Teaching Psychology in VR 2: To live stream or not to live stream, that is the question

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August 15th , 2022

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Post-secondary education has traditionally relied on colleges and universities to host courses in face-to-face settings such as lecture halls and classrooms. However, in recent years, teaching has increasingly taken to online formats, especially during the recent lockdowns during the COVID19 pandemic. Many post-secondary institutions transitioned to online teaching formats which often required students to participate in asynchronous lessons via pre-recorded video or synchronous lessons held over communication platforms such as Zoom. However, online learning can limit the communication possible between student and teacher which may result in lower student engagement with the instructor and their lesson material. Students may have felt distanced from their educational environment, hampering their satisfaction levels with their courses and educational institutions. The current research aims to investigate means of addressing such concerns by comparing: 1) learning vs. satisfaction outcomes, 2) synchronous vs. asynchronous instruction, and 3) the use of virtual reality (VR) in online instruction, discussed in turn.

Learning and Satisfaction as Outcomes of University Teaching In-person vs. Online

Students who choose to take online courses can manage their schedules more freely rather than needing to attend classes only when the instructor is available. Past research has identified that online learning may be just as beneficial for student learning outcomes (e.g., course performance) as traditional face-to-face learning (e.g., Aller et al., 2022; Bergler & Read, 2021; Callister & Love, 2016; Holmes & Reid, 2019; Johnson et al., 2000; Nemetz et al., 2017; Tratnik et al., 2019). This allows post-secondary students and their institutions to undertake educational activities during adverse events such as the COVID-19 pandemic without either party being disadvantaged.

In comparison to learning outcomes, however, student satisfaction with online learning has reported mixed findings as lower satisfaction (e.g., Palmer & Holt, 2009; Tratnik et al., 2019), higher satisfaction (e.g., Bergler & Read; 2021), and no differences in satisfaction (e.g., Wise et al., 2004) when comparing online and face-to-face teaching methods. Inconsistent student satisfaction ratings may exist the instructor's method of teaching and the content taught during an online course. Student satisfaction has been reported as higher when students were offered course content that meets their expectations within an online learning environment (Pham & Nguyen., 2021; Tratnik et al., 2019). Kintu et al., (2017) further reported that courses with blended online and face-to-face components correlated with increased student satisfaction.

Presence and Satisfaction and Learning Outcomes

In person classes seemingly offer students the most opportunity to feel present during a lecture as they are physically and temporally in the same environment with their professor. During the COVID19 pandemic, students reported missing being able to attend lectures in person as they had to transition to online learning platforms. This also transitioned students away from their professors as they found themselves physically distanced from their professors. In addition to being physically distanced from their professors, both synchronous and asynchronous course options may have resulted in students feeling varying levels of presence during their lecture periods.

Research has been contradictory regarding the experience of presence in the classroom and the relationship students form with their professor. Past research has found no strong support for the influence of student-instructor interaction, outlining that students may not need to feel that they are in the same learning environment as their professor to feel satisfied with their learning experience (Wise et al., 2004). Other students found that the student-teacher interaction is not as strong of a predictor of satisfaction when compared to the interaction a student has with their course content (Alqurashi, 2019; Pham & Nguyen, 2021). In contrast, research has also found that students may feel a lack of guidance and support leaves them isolated and struggling to transition to

online learning (Symeonides & Childs, 2015). Studies regarding students' learning outcomes have produced mixed results as well as Wise et al. (2004) state that the student-teacher interaction may not have an overall effect on students' perceived learning but Yen and Abdous (2012) reported an increase in faculty engagement is accompanied by an increased probability of achieving a higher final course grade.

Current research shows that learning environments that lack a high degree of student-instructor interaction may still be effective for students during times where an option for face-to-face interaction does not exist. However, it is not likely that student satisfaction will exhibit the same benefits. Higher levels of instructor presence may facilitate higher student satisfaction, and thus, positively influence learning outcomes. The inconsistency of an instructor's influence on student learning outcomes requires further research, inviting further exploration between instructor presence, student satisfaction, and learning outcomes. To our knowledge, no studies have compared students' sense of presence in the classroom with an instructor present in both synchronous and asynchronous learning environments. Perhaps the use of VR technologies will better simulate instructor presence in comparison to other online learning methods and offer students a deeper engagement with their learning environment, thus increasing their satisfaction and learning outcomes.

Satisfaction and Learning Outcomes in Synchronous vs. Asynchronous University Teaching

Online learning formats offer instructors the option of providing course content to students synchronously or asynchronously. Neither format has resulted in superior learning outcomes for students (Chen et al., 2006; Belliston, 2021) and they have both been considered acceptable alternatives to the traditional face-to-face lesson (de Jong et al., 2013). However, students may have difficulty in establishing educational relationships with the absence of an instructor leaving students feeling isolated (Symeonides & Childs, 2015). In contrast, students who have access to mobile,

asynchronous course components have reported improved learning outcomes and higher levels of satisfaction with their courses (Zhonggen et al., 2019). Asynchronous learning environments have result in positive outcomes for students, however, synchronous engagement between student and professor has been shown to positively impact student performance when compared to asynchronous lesson engagement (Duncan et al., 2021). Furthermore, Fabriz, Mendzheritskaya and Stehle (2021) reported a more positive learning experience for students who participated in synchronous (compared to asynchronous) lecture videos. This may be due to students feeling the support that comes from knowing that their professor is present and with them. Possessing a higher cognitive ability has also been related to synchronous course performance (Offir et al., 2008). Additionally, decreased motivation for academic work and retaining less course content has been related to shifting courses online (Usher et al., 2021).

Use of Virtual Reality in University Teaching

Virtual reality (VR) technology has proven useful in the instruction of mathematics, engineering, technology, medicine, dentistry (i.e., STEM subjects; Radianti, Majchrzak, Fromm, & Wohlgenannt, 2020; Joda et al., 2019) and it can assist individuals with psychological coping techniques such as progressive muscle relaxation (Fusco et al., 2018). Additionally, VR allows for active engagement in training rather than taking on a bystander role (Majka, 2021; Netland et al., 2020). Past studies have shown that students retain more information and are more capable of applying what they had learned after completing VR exercises (Krokos, Plaisant, & Varshney, 2018; Ros et al., 2021). VR offers an immersive, cost-efficient and more accessible method for students to experience aspects of their training that may present limitations such as restricted access to certain areas of facilities while on an in-person field trip (Netland et al., 2020). Additionally, VR may offer students the ability to complete tasks in a timeframe that is better suited for the individual instead of feeling rushed to complete tasks in equal time to their peers (Reeves et al., 2021). Joda et al. (2019) remark that the blending of real learning environments with digital elements enable VR to

offer new teaching opportunities which have been shown to positively impact the quality of a lesson and enhance knowledge transfer.

Higher spatial and temporal presence has been reported by student who used VR technologies to attend pre-recorded lectures and were more satisfied overall with the videos of psychology lectures when using a VR HMD(Frewen, Oldrieve & Law, 2022). Other research involving counseling psychology has found that education was declared more interesting, engaging, and immersive when using a VR headset when compared with standard computer monitors (Rogers et al., 2020). These differences in felt presence and student satisfaction with psychology teaching via VR technologies may be encouraging to students in the online learning environment, increasing their satisfaction. Recent research has, however, also explored VR learning outcomes and found either no added benefit or even poorer performance in the VR modality. For example, Frewen, Oldrieve and Law (2022) reported no significant differences in final scores between VR and non-VR conditions on multiple choice questionnaires administered immediately after a lesson in psychobiology, although this study focused solely on online teaching and did not compared to a traditional in-person condition. VR instruction in psychology has not yet been compared to the traditional face-to-face instructional format in the context of teaching psychology and invites the opportunity to compare the two conditions in the current study.

Hypotheses

Learning Outcomes:

1. Participants will not differ in their learning outcomes between in person and online conditions.

2. Participants will not differ in their learning outcomes between synchronous and asynchronous conditions.

Satisfaction:

1. Participants will be more satisfied with the VR and synchronous learning conditions compared to the standard flatscreen and VR asynchronous conditions.

2. Participants will be more satisfied with their learning experiences in VR compared to the flatscreen conditions.

Presence:

1. Participants will report higher spatial temporal presence in the VR condition when compared to the standard laptop/tablet condition.

2. Participants will report higher spatial temporal presence during synchronous lesson conditions in comparison to asynchronous lesson conditions.

Method

Procedure

Participants will be recruited from Western University's mass email or SONA system and will be either compensated with $10 or with SONA credits.

Participants will complete a 7 to 8-minute in-person introductory psychology lecture and then participate in two additional 7 to 8-minute psychology lectures that will be recorded using a 360° camera. For the online portion of the study, participants will be randomly assigned to complete one of four possible pairing combinations: 1) both pre-recorded conditions; 2) both live stream conditions; 3) both with HMD conditions; 4) both without HMD conditions. Three different introductory psychology lectures teaching sensation and perception fundamentals will be randomly assigned to each participant to control for order effects in counter-balanced fashion. Participants will be assessed on their knowledge of the content learned directly after each video by a five-question multiple choice quiz. Participants will also report their sense of temporal presence, spatial presence, interpersonal presence, overall satisfaction and the ease with which they could complete the class on a numeric rating scale. The entire experiment is estimated to take less than 60 minutes.

Materials

Psychology Lessons

Three introductory psychology lecture videos were designed to be 7 – 8 minutes in length and were scripted by the researchers. Each lecture video explains theoretical psychology content which may influence student satisfaction (Perez-Villalobos et al., 2021). Specifically, the videos explain and describe topics relating to visual perception, colour, illusions, and perceptual organization that were designed to be high-level educational content attempting to establish an equal level of difficulty between each. Videos would introduce the topic, discuss key topics, and then summarize the lesson.

Questionnaires

Participants will answer five multiple choice questions to assess their learning outcomes after each lecture session. The questionnaires ask questions relevant to the instructional content. Example questions such as: "*The German term "Gestalt" refers to all of the following EXCEPT?*", "*What is size constancy*?", and "*What is spectral reflectance?*" will be asked. Additionally, participants will indicate the degree to which they experienced spatial, temporal, and interpersonal presence during the psychology lessons after each lecture and will indicate their answers on a scale ranging from 0 (Not at all) to 10 (Completely). Questionnaire items are as follows: "*How much did you feel like you were in the same physical space or location as the one where the activity was taking place?*", "*How much did you feel like the activity was occurring in the present, rather than sometime in the past?",* "*How much did you feel like you were interpersonally a part of what was happening, as if the two of you were taking part in the activity together?".* Satisfaction and difficulty will also be assessed on a similar rating scale. The satisfaction question item is *"How satisfied were you with this instructional format?"* and the difficulty question item is *"How difficult did you find this activity?".* Finally, comfort and nausea were assessed with the questionnaire item *"Did you feel nauseous or*

unbalanced during the activity?". The spatial and temporal questions were adapted from the survey used by Frewen, Paige, and Law (2022) while a face valid question assessing interpersonal presence was also added.

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Note: Appendix omitted as the study has not been completed yet.

Note: Video links for USRI staff are available on request. They have not been included in the Method section as the study has not beeen completed yet.