It’s All in the Design - the Learning Design: Comparing Active Learning Affordances within VLEs

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Using a cross-case thematic comparison of Virtual Learning Environment (VLE) studies we focused on distinctions among student reactions to validate the design of a browser-based virtual field experience. Results show that addressing higher-order learning through a given technology in the learning design creates comparable student responses to those received from more immersive experiences. This suggests that more democratized

Introduction

The pandemic had historic impacts in the context of shifting learning online. Since this transition to online learning, there has been an increased exploration of virtual learning experiences across various disciplines. However, in the spatial disciplines, particularly in the geosciences, fieldwork continues to experience challenges with facilitating trips (e.g., large classes, weather, etc.) which existed long before the onset of COVID-19. Before COVID, various solutions, including immersive options, were growing in popularity. To address the issue of transitioning from actual to virtual fieldwork, we need to understand how learning is being modeled across different modalities. Actual field trips are considered active learning experiences and how we address active learning in virtual counterparts is important to the success of a virtual field trip.

The pandemic introduced additional challenges in conducting virtual versions of field trips. Immersive technology, often hailed as a solution, leverages virtual reality (VR) headsets to create an embodied sense of space and enable interactions not possible within the real world (Zhao et al., 2020). However, immersive experiences come with inherent limitations for students with disabilities. The onset of the pandemic exacerbated the disparity in utilizing VR headsets, restricting access to such technology. Unfortunately, not all students were able to secure access to VR headsets and university resources were unavailable.

The benefits of immersive virtual experiences are hard to compare to non-immersive experiences for learning. We know immersing learners in the context of an experience can greatly increase knowledge attainment and retention (Dolphin et al., 2019), but does it account for learning designs which are more passive? The affordances of immersive virtual learning are highly dependent on the experience of the technology to elevate the learning. In comparing non-immersive learning experiences, however, good active learning design may present a way to validate the potential to meet student needs without the need for immersive technology.

Background

VLEs are gaining popularity with universities among students and instructors (Annansingh, 2019). VLEs can be valuable learning spaces as they provide a range of educational opportunities, serving as virtual field trips (VFTs), experiences, and tours which enable place-based learning. In addition to increasing the flexibility of accessing different sites for all learners more equitably, VLEs also promote independent learning through active exploration. Active learning has several positive effects on students, including improved learning outcomes, enhanced critical thinking and problem-solving skills, greater engagement and motivation, improved attitudes toward learning, and increased student participation (Cooper et al., 2018; Markant et al., 2016).

As a potential alternative to an actual trip, VLEs provide a real solution to the issues of conducting an actual field trip, a learning experience considered a core element within geoscience education (Lenkeit & Cuffey, 2012). However, vast resources are needed to invest in immersive VLE solutions. Thus, understanding if a non-immersive solution focused on a learning design which considers the affordances of the technology is comparable would make this core element of geoscience more accessible. VFTs offer place-based alternatives for learning with the promise of mimicking the active learning experienced on an actual field trip, particularly in the field of geoscience. This place-based experience acts as a type of VLE which spans both immersive and non-immersive technology. Our topic focuses on the state of existing comparisons within VLEs used in geoscience which found immersive and non immersive experiences differ in many regards but not necessarily in learning outcomes (Zhao et al., 2020). This suggests there is a need to examine how learning is designed within immersive and non-immersive VLEs to better assist with the decision to invest in immersive or non-immersive solutions.

A key factor leading this topic on the learning design comparison of immersive and non-immersive VLE centers on how instruction is designed for an actual field trip. In the replication of an actual trip, Dolphin et al. (2019) indicated the need to further examine the learning design of the actual trip to compare it with its virtual counterpart. This suggests while many benefits exist from using immersive technology including presence, increased engagement, and enjoyment (Zhao et al., 2020), learning which replicates the actual field experience may also not have a strong learning design. Therefore, we designed our VLE to validate the ways we can involve geoscience students in active learning without the need for immersive equipment.

Problem Statement

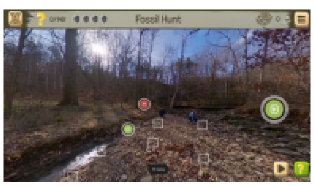
We explored multiple forms of browser-based VFTs unsuitable for our direct needs. This resulted in our browser-based VLE to engage in active learning. The design focused on connecting with the actual field trip experience while adding higher-order learning through gamified activity. While our effort presented a design based on active learning principles, we aimed to understand if students could identify the value compared to students who had experienced an immersive field trip.

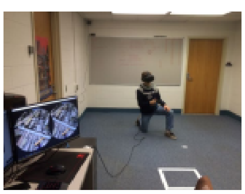
Methods

To validate our browser-based VLE (n= 91), we conducted a cross-case thematic comparison with a previous study (n= 19) used in a similar large undergraduate general education geoscience course (Figure 1). The validation study (Cook & Hatala, 2016) focused on how the immersive virtual field trip (iVFT) utilized immersive technology. This allowed us to identify how our interpretations in designing a browser-based VLE were similar based on student responses. Efforts focused on distinctions among student reactions to being involved through the different systems supplementing a full class field trip experience. This data came from the first year of each project and utilized open ended questions asking about likes and dislikes as well as the potential of these types of VLEs.

Figure 1

Two VLEs with the first Case on the Left and the second Case on the Right.





Browser-Based VFE HTC Vive iVFT

Our primary case was a Virtual Field Experience (VFE) offered as a browser-based implementation which virtualized a learning experience in a local state park located in the midwestern United States. A VFE focuses on having more active engagement in the experience compared to the more passive VFT experience. The experience included various programs such as Storyline and Thinglink's ability to navigate 360 images, apply sounds, and embed videos and images. We also connected learners with 3D models of rocks and fossils found on the site through Sketchfab, and narration. The point-and-click interaction allowed us to gamify the interface, incorporating collecting activities to earn points and learn facts while built-in assessment encouraged learners. Particular care was taken to form the experience around learning during COVID-19 when field trips were less frequent. The Canvas learning management system provided access to the VFE.

The second case focuses on data collected pre-COVID from an iVFT which incorporated an HTC Vive headset to experience an outcrop located in the northeastern United States. The virtual experience similarly included 360 images, diagrams and images from the accompanying textbook, text descriptions, and 3D rocks derived from photogrammetry all presented within Unity3D. Learners could stand and look around, navigating with the two controllers to teleport from point to point along the outcrop. The interactive activity provided further engagement with an active measurement of the 3D rocks. Students would measure, confirm their measurements, and enter their school email address to have the results sent to them to fill in their field trip reports. Additionally, the experience engaged learners in a unique feature of virtual experiences, to view a bird's eye perspective of the outcrop. This provided insights not possible from the actual field trip. The focus of the iVFT was to engage learners in an immersive experience of the outcrop without having to travel there. Students participated one at a time by scheduling to use the VR lab on campus.

Results

Using an interpretivist approach to parse and compare the student feedback, we found two primary themes: technocentric comments and content involvement. As the first year for each of these cases, we expected many comments to focus on technology issues, taking on a similar technocentric lens to the use of technology. These further aligned with expectations of how the technology should or could perform. However, comments began to differ when examining the experience of content involvement where issues of repetitive acts versus guidance were seen as helpful or boring. Content involvement through the activities within the experience evoked perceptions towards the nature of the educational experience and engagement.

Discussion

The notion that learners perceive involvement in an active learning experience differently based on the modality holds implications for examining the design of learning through technology. Comments which considered the experience as a whole versus individual elements present insights into how perceptions towards involvement were considered. For the iVFT one student wrote, "I liked measuring the layers of rocks." This differed from comments towards the VFE where another student wrote "I thought it was really well thought out and also executed well." As such, there was a notable distinction between the perception of involvement where the iVFT was described more by the active parts and the VFE was described more as an experience. In investigating the design based on the level of activity presented by the technology, comments within the iVFT fixated on looking around and feeling present while in the VFE, collective activities were described. This concurs with Webster's (2015) findings that engagement and interaction increased within the VLE but that active learning is what ultimately increased learning outcomes. While we did not compare learning outcomes, we examined the differences among student comments. Students from both studies recognized the nature of activity and their comments reflected on what interactions were more active and experiential.

Conclusion

The challenges associated with creating VLEs for undergraduate geoscience education stem from how we design learning experiences. While recent research indicates a need to examine how in-person pedagogical practices are conducted, there remains a need to examine how we can use technology to improve these experiences. While our findings note the obvious distinctions between the technology mediums, we also identified students were aware of how they were being involved in the learning process by the different activities they were engaged in. Different media embedded into our browser-based approach signaled a more involved experience engaging the learning as opposed to being present in the space and translating information into an externally submitted form.

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