Exploring the Path of Environmental Design Teaching Reform Supported by Virtual Simulation Technology

Xin Xu* and Yizhang Li

College of Arts, Sichuan University, Chengdu, Sichuan, 610207, China

*xu_xin@scu.edu.cn

Abstract. The introduction of virtual simulation technology offers a novel pathway to bridge the gap between classroom instruction and practical application in environmental design education. Aiming at existing shortcomings in traditional environmental design courses—particularly weak practical components and insufficient development of students' innovative abilities—this study develops an immersive teaching platform supported by Virtual Reality (VR). It restructures course content and teaching methodologies, ensures smooth implementation through faculty training and industry-university collaboration, and adopts a phased approach by starting with small-scale pilots and gradually expanding the initiative. Specifically, the "Exhibition and Display Design" course utilizes virtual simulation, enabling students to complete the entire process of planning, designing, and showcasing within virtual exhibition spaces. This greatly stimulates students' interest and creativity. The reform outcomes demonstrate that VR technology significantly enhances students' practical abilities and creative thinking, improving both teaching efficiency and quality, and providing valuable insights for innovation in environmental design education. Additionally, this reform aligns with the broader trend of educational digital transformation, aiding in cultivating digital design talent suited to future needs.

Keywords: Virtual Reality, Environmental Design, Teaching Reform, Exhibition and Display Design

1 Introduction

In recent years, virtual simulation technology has been increasingly applied in higher education, especially in environmental design teaching[1][2]. Digital technologies such as virtual reality (VR) allow educators to create realistic three-dimensional design scenarios, overcoming traditional teaching limitations related to space, resources, and practical opportunities[1]. Traditional environmental design courses often face challenges such as limited classroom space, high costs of physical model production, and inadequate practical activities, which hinder the development of students' spatial thinking and hands-on skills. As early as 2015, scholars proposed integrating virtual reality into environmental design education to enhance practicality and immersion[3].

© The Author(s) 2025
A. Y. M. A. Islam et al. (eds.), *Proceedings of the 2025 4th International Conference on Science Education and Art Appreciation (SEAA 2025)*, Advances in Social Science, Education and Humanities Research 952,
https://doi.org/10.2991/978-2-38476-452-5_61

The field of environmental design encompasses disciplines such as interior design, landscape architecture, and exhibition and display design, emphasizing the cultivation of students' innovative thinking and practical skills. Historically, teaching models have focused primarily on theoretical instruction, with insufficient practical resources and limited student participation in real projects, resulting in designs that fail to meet industry expectations for innovative talent[1].

Rapid advancements in information technology present new opportunities for educational reform. The mature applications of virtual simulation technologies such as VR and augmented reality (AR) have opened new possibilities for environmental design teaching[4]. Through virtual simulation, immersive educational environments can be constructed, allowing students to freely arrange and modify design schemes in virtual spaces, observe outcomes in real-time, and promptly adjust their solutions, thereby enhancing their spatial understanding and decision-making skills[2].

The goal of educational reform is to bridge the gap between classroom instruction and real-world design practice by leveraging virtual simulation technology, thereby strengthening students' practical capabilities and innovative thinking. By establishing a virtual design experimental platform and implementing project-based teaching methods, the reform seeks to stimulate student interest and foster autonomous exploration. Immersive experiences further improve students' intuitive understanding of design elements such as space, materials, and lighting. Integrating virtual and real-world assessments promotes the practical application of theoretical knowledge[4], ultimately developing interdisciplinary designers equipped with solid theoretical foundations and digital technological competencies, ready to meet industry demands.

2 Implementation Path of Teaching Reform

The implementation path of this teaching reform includes the establishment of a virtual simulation platform, restructuring of course content, faculty training and university-enterprise cooperation, as well as phased implementation with feedback-driven improvements. The detailed teaching reform implementation process is illustrated in Figure 1.

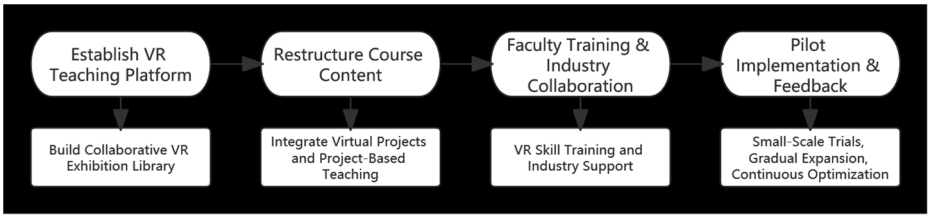


Fig. 1. Implementation Path of Teaching Reform

2.1 Establishing a Virtual Simulation Teaching Platform

A specialized virtual simulation teaching platform comprises VR exhibition spaces and accompanying software resources. Based on the specific requirements of environmental design education, the teaching team developed a universal virtual exhibition model library and a collection of exhibition props. This allows students to assemble design components such as showcases, panels, and lighting fixtures in a virtual environment. The platform supports real-time online collaboration and interaction, facilitating demonstrations and discussions between teachers and students in virtual spaces.

2.2 Restructuring Course Content and Teaching Methods

The course integrates virtual simulation modules into its curriculum, adding practical components such as "Virtual Design Practice," which constitutes over 30% of the course duration, ensuring students have ample time for virtual design exercises. Project-oriented and task-driven teaching approaches are adopted, where the class is divided into groups, each responsible for a comprehensive virtual design project—from theme planning and spatial layout to digital presentation. Teachers act as facilitators, guiding and assisting students through periodic evaluations and feedback to optimize their projects.

2.3 Faculty Training and University-Enterprise Collaboration

To ensure smooth implementation of the reform, targeted training sessions were organized for instructors, enabling them to master basic VR software operations and effective instructional techniques. Additionally, the university partnered with relevant enterprises to establish virtual simulation laboratories and involved industry mentors in instructional guidance. Through corporate support, the courses were equipped with advanced VR hardware and abundant digital case resources, enhancing the realism and relevance of teaching content.

2.4 Phased Implementation and Feedback Improvement

A gradual and systematic implementation approach was adopted. Initially, the virtual simulation teaching model was piloted in small-scale classes, continually refining platform features and teaching methods based on student feedback. Subsequently, the approach was progressively expanded to other related courses within the environmental design major. After each phase, teacher and student feedback were gathered through questionnaires and seminars, promptly addressing identified issues. For example, responding to student difficulties in initially adapting to VR software, the teaching team developed a concise operating manual and added pre-class training sessions to facilitate quicker student adaptation.

3 Case Study: Application of Virtual Simulation in Exhibition and Display Design Course

Exhibition and Display Design is a core course within the environmental design major, primarily teaching methods for planning and designing various exhibition spaces. In traditional instruction, students typically present their design concepts through floor plans and scale models, lacking authentic experiences at actual scale. The teaching reform selected this course as a key case for virtual simulation application, achieving notable outcomes.

During the reform implementation, teachers provided students with a virtual exhibition space as their design site. This digital exhibition hall was modeled after an actual museum gallery, featuring adjustable walls, display boards, lighting, and props. Students worked in groups on specific design assignments, such as creating thematic cultural exhibition spaces. The entire teaching process integrated virtual simulation technology:

(1) Initial Conceptual Stage: Using VR headsets, students "walked" through the virtual exhibition hall to observe spatial layouts and establish preliminary exhibition arrangements.

(2) Intermediate Design Refinement Stage: Students utilized the virtual simulation platform to construct exhibition structures, arrange displays and explanatory texts, and repeatedly adjusted lighting intensity and projection effects to achieve optimal presentation atmospheres.

(3) Final Presentation and Discussion Stage: Groups showcased their completed designs within the virtual environment, where teachers and classmates could explore the spaces firsthand and provide feedback.

The specific course implementation flowchart is detailed in Figure 2:

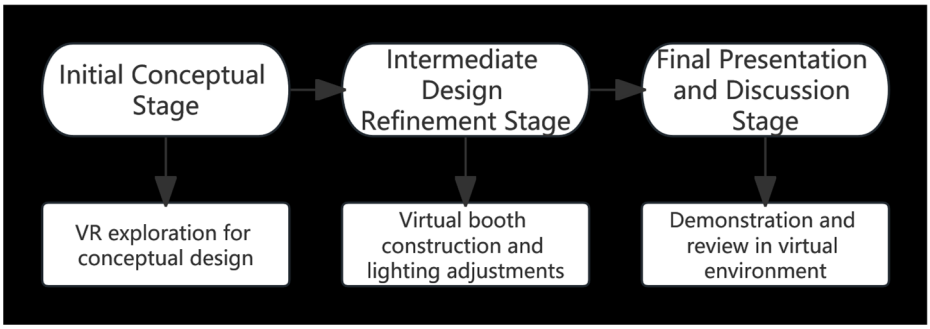


Fig. 2. Implementation Process of Virtual Simulation in Exhibition and Display Design Course

Through this process, students not only mastered general exhibition design methodologies but also deepened their understanding of spatial dimensions, aesthetic effects, and visitor flow by engaging directly with virtual construction. For instance, one group chose the theme of "Intangible Cultural Heritage Exhibition," designing an arched entrance, multimedia screens showcasing heritage techniques, and interactive digital

exhibits within the virtual hall, creating an immersive cultural experience. These VR-rendered designs were vivid and intuitive, significantly surpassing traditional paper-based presentations.

Practice demonstrated that introducing virtual simulation technology significantly enhanced the effectiveness of the Exhibition and Display Design course. Students became fully engaged in planning and executing digital exhibition projects, displaying heightened enthusiasm. The iterative process of trial and error within the virtual environment encouraged students to innovate boldly. Some students further developed their virtual exhibition proposals into graduation projects or professional competition entries, achieving excellent results. The successful implementation of this course provides a model for teaching reform across other environmental design courses.

4 Reform Outcomes

4.1 Significant Improvement in Student Interest and Engagement

After the introduction of VR technology, students demonstrated higher engagement and enthusiasm towards the course. Previously monotonous exhibition design principles became vivid and tangible within the virtual context, leading students to report experiences such as "feeling immersed in designing real exhibitions," thereby greatly increasing their interest in learning. During practical sessions, most students actively participated in discussions and repeatedly revised their virtual design proposals, significantly improving classroom participation compared to before the reform. This aligns with findings from related research indicating students generally hold positive attitudes toward VR-enhanced instruction[5].

4.2 Enhanced Practical Skills and Innovative Thinking

Through virtual simulation training, students experienced substantial improvement in their hands-on capabilities by personally building digital models and fine-tuning exhibition layouts. Continuous experimentation with various design options, along with immediate visual feedback, notably stimulated their creativity, resulting in many innovative and unique design ideas. Teachers observed that compared to previous cohorts, VR-taught students produced better work in terms of spatial layout rationality, lighting application, and interactive experiences. Several student groups earned accolades for their virtual exhibition projects in school competitions, clearly demonstrating the value of this teaching reform in fostering innovative design capabilities.

4.3 Improved Teaching Quality and Efficiency

Applying virtual simulation technology optimized the instructional process. Teachers delivered more intuitive and effective demonstrations of exhibition design cases through virtual platforms, allowing students to grasp concepts more quickly compared to traditional oral descriptions or 2D diagrams. Conducting exercises in virtual

environments reduced physical material consumption and spatial constraints, enabling more frequent practice sessions and thus enhancing training effectiveness. Furthermore, the virtual platform recorded comprehensive data throughout students' design processes, facilitating targeted instruction on common issues and increasing teaching precision. Consequently, the reformed course delivered substantially greater practical teaching content within limited class hours, significantly improving overall teaching efficiency.

5 Problems and Countermeasures

Despite achieving positive outcomes, this teaching reform revealed several issues during its implementation, necessitating further improvements.

5.1 Insufficient Equipment and Resources

Virtual simulation teaching depends heavily on hardware equipment and digital resources. Currently, the college has limited VR equipment, which cannot adequately meet the demands of large-class teaching where each student requires simultaneous access. Consequently, students have to take turns entering the virtual environment, disrupting the continuity of their experience. To address this, investment in the virtual simulation laboratory should be gradually increased, including adding equipment and optimizing scheduling mechanisms. Additionally, employing a staggered group practice method can ensure sufficient VR operational time for each student.

5.2 Steep Learning Curve of Technical Skills

For some students, the initial use of professional virtual simulation software presents significant difficulties due to the steep learning curve. At the outset, certain students exhibited lower efficiency during practice sessions owing to unfamiliarity with the software. To mitigate this issue, the course team arranged software training sessions and demonstrations prior to course initiation and provided assistance during practical activities. Moving forward, basic software operation skills could be integrated into prerequisite course content, or simplified tutorial videos can be produced to facilitate independent student learning and lower technical entry barriers.

5.3 Faculty Skills and Attitudinal Shifts

Some senior faculty members remain cautious about adopting new technological methods in teaching, concerned that excessive reliance on technology might diminish the teaching of foundational design principles. Updating faculty attitudes is an essential aspect of this reform. By conducting educational seminars and training sessions, allowing instructors to directly experience the benefits of VR teaching, and sharing successful examples, it becomes possible to gradually enhance teachers' technological capabilities and enthusiasm. Insufficient faculty training remains a key challenge facing

intelligent teaching methodologies, warranting serious attention [4]. In practice, the active participation of younger instructors has provided momentum for reform, and future efforts should focus on promoting collective advancement across the entire teaching staff.

5.4 Need for Enhanced Integration of Virtual and Real-World Applications

Virtual simulation is ultimately a tool, and better integrating its outcomes into real-world design is a challenge requiring further exploration. For example, outstanding exhibition designs developed by students in virtual environments could be physically realized in part using digital fabrication techniques, reinforcing the connection between virtual outcomes and tangible results. Furthermore, students should be guided to recognize potential discrepancies between virtual design and real-world execution—such as structural safety and material texture—cultivating their ability to transition thoughtfully between virtual and physical contexts. Effective integration of virtual and real scenarios is crucial to fully harnessing the comprehensive benefits of virtual simulation teaching.

6 Conclusion

The teaching reform of environmental design supported by virtual simulation technology has injected new vitality into traditional design education. Using the curriculum reform practice of the "Exhibition and Display Design" course as an example, it demonstrates that an immersive virtual teaching environment can effectively enhance students' learning interest, practical skills, and innovative consciousness, thereby improving the quality of education. The experience gained during this reform holds valuable implications for environmental design and related design courses. On the one hand, virtual simulation provides students with broader creative space and trial-and-error opportunities, helping them better apply theoretical knowledge to practice; on the other hand, the integration of digital technologies aligns well with the contemporary trend of educational digital transformation, contributing to the cultivation of "digital designers" capable of adapting to the future. The application of VR technology also provides opportunities to incorporate cultural education elements into the curriculum. For instance, there are cases exploring ways to integrate red cultural heritage into environmental design courses using VR technology[6]. This indicates that virtual simulation teaching is not limited to skill training but can also serve more comprehensive educational objectives.

This teaching reform, centered on the effective application of virtual simulation technology, has constructed a new model for environmental design education. In the future, as technology continues to develop and mature, it will be essential to continuously optimize teaching strategies, enhance software and hardware support, and further expand the depth and breadth of virtual simulation applications in environmental design education, keeping the cultivation of design talents aligned with the times.

Acknowledgments

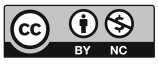
(1) The 2024 National Social Science Fund West Project "Research on Cultural Inheritance and Digital Protection of Rural Settlements in Southwest China" (Project number: 24XSH012).

(2) The 2024 Provincial Undergraduate University Innovative Experimental Project "Innovative Design Experimental Teaching Project under Digital Twin 3D Visualization Platform".

(3) The 2025 Sichuan University Artificial Intelligence Empowered Innovative Experimental Technology Research Project "Research on the Upgrade of VR-based Exhibition Space Free Construction and Dual-user Interactive Virtual Simulation Experimental Platform" (Project number: SCU2025009)

References

1. Wu, X. (2024). Discussion on the teaching reform of environmental design courses in colleges and universities under the background of the education digitization strategy. Public Relations World, (21), 172–174. DOI: 10.3969/j.issn.1005-3239.2024.21.058
2. Cui, C. (2021). Innovative research on the application of virtual simulation technology in environmental design courses: Taking the basic landscape design course as an example. Art Education Research, (19), 110–111. DOI: 10.3969/j.issn.1674-9286.2021.19.049
3. Yin, M. (2015). Research on introducing virtual reality courses into environmental design teaching. Art Education Research, (9), 170. DOI: 10.3969/j.issn.1674-9286.2015.09.101
4. Tang, S. H., Wu, C. Y., & Yang, Q. X. (2024). Application reform of intelligent teaching in environmental design major. Education and Research, 6(6), 19–23. DOI: 10.59429/jyyj.v6i6.6897
5. Guevara, D., de Laski-Smith, D., & Ashur, S. (2022). Interior design students' perception of virtual reality. SN Social Sciences, 2(152). DOI: 10.1007/s43545-022-00423-7
6. Zhang, Q., & Wang, M. (2022). Research on the integration path of red culture and environmental design based on VR technology. New Art Domain, (3), 82–84. DOI: 10.3969/j.issn.1009-7066.2022.03.029

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.