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Integration of VR in Landscape Architecture Education: Insights from Case Studies

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Abstract

Virtual Reality (VR) is increasingly integrated into education, offering immersive and interactive experiences that enhance teaching and research. This paper explores how VR technology is reshaping learning environments in landscape architecture through case studies conducted at the VR-Lab at the Norwegian University of Life Sciences (NMBU). The studies address diverse topics, including architectural style perception, urban park safety, historical landscape education, and cultural heritage documentation. By incorporating VR, these studies illustrate its potential for improving student engagement, spatial analysis, and collaborative learning. The findings highlight VR's role in facilitating more effective decision-making processes and promoting accessibility to complex design and planning concepts. The paper provides insights into the advantages and limitations of VR as an educational tool and its implications for future pedagogical approaches.

Keywords: *Virtual reality; landscape architecture education; immersive learning; spatial perception; design communication.*

1. Introduction

The integration of digital technologies into higher education has revolutionized the way students and researchers engage with complex spatial, social, and environmental issues. Among these technologies, VR has emerged as a particularly transformative tool, offering immersive and interactive experiences that challenge traditional pedagogical approaches (Radianti et al., 2020). One of the key drivers of VR's recent increasing adoption in education is its growing accessibility and affordability. The cost of VR hardware and software has significantly decreased in recent years, making it feasible for educational institutions to integrate VR-based learning into their curricula (MATSH, 2023). Advances in standalone VR headsets, cloud-based platforms, and open-source development tools have further reduced barriers to entry, enabling

more universities and research institutions to incorporate immersive technologies into teaching and research (Liu et al., 2017). Moreover, in today's digital age, young generations of students are growing up in a world flooded with digital technologies, and they are highly adept at using these technologies for a variety of purposes, including learning and entertainment. By integrating the latest technological development solutions into teaching, we can leverage students' existing skills and interests to engage them in the subject matter in new and innovative ways.

Since its establishment in 2007, the VR-Lab at NMBU has played a major role in testing visual solutions and advancing the integration of VR technology within higher education. By harnessing VR technology capabilities, the lab facilitates the transformation of teaching methodologies, learning environments, interdisciplinary collaboration, and knowledge accessibility across disciplines, specifically in landscape architecture, urban planning, and social sciences education. A major argument for incorporating VR into these disciplines is the inherently visual nature of landscape architecture and urban planning, where effective communication of design and planning scenarios is essential. Traditionally, these fields have relied on maps, 2D drawings, physical models, and static renderings to convey spatial concepts and design proposals. While these methods remain valuable, they often fail to fully communicate the scale, depth, and experiential qualities of a landscape or urban environment. VR, in contrast, provides an immersive and interactive medium that allows students, designers, and stakeholders to experience and engage with proposed designs at a human scale, facilitating greater spatial understanding and more effective decision-making (Ghadirian & Bishop, 2008).

This paper presents a series of case studies conducted at the VR-Lab, illustrating the diverse applications and benefits of VR in these disciplines. The first study investigates how immersive VR can be used to compare public perceptions of traditional versus contemporary architectural styles in urban spaces. The second study examines perceived safety in urban parks through immersive simulations, providing insights into design strategies that enhance user comfort and security. The third study explores the use of VR as a mediator in teaching landscape architecture history, demonstrating how digital reconstructions can bridge the gap between past and present. Finally, the fourth study explores the use of VR technology in contested landscapes, emphasizing its potential to empower communities and raise awareness about cultural heritage sites.

2. Case Studies

2.1. Architectural Style Perception in Public Spaces

This case study examined how architectural styles influence public perception and emotional responses using immersive VR. It involved students who assessed traditional and contemporary

architectural designs through 360-degree videos. The study employed 360-degree video technology to capture visual representations of eight public spaces in Oslo, Norway, categorized by traditional and contemporary design elements (figure 1). Traditional styles featured symmetry, ornamentation, and connections to local history, while contemporary styles emphasized minimalism, asymmetry, and industrial materials. The findings indicated a preference for traditional styles, associated with relaxation and aesthetic appeal, while contemporary styles evoked mixed reactions. VR facilitated experiential learning, enabling students to critically analyze architectural elements beyond static images or theoretical descriptions. To extend their learning, students engaged in design critique sessions where they applied theoretical frameworks from architectural history and urban planning. These discussions provided insights into how spatial aesthetics influence public behavior and place identity. In addition, the study introduced VR as a comparative tool, allowing students to alternate between different urban scenarios dynamically and refine their understanding of spatial composition (Mouratidis & Hassan, 2020).

Figure 1. Snapshots from 360-degree videos showing public spaces in Oslo that were used in this study. Source: author (2019).

2.2. Perceived Safety in Urban Parks

This case study investigated how hedge height impacts perceived safety in an urban park in Oslo. A mixed-methods approach combined field surveys and VR simulations to assess safety perceptions before and after a hedge-cutting intervention. Female participants reported increased safety following the reduction in hedge height, while male participants exhibited no significant changes. The VR component provided a controlled environment for students to analyze spatial factors influencing safety, reinforcing the importance of empirical testing in landscape planning. The VR-based approach allowed students to assess different hedge height scenarios dynamically, promoting engagement in risk analysis and urban safety measures. By experiencing the spatial effects of enclosure and openness through VR simulations, students developed an understanding of how vegetation influences perceived security. This hands-on methodology helped bridge theoretical concepts in environmental psychology and practical urban design applications. Furthermore, this case study emphasized the importance of gender-

sensitive urban design, encouraging discussions on inclusivity and how environmental modifications can impact different user groups (Evensen et al., 2021).

2.3. Teaching Landscape Architecture History through VR

Historical landscape education often struggles with student engagement due to its abstract nature. This case study introduced VR-based reconstructions of historical gardens and sites, allowing students to explore past landscapes in an interactive format. The integration of VR into coursework improved comprehension, accessibility, and critical analysis, demonstrating the effectiveness of digital tools in bridging historical theoretical knowledge with visual and spatial understanding. By enabling students to virtually immerse themselves in historical sites, VR facilitated an experiential learning process that traditional lectures and textbooks could not offer. Students analyzed reconstructed environments in comparison with historical documentation, helping them build critical evaluation skills and appreciate the evolution of design styles over time (Figure 2). This approach also introduced discussions on the challenges of digital reconstruction and the ethics of recreating historical landscapes, adding a reflective dimension to their learning. Group projects further encouraged collaboration, where students worked on digital reconstructions, reinforcing interdisciplinary skills spanning history, technology, and design (Hassan & Dietze-Schirdewahn, 2024).

Figure 2. Snapshot of an interactive virtual model showing the reconstruction of the historical garden of Barony Rosendal that was used in this study. Source: author (2020).

2.4. VR for Cultural Heritage Documentation in Contested Landscapes

This case study focused on documenting and preserving cultural heritage sites in Palestine using VR. Due to political and physical restrictions, many historical sites are inaccessible. VR

facilitated remote access to these sites, allowing students and researchers to engage with them virtually. The project also incorporated digital storytelling and community involvement, broadening public awareness and educational outreach. The study underscored the role of VR in safeguarding and interpreting heritage sites in conflict-affected areas. Students in this project engaged with historical documentation, GIS mapping, and 3D modeling techniques to develop comprehensive digital heritage archives. The inclusion of virtual storytelling elements made historical narratives more compelling, reinforcing the importance of preserving cultural identity through immersive technology (Figure 3). VR also enabled cross-disciplinary collaboration, incorporating perspectives from archaeology, history, and digital media. The ethical dimension of heritage reconstruction was a key discussion point, prompting students to reflect on issues related to authenticity, representation, and historical accuracy in digital heritage preservation. The VR component further allowed community stakeholders to participate in heritage documentation efforts, raising inclusivity in cultural preservation initiatives (Hassan, 2021).

Figure 3. Pupils at a school in Ramallah, Palestine, are experiencing a heritage site with VR. Source: author (2019).

3. Navigating the Challenges of VR Integration in Education

Despite the significant benefits of VR technologies in education, several challenges and limitations must be addressed for their successful implementation and adoption. Insights from the presented case studies highlight practical obstacles encountered during the integration of VR into teaching and the need for a structured framework.

3.1. Practical Constraints

One of the primary challenges is the cost of implementing VR technology. While the cost of VR hardware and software has declined in recent years, it still represents a considerable investment for educational institutions. The case study on teaching landscape architecture history underscored the necessity of securing access to VR equipment before course implementation. To mitigate costs, collaboration with the VR-Lab at NMBU was established, allowing students access to VR technology without requiring independent institutional investments.

Another significant challenge is the requirement for specialized skills and training to effectively utilize VR technology. Instructors and students must learn not only how to operate VR hardware but also how to create, navigate, and interact with VR content. The case studies demonstrated that integrating VR required additional time investment, both in preparing educators to incorporate VR effectively into curricula and in training students to use immersive environments as analytical and design tools.

A third limitation is the risk of student disengagement or distraction in VR environments. While VR offers captivating experiences, it can also be overwhelming for some learners, potentially leading to disorientation or motion sickness. The case studies revealed that balancing immersive learning with structured guidance was crucial in preventing sensory overload. Designing well-structured VR lessons with clear objectives and intermittent breaks helped maintain student focus and engagement.

Another critical limitation is the effectiveness of VR in teaching abstract concepts such as social and cultural contexts. While VR excels in simulating physical environments, it may not fully capture complex socio-cultural values embedded in historical landscapes. The case study on teaching landscape architecture history demonstrated that, although students could interact with historical reconstructions, discussions and supplementary materials were necessary to convey cultural significance beyond the visual experience. Future improvements in VR educational applications should explore methods to integrate more nuanced cultural narratives.

3.2. The Need for a Pedagogical Framework

Incorporating VR and other digital technologies into teaching without a pedagogical framework risks diminishing their potential impact on student learning. As Zhao and Frank (2003) noted, "the most effective uses of technology in schools are those that are aligned with pedagogical goals, support student-centered learning, and provide opportunities for collaboration and interaction". To maximize the effectiveness of VR-based education, it is crucial to align its integration with well-established pedagogical theories that guide educators in facilitating purposeful and meaningful learning experiences. A study by Otchie and Pedaste (2020) found that constructivism is the most commonly used theory for integrating digital media into

teaching. Constructivism is the learning theory that underlines the importance of active engagement and the construction of knowledge by students. In addition, constructivism offers the benefit in that it highlights the significance of social interaction and cooperation during learning. In the history of landscape architecture case study, for example, students using VR were able to reconstruct historical sites, analyze spatial relationships, and develop their own interpretations of cultural heritage. This interactive approach aligns with constructivist principles by enabling learners to construct meaning based on their experiences.

Beyond constructivism, experiential learning theory also plays a critical role in VR-based education. Experiential learning emphasizes learning through direct experience and reflection (Kolb, 2014). In VR applications, students engage with immersive simulations, where they can interact with different design scenarios, test spatial configurations, and reflect on their observations. This approach enhances spatial cognition and decision-making skills, as evidenced in the study on perceived safety in urban parks. By navigating through virtual environments with varying hedge heights, students gained a stronger understanding of how spatial design influences public perceptions of safety.

4. Conclusion

The integration of VR in landscape architecture, urban planning, and social sciences has demonstrated its value as an educational tool. The case studies presented in this paper illustrate VR's ability to enhance spatial understanding, critical thinking, and collaborative decision-making. By providing immersive learning environments, VR bridges theoretical knowledge with practical applications, reinforcing complex spatial relationships in ways traditional methods cannot. While VR offers significant benefits, challenges such as technological limitations, and the need for tailored pedagogical strategies remain. Addressing these issues requires further research into the development of scalable VR curricula, affordable solutions for institutions, and training programs to equip educators with the necessary technical skills.

To ensure that VR is effectively integrated into curricula, educators must adopt a structured pedagogical framework that includes clear learning objectives, assessment strategies, and scaffolded learning activities. Faculty training is also necessary to equip educators with the skills to design and facilitate VR-based learning experiences. As institutions continue to explore the use of VR, future research should focus on developing models that integrate constructivist and experiential learning approaches with immersive technologies to optimize student engagement and learning outcomes.

The case studies presented here show that expanding VR's use in interdisciplinary settings can encourage broader collaborations across fields, helping students develop holistic problem-solving skills applicable to real-world challenges. As immersive technology continues to evolve, its potential in reshaping education remains vast, requiring continuous adaptation and

innovation in pedagogical methodologies. Building on the insights from these case studies, the VR-Lab is developing new projects on AI-assisted landscape design and multi-user immersive environments for collaborative studio teaching. These initiatives aim to further explore the intersection of emerging technologies and design pedagogy, strengthening innovation in landscape architecture education.

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