 6 (creating) of Bloom's Taxonomy.

Table 4. Independent-samples Mann-Whitney U test for PRVL and LOL Groups for High Cognitive Levels of Bloom's Taxonomy

Level	Group	Median	N	U	Z	p
5 (Evaluating)	PRVL	93.75	68	1257	-4.088	0.000
	LOL	75	64			
6 (Creating)	PRVL	38.89	68	1783	-2.057	0.040
	LOL	33.93	66			

The findings of the study show that PRVL helped students to perform better in their overall assessments in comparison to LOL. These results are contradictory to those of Ramlogan et al. (2014), who found that the live lecture group outperformed the video lecture group in the post-test assessment and Brockfeld et al. (2018), who discovered that live and video lectures had the same effect on the examination performance. When the questions are divided into six cognitive levels of Bloom's Taxonomy, it is also found that the PRVL group performed better on higher cognitive levels of questions that require critical or higher-order thinking and a greater understanding of information (Bloom et al., 1956; Anderson & Krathwohl, 2001). These findings seem inconsistent with those of Hadgu et al. (2015), who reported that students in the live lecture group performed significantly better on higher-order thinking questions compared to the pre-recorded lecture group. For lower order thinking questions that require the understanding of the knowledge (level 2), the LOL group performed better than the PRVL group. For "remembering" questions (level 1), we found no significant difference between the PRVL and LOL groups. These findings contradict those of Hadgu et al. (2015), who found that the PRVL group performed better on memory questions (basic factual details) but not on comprehension questions (requiring processing of the given information).

Conclusion

In this study, PRVL appears to help students perform better in higher cognitive levels of questions. Learning through PRVL has its own advantages. For instance, through PRVL, students can go through the video lectures as many times as they want at their own pace (Prunuske et al., 2012). The ability to pause, rewind, forward and replay the videos (Islam et al., 2020) may enable students to apply their understanding of information, analyse and evaluate information, and generate new ideas. In LOL, students tend to spend more time taking notes at the lecturer's pace rather than at their own (Leadbeater et al., 2013). Additionally, PRVL may be able to help students to improve their higher-order thinking skills by providing auditory and visual clues on emphasised points that they may have missed if they were to learn the material through LOL (Hadgu et al. (2016). Evaluating students' achievement across various cognitive levels of questions in these two online learning methods is essential, as it enables educators to adopt effective strategies to enhance students' learning outcomes.

Suggestion for Future Research

This study has several limitations. First, there was a lack of proper supervision and monitoring during the online assessments. Since the assessments were conducted remotely, ensuring academic integrity can be challenging. Students may collaborate with others, use other groups' learning materials or search for answers online, which could compromise the validity of the assessment results. The second limitation is the variation in learning preferences. Some students might prefer one method of instruction over the other. For instance, visual or auditory learners might benefit more from pre-recorded content that allows replay, while kinaesthetic learners might perform better in live settings where they can ask questions and receive immediate feedback. Thus, such inherent preferences might impact the accuracy of the results. The third limitation of this study is its use of convenience sampling, as it only involved Diploma in Accountancy students from Universiti Teknologi MARA Pahang. It does not consider other courses, programmes, educational levels, and institutions. The fourth limitation is the small sample size. The greatest constraint was due to a lack of time, funding and other resources. During the COVID-19 pandemic, the government enforced social distancing and strict standard operating procedures (SOPs), which negatively affected this study in terms of data collection from a wider population. Hence, generalising findings of this study is not recommended. Future research could investigate how learning outcomes differ between PRVL and LOL across various disciplines, educational levels and institutions. Furthermore, future research could cover the levels of student engagement and participation in PRVL versus LOL and their impact on learning.

Co-Author Contribution

The authors confirmed that there is no conflict of interest in this article. Author 1 conceptualised the study, designed the methodology and supervised the research process. Author 2 and 3 conducted the data collection, performed the formal analysis and contributed to the manuscript writing. Author 4 contributed to the literature review and manuscript writing. Author 5 reviewed and edited the final draft. All authors read and approved the final manuscript.

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