

Investigating the promise of the virtual field trip: Capitalizing on the advantages of virtual reality for conveying field site information

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Abstract. In education today, technologies enable learning far beyond actual boundaries. While students of yesterday went on physical field trips, today's students can experience virtual counterparts. Recent developments in immersive technologies are finally reaching a broad audience, entering the mainstream, and enabling us to deliver on a long-held promise: high-fidelity, immersive virtual field trips that can find their rightful place in education. There is still, however, little known about the effectiveness of virtual field trips compared to actual field trips. We present our research approach to study an introductory geosciences course utilizing virtual field experiences compared to an actual field trip.

Keywords: Virtual Reality. Field Trips. Geology. Higher Education

1 Introduction

Overall there are inconsistent results with virtual reality in education [1] and previous research findings on learning through virtual field trips found they enhanced actual field experiences when used in tandem, highlighting favorable student perceptions [2, 3]. Little research measures the effectiveness of virtual field trips in comparison to their actual counterparts. One study [4], provided mixed results where the virtual enhanced knowledge yet the actual trip resulted in better long-term retention. In another study [2] however, there was no significant difference in knowledge gained from virtual or actual field trips]. With a lack of consensus on the effectiveness of implementing virtual field trips compared to actual field trips, additional research is needed.

2 Developing a Research Approach

We developed a research approach to address whether virtual field trips are suitable proxies for actual field work. To explore this question, we developed a series of empirical evaluations focused on introductory geoscience field exercises in a course. We formed a three-category taxonomy to guide our experimental design: basic, plus, and

advanced immersive virtual field trips (iVFTs). *Basic* replicates a physical environment comparable to actual field trips. *Plus* replicates the physical environment while adding access not possible in the physical world (i.e. overview perspectives through drone imagery). *Advanced* adds simulation features like interacting with a site over time.

2.1 Virtual Field Trip Development

Our approach uses head-mounted displays, HTC Vive, to deliver virtual content (contrasting from desktop experiences to create a basic iVFT. We used 360° images, 3D models from structure for motion mapping, high resolution SLR (single lens reflex camera) images, lab manual diagrams, and audio recordings narrated by a teaching assistant to replicate actual field experience. We implemented basic tools for field work such as measuring and recording the thickness of rock layers.

2.2 Iterative Experiments

The first experiment compared our basic iVFT to the actual field experience. The results indicated a positive reception of the iVFT and significantly higher learning, enjoyment, and lab grades. From these results, we generated a list of updates to address in a second experiment: 1) Image Resolution through high-resolution 360° images, 2) 3D Resolution through drone footage to create higher resolution 3D models, and 3) Elevated Perspective from high-resolution 360° images taken with a 27' tripod. The ongoing experiment uses an AB design where students participate in both the iVFT and the actual field trip. This experiment seeks to investigate the following hypotheses: 1) higher fidelity, resolution of images and 3D models, will improve the overall experience, 2) multiple perspectives, 27', will improve formation of a spatial situation model, and 3) the plus iVFT will show higher learning outcomes than basic iVFT.

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