

Immersive Virtual Field Trips in Construction Education: A Pilot Study

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Problem Statement & Motivation

Field trips to actual project sites form an important component in construction management and civil engineering education. They provide students with real-world experience and valuable exposure to the context to which their technical knowledge gained from classroom learning can be applied. However, safety, transportation, weather, and other logistics challenges may make physical field trips impossible. The emerging health risks under the recent COVID-19 pandemic have further limited the viability of field trips. As an alternative, researchers have investigated virtual field trips (VFTs) using images and videos. However, despite some promising results, scholars also noted the lack of robustness and immersiveness with VFTs.

Research Objectives

This study aims to explore new VFT solutions with emerging visualization technology such as VR and develop a prototype deployed via an online VR platform to facilitate field knowledge transfer in CM and CE education. The proposed VFT prototype consists of 3D models and field-captured 360-degree photos, live audio/video recordings of field production and installation, and other project information obtained with permission from industry partners committed to this research. Students can access this VFT prototype via a designated VR platform and experience a self-guided or guided immersive tour with or without VR headsets.

Research Design and Methodology

The pilot study went through the following four stages:

VR Platform Selection



Project Data Collection



Prototype Design and Development



Pilot and Learning Assessment

From left to right:

Figure 1. A traditional field trip

Figure 2. A sample view of the first VFT prototype on HoloBuilder

Figure 3. A HoloBuilder SplitScreen view displaying a 3D model scene and an active construction site scene

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Important Findings, Conclusions and Recommendations

A pilot test was conducted in two introductory construction management courses in fall 2020 with 33 student participants. Students were tasked with identifying building elements and systems, reviewing project documentation, and completing an assessment quiz.

Description	Attempt 1	Attempt 2	Attempt 3	Final
No. of Students	33	23	8	33
Part 1 Average Score (%)	80.7%	93.9%	96.2%	96.2%
% Improvement Compared with Attempt 1	—	15.4%	18.5%	18.5%

Table 1. Student attempts and scores of Part 1 of the assessment quiz



The preliminary results indicated that in the VR-enhanced VFT, students could achieve better learning outcomes than traditional field trips because of the unlimited revisits to the virtual job site and repetitive interactions with learning objects, which was impossible with traditional field trips.

Description	Indicators	Count
Total time spent on VFT	=< 10 minutes	10
	10 to 15 minutes	6
	15 to 20 minutes	3
	>= 20 minutes	9
	Did not specify	5
Did you go back to the VFT for a 2nd visit in order to answer the quiz questions?	Yes	29
	No	4

Table 2. Efficiency and effectiveness of the VFT helping students with the assessment quiz.

Another important takeaway was that the majority of the students conducted the virtual tour more than once and repeated the assessment quiz several times to get a better learning outcome, which constituted a direct indicator and evidence of enhanced student learning engagement and better learning outcomes.

Research Impact

- ❖ The proposed VFTs provide student quick access to a greater variety of construction projects for practical application of class-taught concepts.
- ❖ The open-access nature of a VR platform makes it possible to have collaborative teaching and learning experience among students, faculty and industry professionals.
- ❖ In the long term, it can become a collaborative effort of institutions and the architecture, engineering, and construction (AEC) industry as they can all contribute to the platform by adding new materials reflecting the latest science and technology, which allows for a continuous and healthy growth of the shared knowledge base.