



Immersive Technology-Enhanced Learning System Design in Civil Engineering Education

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Abstract. This positional paper proposes the use of immersive technology-enhanced learning systems (ITELS) to enhance civil engineering education and develop 21st-century competencies. The integration of immersive technology, including virtual reality and augmented reality, can create interactive and immersive environments that simulate real-world scenarios and engage students in problem-solving activities. To effectively integrate immersive technology in civil engineering education, evidence-centered design, appropriate pedagogical strategies, and alignment of learning activities to workforce training are crucial. Future research can explore how evidence-centered design, pedagogical strategies, and evaluation frameworks can enhance the effectiveness of immersive technology in civil engineering education. Ultimately, the successful integration of immersive technology in civil engineering education can contribute to producing competent and future-ready graduates who can address the complex challenges of the industry aligned with future workforce development.

Keywords: Immersive Learning, Technology-Enhanced Learning, Civil Engineering Education, Positional Paper.

1 Introduction

Civil engineering education plays a crucial role in equipping students with the necessary knowledge and skills to design, build, and maintain the infrastructure of our society. However, traditional methods of teaching may not always engage students, particularly with the rise of digital technologies and the increasing demand for 21st century skills such as design problem-solving. To address this, there is a need for innovative approaches to civil engineering education that can enhance student engagement and promote hands-on learning. Immersive technology-enhanced learning systems, such as virtual reality and digital games, offer a promising solution by creating interactive and immersive environments that can simulate real-world scenarios and engage students in problem-solving activities. In this paper, we propose a situated design context and aligned research goals for the development of immersive technology-enhanced learning systems and their supporting infrastructure in civil engineering education. Our proposed idea involves evidence-centered design, pedagogical approaches to support experiential learning, and the need of assessment in an immersive learning environment system. By incorporating these ideas, we believe that immersive technology-enhanced learning systems can create more effective and engaging learning experiences for civil engineering students. Our research question is: How can the design and implementation of an immersive technology-enhanced learning system support the development of 21st-century competencies in various fields of civil engineering education?

2 Context

Civil engineering education has been rapidly changing to prepare students to be proficient in 21st-century skills, such as critical thinking, problem-solving, and collaboration, which leads to their future success in workforce. To meet these needs, we will propose the need of an immersive technology-enhanced learning system (ITELS) that can be an effective tool for supporting civil engineering education. In particular, Building Information Modeling (BIM) has been one of the areas aligned with the needs of immersive learning technology [1]. BIM has revolutionized the way the AEC (Architecture, Engineering, and Construction) industry operates, and its impact is also being felt in civil engineering education. BIM is a digital model that represents both physical and functional characteristics of a facility. As an integrated system, it enables multiple stakeholders to collaborate throughout the life cycle of a project. BIM-based immersive technology can create an experiential learning environment for engineering students that is engaging, authentic, and closely aligned with real-world scenarios. Immersive technology such as virtual reality (VR), augmented reality (AR), and digital games, has a potential to support BIM-based civil engineering education. VR technology can create an immersive environment where students can experience different aspects of a project, such as construction, operation, and maintenance. It can provide an interactive and engaging experience for students to explore complex models and simulate different scenarios. AR technology can overlay digital information on the real world, providing students with a new perspective on the construction process and the ability to visualize and understand complex structures. The systematic architecture design of a learning system that involves the alignment from learning activities to assessment in relation to workforce training is crucial. The learning activities need to be aligned with the competencies required for the workforce, and the assessment needs to measure the students' ability to apply their learning in a real-world context. This can be achieved through evidence-centered design, which involves designing assessments that measure specific competencies and aligning them with learning activities that support the development of those competencies.

3 Future Research and Design Directions

3.1 Evidence-centered Design for Adaptive and Experiential Learning Trajectories

Evidence-centered design is an effective framework for designing immersive technology-enhanced learning systems that support adaptive and experiential learning trajectories. It focuses on defining the competencies (e.g., design thinking, collaboration, information management, and data literacy) design and learning objectives of the system and designing assessment tasks that support evidence-based reasoning.

3.2 Pedagogical Strategies for Integrating Immersive Technology in Civil Engineering Education

The effective integration of immersive technology in civil engineering education, including BIM, requires the use of appropriate pedagogical strategies that support experiential learning. Future research can explore how pedagogical strategies such as project-based learning, problem-based learning, and inquiry-based learning can be used to integrate immersive technology in civil engineering education. Additionally, research can also explore how the use of immersive technology can enhance the effectiveness of these pedagogical strategies, particularly in developing competencies aligned with 21st century skills such as critical thinking, creativity, collaboration, and communication.

3.3 Evaluation of the Effectiveness of Immersive Technology-Enhanced Learning Systems

The effectiveness of immersive technology-enhanced learning systems for civil engineering education needs to be evaluated to determine their impact on student learning outcomes. Future research can explore how the effectiveness of these systems can be evaluated using appropriate evaluation frameworks such as Kirkpatrick's model. Additionally, research can also explore how the use of immersive technology can enhance the effectiveness of evaluation frameworks.

4 Conclusion

The integration of immersive technology in civil engineering education has the potential to support the development of necessary competencies and 21st century skills required by the industry. By creating a digital

environment that is engaging, authentic, and relevant to real-world scenarios, students can benefit from an experiential learning experience that provides them with practical and applicable knowledge. However, the effective integration of immersive technology in civil engineering education requires a systematic approach that includes evidence-centered design, appropriate pedagogical strategies, and alignment of learning activities to workforce training. Future research should continue to explore how immersive technology can be used in various civil engineering contexts and how it can enhance the effectiveness of pedagogical strategies. Ultimately, the successful integration of immersive technology in civil engineering education can contribute to producing competent and future-ready graduates who can address the complex challenges of the industry aligned with future workforce development.

References

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