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# Field Trips and Their Effect on Student Learning: A Comparison of Knowledge Assessment for Physical versus Virtual Field Trips in a Construction Management Course

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**Abstract:** Teaching through field trips has been very effective in the architecture, engineering and construction (AEC) disciplines as it allows students to bridge the gap between theory and practice. However, it is not always feasible to take a large class on field trips due to time, safety, and cost limitations. To adequately prepare future professionals in the AEC industry, it is imperative that institutions adopt innovative methods of providing the field trip experience. One such approach is using virtual reality (VR) technology. Creating 3D VR construction environments and immersing students in that virtual world could provide an engaging and meaningful experience. Although researchers in AEC schools have developed and deployed many virtual field trips (VFTs) in education, little is known about their potential to provide the same knowledge base. For that reason, a VR app was created to teach students about the design and construction of steel structures, called the Steel Sculpture App (SSA). The SSA served as a VFT, and the location of the steel frame structure served as the actual field trip (AFT). The research was conducted in structure-related courses in the spring, summer, and fall of 2021 and the spring and fall of 2022 semesters. Each semester, students were split into groups, one being the control group and the other being the experimental group. The control groups learned through AFTs, whereas the experimental groups learned through VFTs. A knowledge test was administered at the end of each treatment to collect quantitative data on the students' performance, understanding, and knowledge retention. The results indicated that the students learning from VFTs scored higher than those learning from AFTs. The paper discusses student assessment results and student feedback about replacing AFTs with VFTs in times of need.

**Keywords:** virtual reality; construction education; pedagogical changes; steel structures; virtual field trips; learning assessments

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## 1. Introduction

Given the pragmatic essence of the architecture, engineering, and construction (AEC) industry, it becomes crucial to delve into innovative teaching approaches to uphold elevated standards of education. In AEC education, educational field trips, often taking the form of site visits, play a pivotal role. These field trips offer participants a firsthand encounter with the topics or concepts discussed in the classroom. Nevertheless, organizing such field trips is not always practical due to constraints related to time, cost, and safety concerns [1]. It is crucial to find an alternative to having no field trips because the ability to visualize the built environment and learn the building construction processes is critical for students in the AEC disciplines [2]. For students lacking field experience, visualizing the construction processes and thus making informed decisions is difficult [3]. Creating 3D VR models and immersing students in the virtual world could provide an engaging and meaningful experience for all students in the AEC disciplines [4]. For this purpose, an interactive VR app was created for Oculus Quest, the "Steel Sculpture App" (SSA), to teach students about the design and construction of steel structures. Structural understanding is extremely important for all AEC students. However, teaching such skills in a traditional classroom setting becomes challenging.

The aim of the SSA app presented in this paper was to provide support to building science and architecture students, particularly in understanding onsite steel connections in a classroom-based education. This app was specifically created for structure-related courses in which students learn the design of steel, timber, and concrete structural members. The topic of steel connections was chosen because of its inherent complexity. In a steel building, connections play an important role, and many structural failures are attributed to connection failures [5]. The recent failure of the I-35W Bridge in Minneapolis in 2007 was due to the connection failure. The SSA is a self-explanatory interactive app that is also designed to cater to people with hearing impairments. In addition, for better understanding, the app shows the assembly and erection of steel members on a construction site. The app allows students to see modules again and again, pause, and exit at any time.

This interactive app could also bring an end to passive learners' attitudes, which are often found in traditional academic teaching settings [6]. Actual field trips, though helpful, require significant planning, funds, and time and still have many safety concerns. This paper explains the student learning assessment and student perspective of the VFT versus the AFT. The app served as the VFT, and the location of the actual steel structure served as the AFT. Controlled group and experimental group methods were used to analyze student learning assessments. After the learning assessment, all students were given a chance to experience both pedagogies to get their feedback.

## 2. Literature Review

The adoption of technology to effectively convey concepts to students is a common practice [6]. As technology advances, new means and methods are developed for integrating it effectively into teaching. When looking at mechanics and related courses, which are a vital part of understanding how a building carries loads, it is critical to clarify the concepts and details regarding the structural members using steel, timber, and concrete [1]. Such a task cannot be performed only within the boundaries of a classroom [7]. Visualization of these elements and their configuration is crucial for precise understanding and knowledge retention [7]. For this purpose, a field visit can enhance the concepts, where students can view these members being put together to form the structure rather than just reading them in a plan view [8]. The site visits, while educational, pose cost, safety, and time constraints. Visits are also dependent on the availability of the construction project during the structural phase [1].

VR was first used in the form of flight simulators, and it has come a long way since then [9]. As described by Merchant et al. [10], the aspect of being in a three-dimensional space, the ability to create and interact with three-dimensional objects, a digital representation of the learner in the form of an avatar, and the capability of communicating with other learners in the virtual world are all features of virtual reality. Virtual worlds are open-ended settings where users can design and develop their own objects, in contrast to the organized environments of simulations and games.

With immersive and interactive experiences in fields ranging from science and engineering to foreign languages and social sciences, virtual reality has long held promise as a tool to improve education [11]. As a cutting-edge teaching strategy that offers unique experiences to users, head-mounted VR-supported learning may influence students' self-efficacy in a specific area and further improve their future development [12]. Using VR modeling, you can better capture the audience's attention and immerse them to even change their attitude toward an issue such as environmental issues, and the model can be updated as new data is received [13]. In the medical industry, many surgical trainers use VR for educational purposes [14]. The use of VR for teaching anatomy was found to be more effective than traditional methods [15].

Virtual reality engages students in the learning process, particularly in lessons that require visualization and cannot be adequately addressed in conventional instruction [16]. For understanding concepts where spatial access is difficult, such as the world of atoms and molecules, VR has shown to improve the understanding of students, while making it much easier to teach [17]. On the other hand, students in a virtual reality learning environment have the potential to reach deeper levels of conceptual clarity, leading to knowledge retention, in a shorter amount of time, enabling students to focus on the learning scenario [18]. A 3D virtual environment was also shown to improve the cognitive skills of students with learning disabilities such as ADHD and dyslexia by allowing them to better visualize the material [19].

In addition, the concept of Industry 4.0 has an impact on the construction industry since structures are evolving into complex productions [20]. Construction management is integrating cutting-edge technologies like VR and augmented reality (AR) to improve efficiency and effectiveness in the construction process [21]. Therefore, it is important to equip students with the skills to use such technology in the classroom. According to Ververidis et al., virtual reality (VR) offers significant advantages in the realm of construction through its immersive visualization capabilities, enabling interactivity with the model, spatial awareness, and immediate real-time feedback [22].

While the architectural, engineering, and AEC industry would be transformed by integrating VR technologies and immersive collaboration among different stakeholders, it can be a valuable tool for improving students' capacity to recognize a range of building principles [23]. It is now possible to educate students by utilizing immersive digital environments that enable them to view and experiment with a 3D/4D full-scale virtual model of a construction project. A student's comprehension of complicated building projects can be considerably improved by this enhanced visual communication [2]. For example, for construction safety, VR is being used to develop simulations that give workers a first-person perspective of a construction process that has not yet begun, to spot potential issues before construction begins, and to train construction workers for potential hazards that may emerge on construction sites [24]. By using virtual reality technology, it has shown that most construction-related traffic incidents might be linked to workers who are easily distracted and are susceptible to boredom [25].

In order to teach the newer generation, which is fairly tech-savvy, the use of technology such as virtual reality (VR), augmented reality (AR), and mixed reality (MR) can provide ways to engage students in a social, collaborative, and active learning environment [4]. Kıral et al. [26] developed a V-SAFE app in which trainees are exposed to actual building risks in a secure virtual environment. Users become knowledgeable of the dangers they can encounter at work and experience the possible consequences of their own or other decisions [26]. In fact, virtual reality teaching is promoted for practical subjects like civil engineering and physics but not for theoretical subjects [27].

Recently, work has begun to see if VR technology can replace actual construction site visits [28]. This study used 360° panoramic photographs with modalities to enhance their experience through a focus on immersion, perception, and telepresence. For the modalities, iPads and VR headsets were used. Shahbaz et al., developed SimYA, which is an interactive 3D VR software where students can experience the basics of the construction process in a virtual environment and learn through trial and error as if they were at the construction site [29]. Özacar et al. conducted a complete building survey class in VR using tools like measuring tape, plumb, hose level, etc. The students and teachers were able to communicate using avatars using VRArchEducation [3].

It is evident that work is being performed to improve technology so that it can be used for teaching in the construction industry as well as education. To improve the learning experience and engagement of the newer generation, VR can be used, especially in courses where visualization is crucial. By providing an alternative to AFTs, a VFT can facilitate the instruction of important aspects of the construction site in a controlled and safe environment. Although a virtual trip may never completely replace or compare against AFTs, it can be helpful in times of need and can avoid time, cost, and safety concerns.

## 3. Research Methodology

This research study aimed to determine the validity of replacing VFTs with AFTs due to time, safety, and cost concerns in times of need. After an extensive literature review of VR in AEC academia and industry, a plan of approach was developed on how to compare a VFT with an AFT. For this purpose, the Steel Sculpture App (SSA) was developed in VR. The focus of this application was to create a virtual field trip and teach students about steel construction and connections in structure courses. The app was introduced in the Structures of Building-II course, where a major part of this course involved the design of steel, timber, and concrete structural members. Steel construction was selected due to its inherent complexity. The virtual trip explained seven basic connections of the steel structure, their uses, and a field example. The location of the steel sculpture served as the actual field trip, and the app served as the virtual field trip. The following objectives were established to investigate the efficacy of VFTs:

- To examine and assess student learning and understanding through VFT and AFT.
- To assess students' knowledge retention for VFT and AFT.
- To assess the challenges and student perspective of learning through VFT versus AFT.

To conduct this study, the following research hypothesis was developed.

**Alternate Hypothesis: $H_A$:** *Students who participated in AFT learn better than those who participated in VFT.*

**Null Hypothesis: $H_0$:** *There is no significant difference in student learning between the two ways of teaching.*

### *3.1. Research Design*

To carry out this research, the action research method was chosen. Action research is a research philosophy and methodology that is commonly used in the social sciences. It seeks transformative change through the concurrent processes of action and research, which are linked by critical reflection involving the following steps:

- Diagnosis: finding problems.
- Action plan: how to approach the problem's solution.
- Action taking: application of the planned action.
- Evaluating: determination of the effects of the action.
- Specific learning: reflection on the action taken and recording the results.

The detailed action research road map is shown in Figure 1.

### *3.2. Steel Sculpture App (SSA) Development*

After the 'Diagnosis' of the problem, 'Action Plan' was set to resolve the problem (Figure 1). The Steel Sculpture App (SSA) was developed, which served as VFT. For the development of the SSA, a sketch-up model of the steel sculpture was created (Figure 2, right). The location of the steel sculpture served as an AFT (Figure 2 left). This model was imported into Unity 3D (a virtual environment development software), where animations and voice-overs were added, and details were added for each connection type (Figure 3). The app developed in Unity 3D was then transferred to the Oculus Quest, where it was tested (Figure 4). The Oculus Quest can be seen in Figure 5.

### *3.3. Testing the SSA*

The steps shown in Figure 6 were used to assess students' understanding of the SSA and knowledge retention of VFT versus AFT. For each semester, the students were separated into two groups, as detailed in Figure 6. One group was given a virtual tour using SSA, while the other was assigned a physical visit. In both trips, details regarding the model were taught to the students. A week after the trips, the students were evaluated through a quiz to determine their knowledge retention (Appendix A). In the next class period, students who had a VFT went on an AFT, and students who went on an AFT experienced the VFT. After both groups had gone through both trips, their feedback was collected. Both the feedback and the data from the quiz were then compiled and taken for analysis.

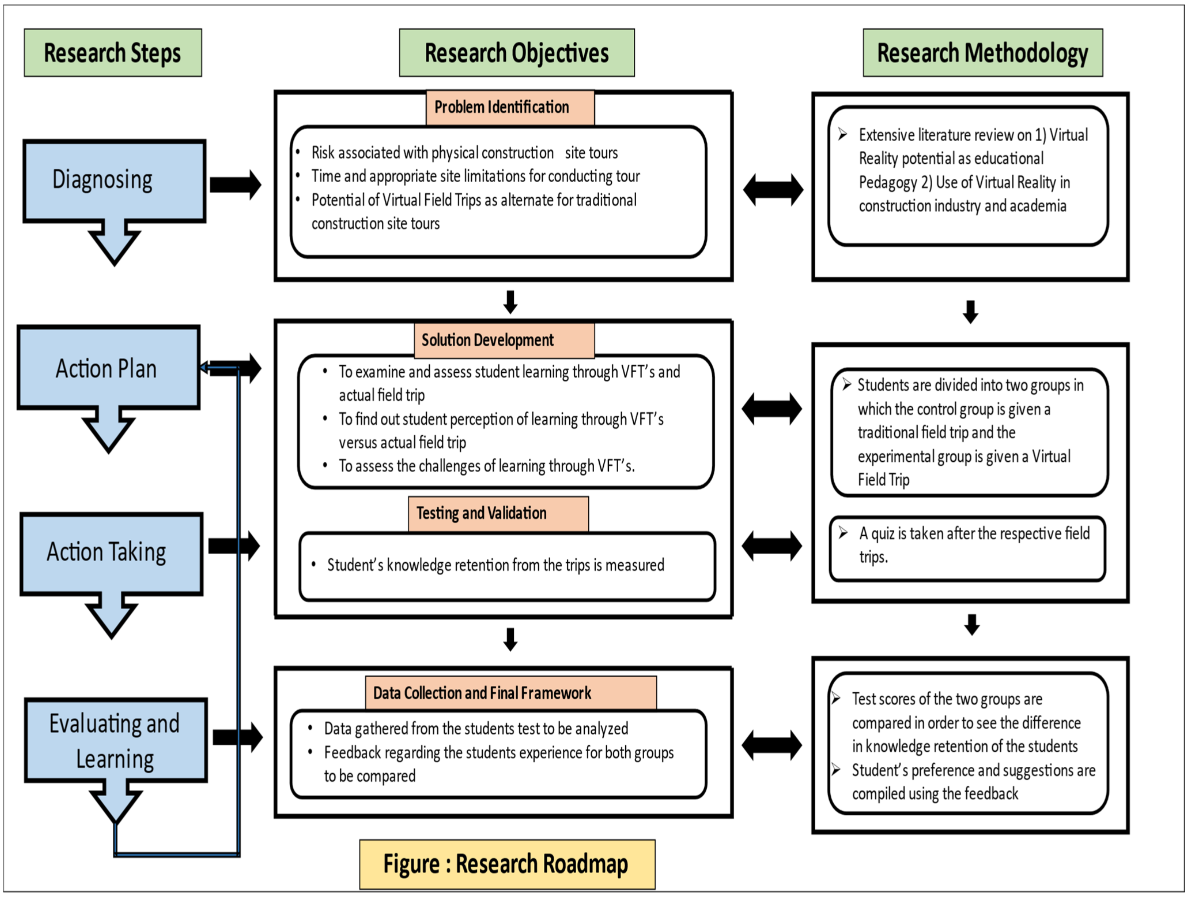


**Figure 1.** Research Design.

**Figure 2.** Steel sculpture for AFT; (**a**) VS steel sculpture 3D model in Oculus (**b**).

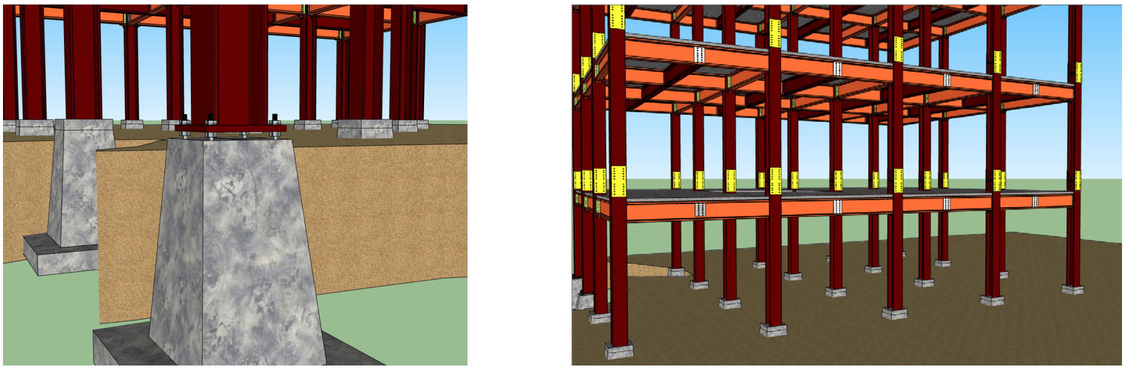

**Figure 3.** Images from the Steel Sculpture App.

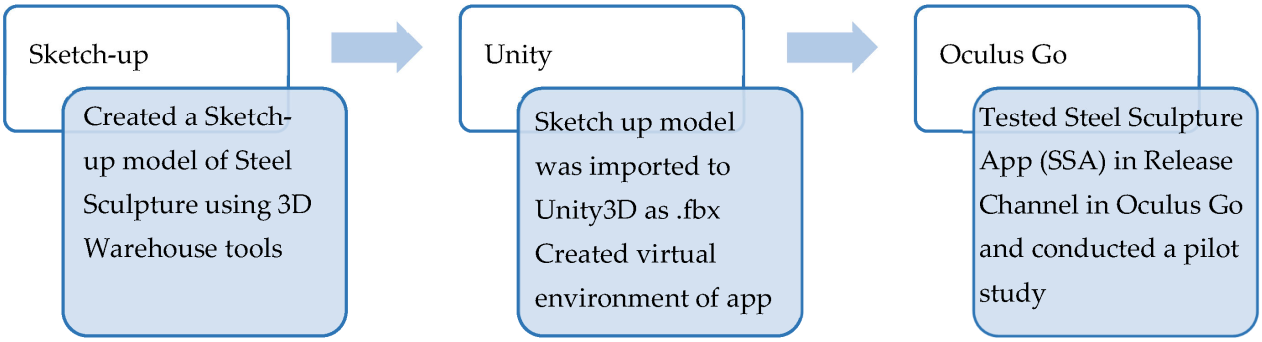


**Figure 4.** Development of SSA.

**Figure 5.** Oculus Quest.

### *3.4. Data Analysis*

To evaluate the extent to which students retained knowledge from the two field trips, a quiz was administered one week after the trips occurred. Additionally, during the subsequent class period, students were exposed to both types of field trips to gauge their perceptions and feedback regarding each experience. To examine the data in detail, the student demographics and various tests used to analyze the data are given below.

### *3.5. Students' Demographic*

To assess the effectiveness of the Steel Structure App (SSA), an experimental investigation of the VFT was carried out involving students from Auburn University's Architecture and Building Construction program. The study was conducted during the spring, summer, and fall of 2021 and the spring and fall of 2022. The study included a total of 182 students, of whom 94 were in the experimental group and 88 were in the controlled group. The results and analysis of the study incorporated feedback and assessments from 72 architecture students and 94 building science students.

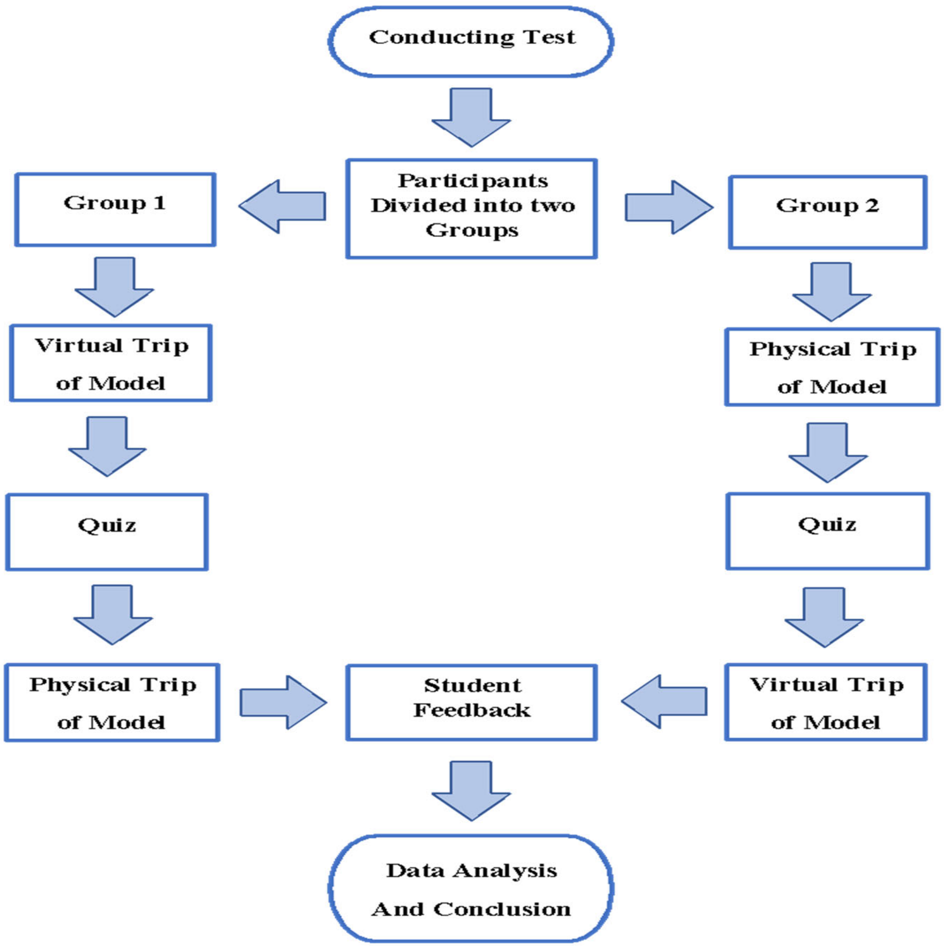


**Figure 6.** Flowchart for testing.

### 3.6. ANOVA Test (Analysis of Variance)

ANOVA is a statistical method employed to ascertain if there are significant differences in the means of two or more groups. It compares the means of various samples to assess the influence of one or more factors. ANOVA tests are commonly utilized to determine the significance of survey or experiment results. Essentially, they aid in making decisions regarding whether to accept the null hypothesis and reject the alternative hypothesis, or vice versa.

The null hypothesis in an ANOVA is valid when all the sample means are equal or do not have any significant difference. Thus, they can be considered part of a larger population. On the other hand, the alternate hypothesis is valid when at least one of the sample means is different from the rest of the sample means. This test is performed using MS Excel with a built-in plug-in. In simpler terms, if the $p$-value from the ANOVA test is $< 0.05$, then the alternate hypothesis is true. If the $p$-value is $> 0.05$, then the null hypothesis is true.

### 3.7. Mean and Standard Deviation

After determining if there was variance in the data, the mean score for the data was calculated. This was performed by taking the results of the students in the two groups and taking an average. This shows which of the two groups performed better in the test. The standard deviation was also calculated to see which of the two groups had more consistent data, i.e., less variance in their results. Both the mean and the standard deviation were then used to draw a conclusion.

*3.8. Feedback*

In terms of the feedback obtained from the students regarding both methods of tours, the data was collected on a Likert scale of 1–7, with "1" being strongly disagreed with and "7" being strongly agreed with. This data was then used to calculate the mean, mode, and standard deviation of the feedback statements. In addition, the weighted mean was also calculated for the statements.

## 4. Results and Discussion

To draw conclusions about the performance of the two groups, a quiz was administered one week after their respective tours. Upon analyzing the quiz results, it was observed that the experimental group, which underwent a virtual tour (group 1), achieved a higher mean/average score of 8.08 on the quiz. In contrast, the control group, which experienced a physical field trip (group 2), obtained a lower mean/average score of 7.39 (Table 1). These findings indicate that the performance of the experimental group was superior to that of the control group. Examining the standard deviations, the experimental group exhibited a standard deviation of 1.12, while the control group had a standard deviation of 1.27. As the standard deviation of the experimental group was lower than that of the control group, it can be inferred that there was less variation in the results of the experimental group.

**Table 1.** Student assessment results.

| Groups | Count | Sum | Average | Standard Deviation | Variance |
|---|---|---|---|---|---|
| Group 1 (Virtual tour) | 94 | 760 | 8.085106383 | 1.1232 | 1.261496225 |
| Group 2 (Physical model visit) | 88 | 651 | 7.397727273 | 1.2734 | 1.621603971 |

An ANOVA (Analysis of Variance) test was performed to find which of the hypotheses was true. By comparing the values gained from the ANOVA test, it was determined that group 1 had less variance in their scores, which shows that all students perceived roughly the same amount of information that was given to them during the virtual tour (Table 2). The F value is compared with the F-critical value to see if the test was significant. Since F > F-critical, the test is considered significant, and the null hypothesis can be rejected (Table 2). Also, to back up the results, the $p$-value was assessed. In this case, the $p$-value is <0.05, and the alternate hypothesis is true, meaning there is a difference in knowledge retention between students who took a VFT and those who took an AFT.

*Student Feedback*

To receive student perspectives about replacing AFT with VFT in times of need due to time, cost, and safety concerns, a survey was developed. Figure 7 shows the questions and student feedback from the survey. Table 3 shows the median, mode, SD, and weighted average of the results of the data received, where strongly agree = 7 and strongly disagree = 1.

**Table 2.** ANOVA test results.

| Source of Variation | SS | df | MS | F | $p$-Value | F Crit |
|---|---|---|---|---|---|---|
| Between Groups | 21.4749 | 1 | 21.4749 | 14.95939353 | 0.000153351 | 3.89364 |
| Within Groups | 258.399 | 180 | 1.43555 | | | |
| Total | 279.874 | 181 | | | | |

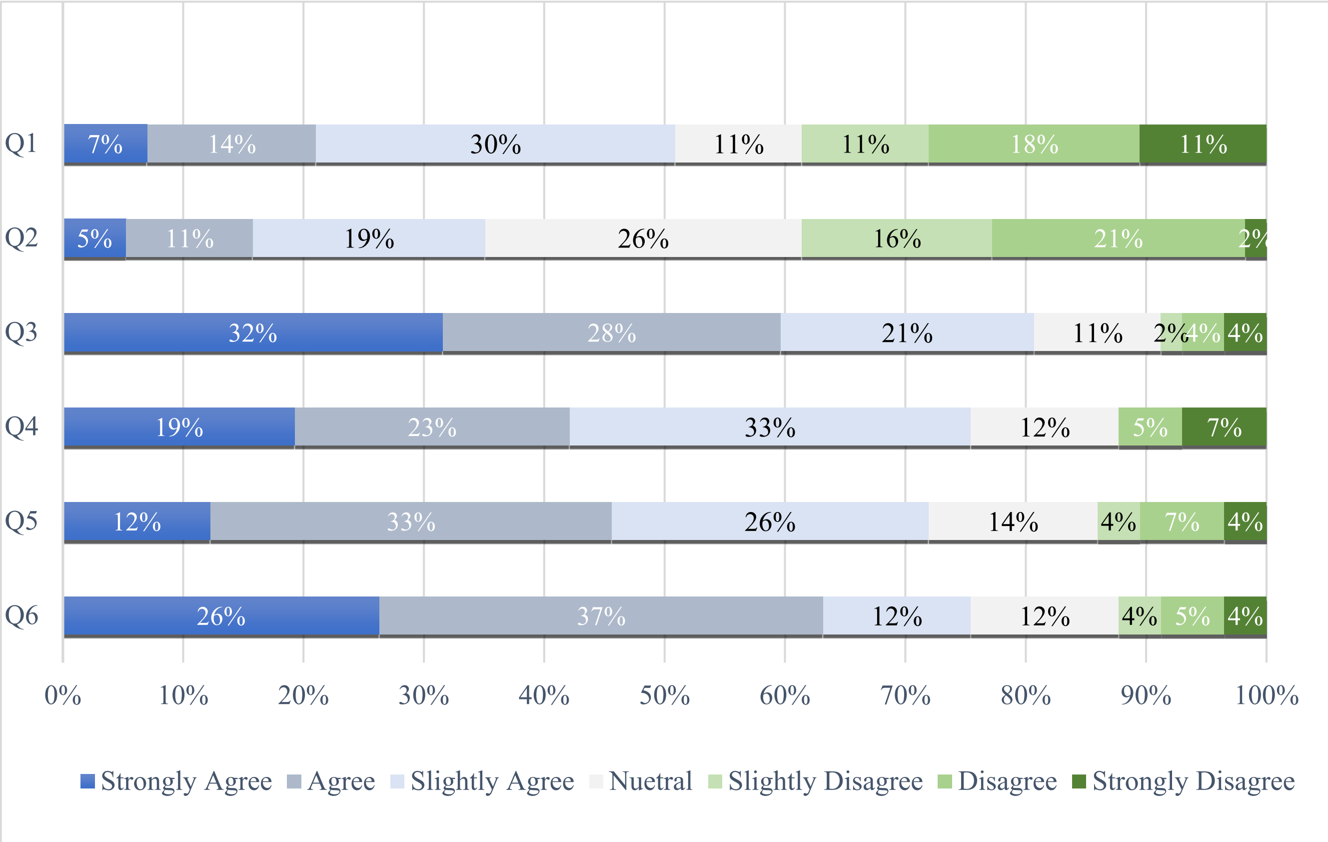


**Figure 7.** Student perception and feedback.

According to the survey results, 126 out of 168 students (75.4%) either slightly agree, agree, or strongly agree that virtual field trips (VFTs) can be used as an alternative to actual field trips (AFTs). The weighted average for this statement is 5.05, indicating that most of the students agree with this proposition (Table 3). However, it should be noted that there were a few students who were using the VR Oculus Quest headset for the first time, and it took longer for them to understand the subject matter (Q5: weighted average = 3.93). This suggests that there might be a learning curve associated with using virtual reality (VR) technology for educational purposes. Additionally, some students reported experiencing motion sickness during the VR experience (Table 3, Question 6, weighted average = 4.02). This highlights a potential drawback of VR technology, as certain individuals may be more susceptible to motion sickness when using VR headsets. Students also wanted to see more educational tools developed in VR (Q1, weighted average = 5.4).

In some open-ended questions, the students explained their likes and dislikes about the app. One student said, "I enjoyed how you were able to view the connections from multiple vantage points, as well as the aspect of if your instructor cannot plan a field trip, VR could be used as an alternate". Another student said, "that I could go back and hear the same thing again". Another student said, "I liked being able to see the structure from multiple angles, including from above; this is not possible in a real field trip". When asked about improvements in the app, a student said, "If there is a way to make it to where you don't get a headache, I think it would greatly improve my opinion about it". The students were also asked about what they did not like in the app, and one student said, "I did not like the voice changes, and the screen strained my eyes". These comments call for improvements in the technology to make it more comfortable for end users.

**Table 3.** Student perception and feedback.

| Questions | N | Median | Mode | SD | Weighted Average |
| --- | --- | --- | --- | --- | --- |
| Q1: You want to see more educational tools developed in VR? | 168 | 6 | 6 | 1.61 | 5.4 |
| Q2: You enjoyed VFT without having to go out of classroom? | 168 | 5 | 6 | 1.53 | 5.02 |
| Q3: You believe we can sometimes use VFTs as an alternative to actual field trip? | 168 | 5 | 5 | 1.66 | 5.05 |
| Q4: Teaching a class of 30 students through the physical field trip will be challenging as some students may not be able to hear, some may be far away from the model to actually understand it well? | 168 | 6 | 7 | 1.3 | 5.53 |
| Q5: As a learner, it took longer to understand the subject matter in VR exercise than the physical field trip? | 168 | 4 | 4 | 1.51 | 3.93 |
| Q6: One of the reasons you did not enjoy VFTs is because you felt motion sickness during the VR experience? | 168 | 5 | 5 | 1.8 | 4.02 |

Overall, while the majority of students agreed that VFTs can serve as an alternative to AFTs, there were a few concerns related to the learning curve and potential discomfort associated with using VR technology. However, an informal discussion with the participants reached the conclusion that there are some experiences for which we must visit the actual site. Especially for freshmen and sophomores who have little field experience. However, for juniors and seniors, VR-based educational tools should be developed for conceptual clarity. These findings provide valuable insights into the students' experiences and perceptions regarding the use of VFTs in educational settings.

## 5. Conclusions

In this study, student assessment and perception of virtual field trips (VFT) versus the actual field trip (AFT) were examined. A Steel Sculpture App (SSA) was created as the VFT, and the location of the actual steel sculpture model served as the AFT. The study was performed in the Structures of Building-II course, and students had no prior knowledge of steel connections or design. It was found that students not only learned better in VFTs but were also able to achieve conceptual clarity of the subject matter. During the AFT, students who were closer to the instructor were able to listen and see well, whereas those at a distance were either distracted, not able to listen, or could not see the connection properly. VFTs give students a chance to focus on subject matter very closely with visual demonstrations and applications. The actual field trips entail a lot of planning on the instructor's part. However, there are some experiences for which actual field trips are essential. Evidently, VFTs cannot provide the physical perception that one has in the field, such as touching soil, walking on muddy dirt, hearing sounds and smells, or climbing the stairs of a construction site. A well-designed VFT, involving proper visualization, real-time maps, sound, and video clips in a variety of formats, could, however, help students imagine what an actual site visit would be like. In targeting the learning objectives through a VFT, one must be realistic in its design, information presented, and voiceovers. The SSA created for this study is an Oculus Quest app that has been published for everyone to download from the Oculus library and incorporate into their curriculum. After the study, students proposed some improvements to the app, which are under process. In conclusion, VFTs offer a compelling alternative to actual field trips (AFTs) in construction education, considering the time, safety, and cost concerns involved. Using immersive technology, students can engage in realistic and interactive experiences that simulate real construction environments.

Although students scored better with VFTs, they still expressed the belief that actual field trips are necessary, productive, and foundational. The students emphasized the importance of hands-on learning, as it allows students to physically engage with the construction site. While not advocating for replacing actual field trips entirely, students encouraged the development of better immersive educational apps, recognizing their potential to save in-class time. However, it was noted that having sufficient devices for all students in the class is crucial for effective implementation.

One of the primary advantages of VFTs is the time efficiency they provide. Traditional AFTs often require extensive planning, logistics, and travel time, which can be a significant constraint on the instructor. VFTs eliminate the need for physical travel, enabling students to explore multiple construction sites and scenarios within the convenience of the classroom. This allows for more frequent and varied learning experiences, enhancing students' exposure to different construction practices and projects.

Safety is another critical consideration in construction education, particularly when conducting site visits. Construction sites can present inherent risks, including heavy machinery, hazardous materials, and unstable structures. VFTs eliminate these safety concerns, ensuring a controlled and risk-free learning environment. Students can observe construction processes and safety protocols without exposure to actual hazards, reducing the potential for accidents or injuries.

Cost is often a limiting factor in organizing AFTs. Expenses related to transportation, accommodation, and site access can be substantial, making AFTs financially burdensome, especially for educational institutions with limited resources. VFTs offer a cost-effective alternative, as they require minimal additional expenses once the necessary VR equipment and software are in place. This affordability allows educational institutions to provide more opportunities for students to engage in experiential learning without straining their budgets.

However, it is important to acknowledge that VFTs may not completely replace AFTs in construction education and may only focus on one stage of the project. AFTs offer unique benefits, such as physical presence, tactile experiences, and real-time interactions with professionals on site. Therefore, a balanced approach that combines both VFTs and AFTs can provide a comprehensive learning experience, leveraging the advantages of each approach. As technology continues to advance, incorporating VFTs alongside AFTs can create a well-rounded and immersive learning environment for construction education, preparing students for the challenges of the industry while optimizing resources and ensuring their safety. VR is shaping up to be a powerful tool in teaching and is gradually becoming a part of classrooms. From this research, it is concluded that VFTs are directly linked to the students' knowledge retention and are responsible for a better understanding of the material. Thus, instructors can use VFTs in times of need due to time, safety, and cost limitations.

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**Informed Consent Statement:** Not applicable.

**Conflicts of Interest:** The author declares no conflict of interest.

## Appendix A

Virtual Steel Sculpture Quiz

Please answer the following questions from the best of your knowledge.

**Question 1:** Simple Connection are used to transmit _______________ forces

(a) Shear Forces (b) Bending Moment (c) Both Shear and Bending Moment (d) None of the above

**Question 2:** What is the purpose of moment connection?

(a) To transfer bending moments (b) To transfer bending moments and shear forces (c) To transfer only the dead loads (d) To transfer only the live loads

**Question 3:** In connecting beams to girders, when do we need to cop the beams?

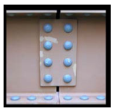
(a) When beams and girders are of same depth (b) When beams and girders of same length (c) When beams have to connect with columns (d) None of the above

**Question 4:** The size of each member, plates and bolts is determined by the magnitude of load applied. (True/False)

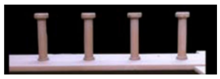
**Question 5:** Which of the following connections do you recommend to use when a beam is too long to be transported in a single piece and has to be spliced i.e., transported in two pieces and joined at the jobsite?

**Question 6:** Which of the following connections is Shear Tab?

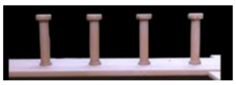
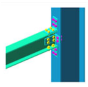
**Question 7:** Which of the following connection do you recommend to use when you have a concrete slab that is bonded to a beam and behaves as composite section?

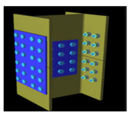
**Question 8:** Which of the following connections do you recommend when you need a shear-moment connection between a girder and column?

**Question 9:** Which of the following connections do you recommend when you need a shear-moment connection between a girder and column?

**Question 10:** Which of the following connection do you recommend when the column is too long to be transported in single piece and needs to be connected at the jobsite?

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