Thesis Project Portfolio

Mapping the Impact of Augmented Reality (AR) and Virtual Reality (VR) in AEC Education

(Technical Report)

Augmented Reality (AR) and Virtual Reality (VR) in the Context of Education: Transforming Learning in the Digital Age

(STS Research Paper)

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Sociotechnical Synthesis

Augmented Reality (AR) and Virtual Reality (VR) technologies have significantly transformed the intersection of education and technology, promising to revolutionize the educational experience. These digital innovations offer immersive and interactive learning environments, seamlessly integrating virtual elements with the real world. While both AR and VR technologies aim to reshape education, they employ distinct methods for engaging with reality and virtual experiences. AR overlays virtual elements onto the physical world, enabling interaction with a blend of real and virtual content, whereas VR immerses users fully into a virtual environment, disconnecting them from physical reality. An extensive literature review anchors this research, with a focus on exploring the complex impact of AR and VR on learning processes, with an emphasis on their applications within the architecture, engineering, and construction (AEC) industry. The practical benefits of AR and VR are illustrated throughout this research; specific applications of these technologies noted in this study are virtual simulations of construction sites and architectural design. These technologies have also been particularly impactful in fields such as medicine and biology, where they allow for detailed, risk-free simulations. Meta-analyses are also utilized to aggregate findings from multiple studies; this foundational work helps identify prevailing trends and methodological approaches in the field. Viewed through the lens of Science, Technology, and Society (STS), the study aims to understand the historical development, affordances, and limitations of AR and VR technologies, as well as their broader societal implications. STS emphasizes the intricate interplay between technology, education, and societal systems, recognizing the profound influence of AR and VR technologies beyond the classroom, including their impact on cultural perceptions of learning, economic structures, and educational policies. The significance of this research lies in its approach to understanding not only the technological landscape of AR/VR but also the socio-cultural implications of their

integration, including their potential to enhance educational access. Looking through a historical lens to analyze and evaluate current implementations of AR and VR will help understand whether past predictions about educational technologies have materialized and how these technologies are positioned within ongoing technological trends. While AR and VR technologies offer transformative possibilities for improving teaching instructions, their effectiveness remains a nuanced landscape. Challenges remain in their widespread adoption, particularly regarding accessibility and cost, which may exacerbate educational disparities. The high costs associated with AR and VR equipment and software limit their widespread integration, particularly in underfunded institutions. These economic barriers contribute to educational disparities, as students without access to these technologies miss out on advanced learning tools. The exploration of open-source AR and VR platforms and strategies can enhance their accessibility, ensuring equitable learning opportunities across diverse educational landscapes. By investigating how AR and VR are practically applied in AEC education, this research aims to assess the industry's readiness to embrace and benefit from these technologies in terms of workforce readiness and skill development. By engaging directly with practitioners involved in implementing these technologies, the research aims to gain deeper insights into their real-world implications and challenges, enriching the understanding of their integration into educational settings. Through the exploration of accessibility and affordability challenges, this research acknowledges the socio-economic disparities that might hinder the widespread adoption of AR and VR technologies, emphasizing the importance of equitable learning opportunities. By recognizing the challenges faced by community colleges due to systematic underfunding, the research transcends the boundaries of conventional engineering, urging exploration into opensource AR and VR platforms and the implementation of strategies to maximize the use of these technologies across diverse student populations. This research stands as a testament to the

multidisciplinary nature of contemporary challenges, requiring not only a deep understanding of technological complexities but also an ability to navigate the intricate intersections of technology, education, and society. It is vital to contribute to a more equitable landscape where the benefits of advanced technologies are accessible to all learners. Thus, by integrating technological analysis with sociocultural insights, the study aims to contribute to a future where educational technologies are not only forward-looking but also inclusive and attuned to the needs of all learners. An ongoing collaboration among technologists, educators, and policymakers is vital for the creation of an educational environment that fully leverages the capabilities of AR and VR technologies. By incorporating STS principles, this research aims to provide valuable insights into shaping a future where learners of all backgrounds can benefit from AR and VR technologies, fostering a more inclusive, equitable, and accessible learning environment.

Keywords: Augmented Reality (AR) and Virtual Reality (VR), education technology, technology integration, AEC education, educational equity, socio-cultural implications.